FINAL
REMEDIAL DESIGN REPORT

PEMACO SUPERFUND SITE
5050 E. SLAUSON AVENUE
MAYWOOD, CALIFORNIA

August 2006

Volume II
Appendix A - Specifications

Prepared for:

Rose Marie Caraway
U.S. Environmental Protection Agency
Region IX
San Francisco, California

John Hartley
U.S. Army Corps of Engineers
Omaha District
Omaha, Nebraska

Prepared by:

T N & Associates, Inc.
Engineering and Science

TABLE OF CONTENTS
FOR SPECIFICATIONS

FINAL SPECIFICATIONS

TABLE OF CONTENTS
FOR SPECIFICATIONS

TABLE OF CONTENTS
FOR SPECIFICATIONS

SECTION 01008

ABBREVIATIONS AND ACRONYMS

AALA	American Association of Laboratory Accreditation
AASHTO	American Association of State Highway and Transportation Officials
ABIH	American Board of Industrial Hygiene
AC	alternating current
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ADS	Advanced Drainage Systems
AEIC	Association of Edison Illuminating Companies
AGC	Associated General Contractors
AIA	American Institute of Architects
AMRL	AASHTO Materials Reference Laboratory
ANSI	American National Standards Institute
API	American Petroleum Institute
APP	Accident Prevention Plan
APR	air-purifying respirator
ASSE	American Society of Testing and Materials
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
Bgs	below ground surface
°C	degree Celsius
CCRL	Concrete and Cement Reference Laboratory
CDQC	chemical data quality control
CDQM	chemical data quality management
CEE	Clean Environmental Equipment
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
Cfm	cubic foot per minute
CFR	Code of Federal Regulations
CHP	Certified Health Physicist
Cm	centimeter
CQC	Contractor Quality Control
CRZ	Contamination Reduction Zone
CSP	Certified Safety Professional
dB	decibels
DCQCR	data chemical quality control report
DOT	U.S. Department of Transportation
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ERH	Electrical Resistance Heating
EZ	Exclusive Zone
°F	degree Fahrenheit
f'c	comprehensive strength
FCCCHR	Foundation for Cross-Connection Control and Hydraulic Research
FM	Factory Mutual Engineering and Research
f.o.b.	free on board

fps	foot per second
FSP	Field Sampling Plan
FTO	Flameless Thermal Oxidizer
G	Government approval
GAC	Granular Activated Carbon
GFCI	ground fault circuit interrupter
GFE	Government Furnished Equipmenet
Gpd	gallon per day
Gph	gram per hour
GRI	Geosynthetic Research Institute
GSI	Geosynthetic Insititute
Ha	hectare
HDPE	high-density polyethylene
Hp	horsepower
HTRW	hazardous, toxic, and radiological waste
Hz	hertz
ID	inside diameter
IEC	Installation Environmental Coordinator
IEEE	Institute of Electrical and Electronics Engineers
Kg	kilogram
kg/m	kilogram per meter squared
kN	kiloNewton
kPa	kilopascal
L	liter
Lb	pound
Lbf	pound force
LEL	lower explosive limit
LNAPL	light non-aqueous phase liquid
LQMP	Laboratory Quality Management Plan
LQM	laboratory quality management
mA	milliamp
MARV	minimum average roll value
MB	megabyte
mg/kg	milligram per kilogram
mg/L	milligram per liter
mL/s	milliliter
mg/m	milligram per cubic meter
min	minute
mL	milliliter
mL/s	milliliter per second
mm	millimeter
MPa	megaPascal
Mph	mile per hour
MQC	manufacturing quality control
MSS	Manufacturer’s Standardization Society
MTC	Material Testing Center
NAPHCC	National Association of Plumbing-Heating-Cooling Contractors
NAPL	non-aqueous phase liquids
NAS	network analysis system
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association

NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NPT	National Pipe Thread
NTP	Notice to Proceed
NTU	nephelometric turbidity unit
NVLAP	National Voluntary Laboratory Accreditation Program
O&M	operation and maintenance
Od	outside diameter
OP	Occupational Physician
OSHA	Occupational Safety and Health Administration
PAHs	polycyclic aromatic hydrocarbons
Pb	lead
PCBs	polychlorinated biphenyls
PE	polyethylene
PEL	permissible exposure limit
PP	polypropylene
PPE	personal protective equipment
Psf	pound per square foot
Psi	pound per square inch
Psig	pound per square inch gauge
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QAR	Quality Assurance Representative
QC	Quality Control
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RECP	Rolled Erosion Control Products
RMS	Resident Management System
RPM	Remedial Project Manager
S	second
SAP	Sampling and Analysis Plan
Scfm	standard cubic feet per minute
SD	submittal data
SDEF	Standard Data Exchange Format
SDR	standard dimension ratio
Site	Pemaco Superfund Site
SOCQ	Statement of Chemical Qualifications
SS	stainless steel
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SSPC	Society for Protective Coatings
SSU	Saybolt second universal
STI	Steel Tank Institute
SVOC	semivolatile organic compound
SZ	Support Zone
TDC	Transportation Disposal Coordinator
TFSO	tank full shut off
TPH	total petroleum hydrocarbon

TWA	timer-weighted average
UBC	Uniform Building Code
UFC	Uniform Fire Code
UL	Underwriters Laboratory
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USC	United State Code
USCS	Unified Soil Classification System
UV	ultraviolet
V	volt
VOC	volatile organic compound

SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

The scope of work is to provide design specifications for constructing and operating the EPA-approved soil and groundwater treatment systems at the Pemaco Superfund Site. The selected soil and groundwater treatment systems are designed to target three subsurface “remediation zones.” The three zones are 1) surface and near-surface soils; 2) upper vadose soils and perched groundwater; and 3) lower vadose soils and groundwater. The table below summarizes the EPA-approved treatment method for each remediation zone:

Remediation Zone	Treatment Method
Surface And Near-Surface Soil	Soil cover/revegetation[1]
Upper Vadose Soil And Perched Groundwater Zone	High-Vacuum Dual-Phase Extraction/Ultraviolet Oxidation/Flameless Thermal Oxidation/Granular Activated Carbon
Lower Vadose Soil And Exposition Groundwater Zone	Electrical Resistance Heating (ERH)[2] with Vapor Extraction/Pump and Treat/Ultraviolet Oxidation/Flameless Thermal Oxidation/Granular Activated Carbon

1. Surface cover/grading to be performed by City of Maywood Park Contractor
2. ERH system to be designed and implemented by ERH Contractor

1.2 ADDITIONAL INFORMATION

Additional information regarding subsurface zones, Site History, Contamination, and the geologic and hydrogeologic setting of the Site is provided in SECTION 01115-SITE DESCRIPTION.

1.3 DESIGN SPECIFICATIONS

Construction and implementation of the remediation system design will be performed according to the specifications and drawings that are included as part of the Design Report. The design specifications provided include:

a. Construction and installation details for dual-phase, groundwater, and soil vapor extraction wells;

b. Excavation, trenching and connection piping installation;

c. Treatment compound and foundation construction;

d. Vapor and groundwater treatment system design.

Design and installation of the ERH system will be addressed by the ERH contractor under separate cover. The groundwater treatment system shall be design/build based on the results of a water treatment pilot study, which will be scheduled as soon as monitoring wells (which are currently buried for park grading) can be accessed.

1.4 EXTRACTION WELLS

A dual phase extraction (DPE) well network has been designed to remediate the upper vadose zone soil and perched groundwater zone. The perched zone plume area is shown on Drawing C-1 and the DPE well field is shown on Drawing C-3. Groundwater extraction well networks have been designed for the Exposition aquifer “A,” “B,” or “C” zones. A composite plume map indicating contaminated area in the Exposition A and B zones is provided on Drawing C-1. The extraction well field is shown on Drawing C-3. Groundwater extraction wells shall also have the capability of being used for vapor extraction.

Not included on Drawing C-3 are vapor extraction wells that will be designed and constructed as part of the ERH treatment system design according to ERH Contractor specifications.

1.5 EXCAVATION, TRENCHING AND CONNECTION PIPING

Three major trenches will be excavated along the east, west, and south sides of the Site for installation of connection piping to the extraction wells, as indicated on Drawing C-3. A Trench Location Plan is provided on Drawing C-2. Elevation and excavation profiles of the three trenches are provided on Drawing C-5.

Connection piping will be attached to each extraction well. The connection piping will run along the trenches and come together at a common manifold where liquid and vapor phase contaminants enter the treatment compound.

1.6 TREATMENT COMPOUND AND FOUNDATION

Location of the treatment compound is shown on Drawing C-1. A pre-engineered steel building will be used for construction of the treatment compound. A profile-view of the compound and estimated build-surface elevations is shown on Drawing C-11.

The treatment compound foundation will consist of a 10-inch thick reinforced concrete slab with a secondary containment berm and sump. Typical Sections of the compound foundation are indicated on Figure C-13.

1.7 TREATMENT SYSTEM DESIGN

The layout of the treatment system and treatment compound is provided on Drawing M-4. Dual blower units will provide the vacuum necessary for the system to extract soil vapor from connected wells for treatment. The treatment system will incorporate a flameless thermal oxidizer (FTO) for vapor-phase contaminant destruction. The FTO will remove all vapor phase volatile organic compounds (VOCs) at destruction efficiency greater than 99% according to the manufacturer. FTO off-gas will be further treated in a polishing step consisting of granular activated carbon in treatment vessels. Following carbon polish, treated vapor will be discharged to the atmosphere.

Prior to implementation of a groundwater treatment system, a UV Oxidation pilot test will be performed to determine the appropriate treatment method. The groundwater will be treated and discharged to the Los Angeles District Sanitary Sewer, in accordance with regulatory discharge limits.

1.8 ERH FACILITIES

Design of the ERH system and associated vapor extraction wells will be performed by the ERH Contractor.

1.9 SURFACE GRADING

Construction of the remediation system shall be performed in concert with on-going construction of the Maywood Riverfront Park. Timing of well installation and trenching shall be performed after grading activities. Final grading and surface re-vegetation of the Site will be performed by the City of Maywood Park Contractor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01115

SITE DESCRIPTION

PART 1 GENERAL

1.1 SUMMARY

This section provides background on the project location, physical setting, environmental media characteristics, operational history, previous remedial actions and the nature and extent of contamination at the Pemaco Superfund Site ("Pemaco" or "Site"). A summary of the physical and chemical data collected during the Remedial Investigation (RI) and Feasibility Study (FS) phases of the project is provided in this Section.

Future contractors are encouraged to refer to additional information referenced in this section and contained in the Site's document repository that may assist in bidding for this project. No warranties or guarantees are made regarding the completeness or the accuracy of information provided in this section or the documents contained in the repository.

1.2 PROJECT LOCATION

Drawing G-1 illustrates the general geographical area of the Pemaco Site. The Site is located in the eastern portion of the City of Maywood in central Los Angeles County. The City of Maywood is bordered on the north and west by the City of Vernon, on the east by the Los Angeles River and on the south by the Cities of Huntington Park and Bell.

Pemaco encompasses approximately 1.4 acres within a mixed industrial and residential neighborhood of the City of Maywood. The address is 5050 East Slauson Avenue, Maywood, California, 90270. The City of Maywood, in conjunction with the Trust for Public Land (TPL), has plans to utilize the Pemaco property as part of a larger 7.3-acre public recreational park. The Maywood Riverfront Park would be one segment of a proposed 51-mile greenway along the Los Angeles River.

1.3 SITE ACCESS

The Site may be accessed through a gate present along the southern property boundary on east 60th Street. Please note posted traffic restrictions to vehicles over 300 tons on East 59th Place (said vehicles must remain on Alamo Street past East 59th Place within the residential neighborhood).

1.4 SITE LAYOUT AND EXISTING STRUCTURES

The Site is currently a vacant dirt lot that is undergoing surface grading in association with the construction of the Maywood Riverfront Park. The Site is bounded on the north by Slauson Avenue, on the east by the Los Angeles River channel, on the south by East 59th Place and on the west by the Los Angeles Junction Railroad (LAJR) Right-of-Way. Negotiations for the removal of the LAJR are anticipated to be completed by summer 2005 to allow for the grading of the entire Maywood Riverfront Park area.

The Park Contractor's construction offices are located Walker Street just south of 59th Place. The Los Angeles River borders the eastern-most side of the property.

1.5 TOPOGRAPHY AND SURFACE WATER DRAINAGE

As stated above, the Site occupies approximately 1.4 acres with a mixed industrial and residential neighborhood which borders the Los Angeles River. In general, the site topography gently slopes in a southwesterly direction away from the Los Angeles River channel. Grading activities for the Park have begun so the topography is currently in flux. The proposed grades and surface improvements for the Park are shown in Drawing C-2.

With exception to the Los Angeles River, surface water features are relatively insignificant in the site vicinity. Site runoff typically follows site topography via sheet flow until being collected into the stormwater inlets.

1.6 GEOLOGICAL AND HYDROGEOLOGIC SETTINGS

1.6.1 Regional Geology/Hydrogeology

The Los Angeles–Orange County coastal plain is a structural basin formed by folding of the consolidated sedimentary, igneous and metamorphic rocks that underlie the basin at great depths. Primary geologic/hydrogeologic units in the area, from youngest to oldest include:

- Recent Alluvium – Primarily unconsolidated braided-river and floodplain deposits. These deposits comprise the uppermost 30 to 40 ft of soil/sediment in the immediate area.

- Pleistocene Lakewood Formation, including the Exposition and Gage/Gardena Aquifers – Consisting of braided river and floodplain deposits. In the Pemaco area, sediments of the Lakewood Formation generally comprise the stratigraphic interval between about 35 and 200 ft bgs. Saturated intervals of the Lakewood Formation within the study area that are stratigraphically equivalent to the Exposition Aquifer do not meet the strict definition of an aquifer because they are not capable of yielding economically significant quantities of water. The Gage/Gardena Aquifer is assumed to be located between 180 and 200 feet bgs in the site vicinity, but this has not been confirmed. The deepest borehole drilled during the RI activities went to 183 feet bgs.

- Lower Pleistocene San Pedro Formation, including the Hollydale, Jefferson, Lynwood and Silverado Aquifers – A variety of lithosomes deposited in both marine and non-marine environments. In the Pemaco area of the Central Groundwater Basin, the stratigraphic top of the San Pedro Formation is generally placed at the base of the Gage/Gardena Aquifer (basal Lakewood Formation), estimated to occur at approximately 200 ft bgs. The uppermost unit of the San Pedro Formation is a 50- to 75-ft thick fine-grained lithosome, generally regarded as an aquitard. The Hollydale and Jefferson aquifers are the upper aquifers in the San Pedro Formation and may be present below the Pemaco Site, with the top of the uppermost coarse-grained unit occurring somewhere between 250 and 325 ft bgs.

The aquifers mentioned above are all used for both municipal and industrial purposes in various parts of the Central Basin. In the Pemaco area, screened/perforated intervals in nearby production wells begin in the San Pedro Formation Aquifers, usually at depths of 350 ft bgs or deeper. The closest active well is approximately ½ mile south of the Site (screen interval begins at 610 feet bgs), one of the two wells owned and operated by Mutual Maywood Water Company No. 3. The shallowest production well within 1 mile of the Site is screened starting at 350 ft bgs within the uppermost aquifer of the San Pedro Formation (the Jefferson Aquifer). In general, the groundwater flow direction in the aquifers is southwest, towards the coast.

1.6.2 Geologic – Study Area

Geologic cross section A-A’ (Figure 1; Appendix 01115 A) illustrates the Site’s geology and hydrogeology as encountered in continuously-cored borings drilled during RI/FS activities (boring logs are provided in Appendix 01115 B). To describe the stratigraphy and lithologic units underlying the site vicinity, the following nomenclature was adopted and will be used throughout the document as they relate to analytical results and remedial actions associated with the Site:

- Surface and Near-surface Soil;
- Upper Vadose Zone Soil;
- Lower Vadose Zone Soil;
- Perched Groundwater Zone; and
- Exposition Groundwater Zones ‘A’ through ‘E’.

Table 01115-1 summarizes site stratigraphy and may be used in conjunction with the discussion of each soil zone below.

1.6.2.1 Surface and Near-surface Soil

Surficial fill in the area varies in thickness from 2 to 6 ft and is typically comprised of dark yellowish brown silty sands and local gravelly sands or clayey gravels.

1.6.2.2 Upper Vadose Zone

For purposes of this report, the upper vadose zone includes the upper vadose zone sands and the perching clay. The saturated zone above the perching clay (perched groundwater zone) is discussed in Section 1.6.2.5.

Upper Vadose Zone Sands

Typical depth of the upper vadose zone is between 2 to 25 ft bgs. These native soils are predominately light olive gray to dark yellowish brown laminated to moderately bedded fine silty sands ranging from 1 to 20 ft in thickness interbedded with pale yellowish brown to light olive gray lenses of laminated to poorly bedded poorly graded sands and fine poorly graded sands with silt which are 2-in to 6-ft thick. Local discontinuous lenses of olive gray sandy silt and lean clay lenses ranging from 3 inches to 4 ft in thickness are also present within the upper vadose zone sand.

Perching Clay

Typical depth of the perching clay is between 28 to 40 ft bgs. The top of this unit is comprised of silty lean and fat clays ranging from 1 to 15 ft in thickness, which are underlain and interbedded with olive gray to moderate yellowish brown clayey and sandy silts ranging from 1 to 8 ft in thickness. The perching clay and associated clayey silts comprise the fine-grained lithosome that ranges from 10 to 20 ft in total thickness. Local unsaturated silty sand and sands with silt lenses are found within the lithosome.

1.6.2.3 Lower Vadose Zone

Lower Vadose Zone Sand

The lower vadose zone sand is typically found between 40 to 50 ft bgs. It is predominately fine- to medium-grained, unsaturated, poorly graded sands and gravelly well-graded sands derived from granitic source rocks. The zone typically coarsens downward with poorly bedded gravelly basal units. The lower vadose zone sands are usually 1- to 14-ft thick with local intervals of silty sands and poorly graded sands with silt which are 6-inches to 3-ft thick. Local interbeds of silt lenses are 6-inches to 4-ft thick within this unit. The lower vadose zone sand appears to be continuous throughout the area as it was encountered in every boring completed in the site vicinity except in the area adjacent to MW-12 (Alamo and 60th Street) where it appears to pinch out locally. The thickest local sequences are found along District Blvd. and in the area underlying 60th Street between Walker Ave. and District Boulevard. Fine silty sands comprise the unit in locations where the interval is less than 3 ft thick.

Lower Vadose Zone Fine-Grained Unit

Typical depth of the lower vadose zone fine-grained unit is between 50 to 65 ft bgs. It is comprised of sandy and clayey silts ranging from 7 to 20 ft in thickness interbedded with lean and fat clays ranging from 6 inches to 5 ft in thickness. Local discontinuous lenses of unsaturated poorly graded sands and silty sands are 0.5- to 2-ft thick within this interval. The thickest areas of the unit are predominately silt. Localized abundant organic material can also be found throughout the interval.

1.6.2.4 Lakewood Formation

‘A’ – ‘B’ Fine-Grained Unit

This zone separates the ‘A’ and ‘B’ Exposition groundwater zones (1.5.1.5) and is typically found between 70 to 80 ft bgs. It is comprised of light olive gray fat and lean moderate to very stiff clays with local interbeds of dark greenish gray clayey silt with sand. Local mottling of the gray clays with dark yellowish orange and medium yellow brown clays may distinguish this unit. This aquitard interval ranges from 5 to 10 ft in thickness and is continuous where both ‘A’ and ‘B’ Exposition groundwater zones are present.

‘B’ – ‘C’ Fine-Grained Unit

This unit is typically found between 90 to 100 ft bgs. It is predominately comprised of olive gray to dark greenish gray fat and lean clays 8- to 10-ft thick with local interbeds of sandy silts and silt with clay 1- to 5-ft thick. Total thickness of the unit is 7 to 12 ft.

‘C’ – ‘D’ Fine-Grained Unit

This unit is typically found between 105 to 125 ft bgs. It is comprised of lean and fat clays 3 to 6 ft thick interbedded with sandy and clayey silts 4- to 12-ft thick. Total unit thickness ranges from 18 to 30 ft.

‘D’ – ‘E’ Fine-Grained Unit

This unit is typically found between 145 to 160 ft bgs. It is predominately comprised of clayey silt with local interbeds of lean clays. Thickness ranges from 12 to 18 ft. Local saturated silty sand lenses to 2-ft thick are located within the interval.

Lower Exposition Fine-Grained Unit

The top of this unit is typically found at 175 ft bgs. It is comprised of clay with silt finely laminated with silt. Local lenses of medium-grained saturated poorly graded sands to 6 inches thick are found within this unit. The depth to bottom and total thickness of this unit is unknown in the site vicinity.

1.6.2.5 Saturated Zones

Perched Zone

The perched saturated interval comprises a few inches to 4 ft of the “perched zone” lithosome (perching clay described above in Section 1.6.2.2). Typical depth of the perched zone is between 25 and 30 ft bgs. This wet to saturated zone is comprised of locally laminated fine silty sands ranging from 6 inches to 4 ft in thickness. Locally, the perched zone is comprised of two perched intervals of sandy silts or silt with sand separated by a 1- to 3-ft-thick layer of “perching” clay. The perched zone is absent in some areas where it is replaced by “high points” of the underlying “perching” clay. Groundwater flow direction and hydraulic communication between different localities of the perched zone is dependent upon the geometry of the underlying perching clay. The perched zone can be characterized by low transmissivities and very limited yield. This is not a viable aquifer.

Exposition ‘A’ Zone

This is the first saturated zone encountered below the perched zone. The ‘A’ Zone is typically found between 65 and 75 ft bgs. It is comprised of light olive gray to dark greenish gray fine silty and poorly graded sands locally interbedded with well-graded sands with silt. The thickness of this zone is highly variable ranging from 3 inches to 10 ft in thickness. The thickest ‘A’ Zone intervals are comprised of interbedded poorly graded silty sands and well-graded sands. The thinnest intervals of the ‘A’ Zone are a series of 1- to 3-in-thick saturated silty sands interbedded with 0.5- to 1-ft-thick silts and clays. Overall, the ‘A’ Zone can be characterized as a series of semi-discontinuous saturated sand lenses.

Exposition ‘B’ Zone

The ‘B’ Zone is the second saturated zone below the perching layer and is typically found between 80 and 90 ft bgs. It is comprised of fine silty sands, poorly graded sands and poorly graded sands with silt ranging from 1.5 to 10 ft in thickness. The fine-grained silty sands are typically light olive gray mottled with moderate yellowish brown or moderate olive brown. Some of the thicker portions of the unit have 4-ft-thick interbeds of silt/clay. The ‘B’ Zone is continuous throughout the site vicinity, except in the area along District Blvd., south of 60th Street, where it pinches out.

A secondary saturated silty sand lens located between 90 and 92 ft bgs was consistently observed during the coring of borings MW-16 through MW-18 and RW-01 located in the southernmost portion of the Pemaco Site. This secondary lens is isolated from the ‘B’ Zone described above by an overlying interval of fat clay ranging in thickness from 1 to 3 ft. Well MW-17-95 was screened solely in this zone for aquifer test purposes. This zone was informally named the ‘B2’ Zone. The ‘B2’ lens was not encountered in any of the offsite borings that were cored below 90 ft bgs.

Exposition ‘C’ Zone

The ‘C’ Zone is typically found between 100 and 105 ft bgs. It is comprised of saturated dark greenish gray fine silty sands, poorly graded sands and poorly graded sands with silt ranging from 2 to 6 ft in thickness. It appears to be continuous throughout the site vicinity within the 95 to 110 ft depth interval.

Exposition ‘D’ Zone

The ‘D’ Zone is typically found between 125 and 145 ft bgs. It is comprised of interbedded fine silty sands, poorly graded sands and poorly graded sands with silt, well-graded sands and gravelly sands and local well-graded sandy gravel intervals. Total thickness ranges from 6 to 15 ft. This zone is the thickest and highest yielding of all the Exposition groundwater zones encountered in the Site vicinity.

Exposition 'E' Zone

The 'E' Zone is typically found between 160 and 175 ft bgs and is comprised of alternating saturated intervals of 1-ft-thick fine silty sands and well-graded sands.

1.6.3 Hydrogeologic Setting – Study Area

As discussed in Section 1.6.2.5 above, there are two distinct hydrogeologic units within the study area: a perched groundwater zone and the stratigraphic equivalent of the more regional Exposition Aquifer. The perched groundwater zone is typically found between 25 and 40 ft bgs within the study area. Beneath the perched groundwater zone, there are five distinct saturated intervals present within the study area that are typically found between 65 and 175 ft bgs that are separated by silt/clay intervals. These saturated zones do not comprise a viable aquifer, as the groundwater yield does not produce economically significant quantities of water to local production wells. However, as these zones are stratigraphically equivalent with the more regional Exposition Aquifer, they have been have been informally named from top to bottom, the Exposition 'A' through 'E' Zones. Seventy-eight monitoring wells are currently installed within the perched groundwater zone and the five Exposition groundwater zones.

1.6.3.1 Perched Groundwater

Groundwater in the perched zone occurs in semi-continuous and discontinuous lenses of poorly graded sand, silty sand, and sandy silt. These lenses are located at different depths ranging from 20 and 40 ft bgs and 5 inches to 5 ft in thickness. The geometry of the perched zone is controlled by the highly irregular and undulating top surface of the underlying, laterally extensive perching clay. Measurements of depths to groundwater in the perched zone in the Pemaco site vicinity have ranged from 18.48 ft bgs (B-31, April 2001) to 39.31 ft bgs (B-17, May 2001) since measurements began in September 2000. Groundwater fluctuations of greater than 5 ft have been observed since routine gauging started.

The complex hydrogeology of the perched zone causes highly variable groundwater gradients. The overall general component of apparent groundwater flow in the perched zone is towards the southwest, but there are many localized areas that indicate that the apparent groundwater flow is in multiple directions.

1.6.3.2 Exposition Zones 'A' through 'E'

Although the groundwater zones present between 65 and 175 ft bgs in the vicinity of the Site do not comprise a viable aquifer, they are stratigraphically connected to the more regional Exposition Aquifer. As such they have been informally labeled Exposition Zones 'A' through 'E' and consist of five distinct saturated zones that are separated by silt/clay intervals. The 'A' Zone is typically found between 65 and 75 ft bgs. It is comprised of fine silty and poorly graded sands locally interbedded with well-graded sands. The thickness of this zone is highly variable ranging from 3 inches to 10 ft in thickness. This interval can be characterized as a series of semi-discontinuous saturated sand lenses. The 'B' zone is typically found between 80 and 90 ft bgs. It is comprised of fine silty sands, poorly graded sands and poorly graded sands with silt ranging from 1.5 to 10 ft in thickness. The 'B' Zone is more uniform and laterally continuous than the 'A' Zone. These two zones are the predominant zones of concern and together are informally named the Upper Exposition Aquifer.

Potentiometric surface measurements in the semi-confined Exposition ‘A’ Zone have ranged from 52.52 ft bgs (MW-7-75, July 2003) to 64.27 ft bgs (MW-20-70, October 2003), and groundwater fluctuations of up to 7 ft have been observed in the ‘A’ Zone since measurements began in May 2001. Groundwater gradient of the Exposition ‘A’ Zone has typically ranged from 0.0035 to 0.011 feet per feet (ft/ft). Apparent groundwater flow directions have been consistently towards the southwest and south-southwest.

Potentiometric surface measurements in the confined Exposition ‘B’ Zone have ranged from 57.71 ft bgs (MW-13-85, May 2001) to 72.40 ft bgs (MW-17-95, October 2002), and groundwater fluctuations of more than 4 ft have been observed in the ‘B’ Zone since measurements began in May 2001. Groundwater gradient of the Exposition ‘B’ Zone has typically ranged from 0.0057 to 0.0092 ft/ft. Apparent groundwater flow directions have been consistently towards the southwest.

The remaining three zones, ‘C’, ‘D’, and ‘E’ are typically found from 95 to 110 ft bgs, 125 to 145 ft bgs, and 160 to 175 ft bgs, respectively. The ‘C’ zone is comprised of saturated fine silty sands, poorly graded sands and poorly graded sands with silt ranging from 2 to 6 ft in thickness. It appears to be continuous throughout the site vicinity within the 95 to 110 ft depth interval. Potentiometric surface measurements in the Exposition ‘C’ Zone have ranged from 87.31 ft bgs (MW-1-100, October 2003) to 97.56 ft bgs (MW-25-110, October 2003), and groundwater fluctuations of more then 4 ft have been observed in the ‘C’ Zone since measurements began.

The ‘D’ Zone is typically comprised of interbedded fine silty sands, poorly graded sands and poorly graded sands with silt, well-graded sands and gravelly sands, and local well-graded sandy gravel intervals. Total thickness ranges from 6 to 15 ft. This zone is the thickest and highest-yielding of all the Exposition lithosomes encountered in the site vicinity. Potentiometric surface measurements in the Exposition ‘D’ Zone have ranged from 97.00 ft bgs (MW-07-130, January 2003) to 106.34 ft bgs (MW-10-170, October 2003), and groundwater fluctuations of more then 6 ft have been observed in the ‘D’ Zone since measurements began.

Groundwater gradients of the Exposition ‘C’ and ‘D’ Zones have been calculated to be 0.0016 and 0.0023 ft/ft, respectively. Apparent groundwater flow directions have generally been towards south and southwest for the ‘C’ and ‘D’ Zones, respectively.

The ‘E’ Zone is typically comprised of alternating saturated intervals of 1-ft-thick fine silty sands and well-graded sands. Due to the limited number of monitoring wells screened within the Exposition ‘E’ Zone, no gradient data is available for this zone.

1.6.3.3 Hydraulic Parameters

A series of groundwater slug, pumping, and recovery tests were performed at the Pemaco Site between December 12th and 24th, 2001. Types of tests performed included:

- Background/diurnal logging of “static” groundwater levels in the ‘A’ and ‘B’ Zones,
- Slug testing of six ‘A’ Zone wells,
- Step drawdown pump testing of the ‘B’ Zone while monitoring ‘A’ and ‘B’ Zone wells,
- Constant rate pump testing (72 hrs) of the ‘B’ Zone while monitoring ‘A’ and ‘B’ Zone wells,
- Post-pumping recovery monitoring of all wells monitored during pumping test, and
- “Stress” pumping of the ‘B’ Zone to determine maximum sustainable pumping rates.

Results of the data analysis are:

- Sustainable pumping rates from the ‘B’ Zone are about 1 gallon per minute (gpm) and about 0.5 gpm from the ‘A’ Zone.
- Calculated hydraulic conductivity (K) values for the ‘A’ Zone range from 8.3 E-04 to 2.3 E-03.
- Calculated hydraulic conductivity (K) values for the ‘B_1’ Zone range from 1.4 E-02 to 1.0 E-01.
- Calculated hydraulic conductivity (K) values for the ‘B_2’ Zone range from 6.7 E-03 to 6.6 E-03.
- Linear Groundwater Velocities calculated for the combined ‘B_1’ and ‘B_2’ Zones averaged 0.47 feet per day (171 feet per year).

1.7 SITE HISTORY

1.7.1 Historical Operations

Pemaco, Inc. formally operated a custom chemical blending and distribution facility at the Site from the 1940s until 1991 (E&E, 1998). Marie B. Richardson was the owner of Pemaco, Inc. until 1984, at which time Lux International purchased the property. Lux International operated the chemical blending facility until 1991 when they went out of business. No other use of the property is documented.

During its operation, the Pemaco facility consisted of a 22,000-square ft warehouse in the northern portion of the property, 31 underground storage tanks (USTs) and at least 6 aboveground storage tanks (ASTs) in the southern part of the property. A wide variety of chemicals were used onsite including chlorinated and aromatic solvents, flammable liquids, oils and specialty chemicals. These chemicals were stored in the ASTs and USTs, which ranged in size from 500 to 20,000 gallons, as well as 55-gallon drums sporadically stored around the Site. Most of the chemicals brought to the Site were delivered via railcar from a rail spur that branched out from the LAJR property west of the Site.

1.7.2 Environmental Investigations

Numerous soil and groundwater investigations have been conducted at Pemaco and the adjacent properties to assess the nature and extent of contamination at the Pemaco Site and the surrounding area. The first soil assessment of the property was completed in 1990 by the Pemaco facility owner. The owner abandoned the Site sometime after 1991 and environmental activities at the Site became the responsibility of the State of California, and eventually the United States Environmental Protection Agency (USEPA) under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

Between 1991 and 1994, approximately four hundred 55-gallon drums and three ASTs were removed from the Site by order of the Los Angeles District Attorney’s office. A substantial fire in 1993 destroyed much of the main warehouse building. In 1994, USEPA Region IX Emergency Response conducted a removal assessment at Pemaco at the request of Los Angeles County. As a part of this assessment, USEPA removed six 55-gallon drums, installed fencing and secured UST fill pipes with locking well caps.

In June of 1995, Bechtel completed a preliminary assessment/site investigation at Pemaco, which led to the listing of Pemaco into the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) under the I.D. number CAD980737092. Ecology & Environment’s (E&E) Superfund Technical Assistance Response

Team (START) completed an expanded site investigation (ESI) in 1997, which included an evaluation of Hazardous Ranking System (HRS) factors. Based on these factors, Pemaco was recommended to the Superfund National Priorities List (NPL).

CET Environmental Services, Inc. (CET) completed additional removal activities at Pemaco between August 1997 and March 1998 under the direction of Region IX's Emergency Removal Office (E&E, 1998a, 1998b). Work included excavation and removal of over 30 USTs, building demolition, environmental sampling and the design, installation and operation of a soil vapor extraction (SVE) system. The SVE system operated between March 1998 and March 1999 (E&E, 1999). By the end of August 1998, the SVE system had operated for 3,230 hours (134.6 days) and had removed and treated approximately 90,000 pounds of hydrocarbons and solvents from vadose zone soils at the Site. The system was turned off on March 3, 1999 due to community concern regarding the possibility of dioxin releases from the thermal oxidation unit used to treat extracted soil vapor.

The USEPA placed the Pemaco Site on the NPL in January 1999, making it eligible for cleanup action under Superfund. A full-scale RI was performed by USEPA between January 2001 and November 2001 to identify the nature and extent of soil and groundwater contamination present at the Site. EPA also conducted treatability tests and additional "data gap" assessments between December 2001 and December 2002 to support the FS phase of the Superfund process, which was performed between January 2002 and August 2003. These activities included the collection of over 2,500 ambient air, soil, soil vapor and groundwater samples.

1.8 SITE CONTAMINATION

1.8.1 Investigation Results

The aforementioned environmental investigations, in particular the RI and FS, resulted in a large database of physical and chemical information associated with the various site media (i.e., surface and near-surface soil, upper vadose zone soil, perched groundwater, lower vadose zone soil and Exposition groundwater). A summary of each environmental investigation is provided in Table 011115 - 2. The following documents may be referenced for a more detailed account of activities and results.

- Active Leak Testing, Inc. (12/26/90) *Subject Site Assessment Investigation Report*;
- Ecology and Environment, Inc. (2/25/94) *Final Site Assessment Report*;
- Ecology and Environment, Inc. (3/10/98) *Pemaco Maywood Expanded Site Inspection*;
- Ecology and Environment, Inc. (3/98) *Subsurface Investigation*;
- CET Environmental Services, Inc. (3/98) *Design Report*;
- CET Environmental Services, Inc. (4/4/98, 5/11/98, 6/8/98, 7/8/98, 8/5/98, 9/2/98, 10/29/98, 11/12/98, 1/4/99 and 2/4/99) *Vapor Extraction Reports*;
- CET Environmental Services, Inc. (5/6/98) *Pemaco Stack Test*;
- Ecology and Environmental, Inc. (5/99) *Pemaco Removal Site Final Report*;

- T N & Associates, Inc. (12/00) *Preliminary Summary of Groundwater and SVE System Sampling Events*;

- T N & Associates, Inc. (3/02) F*inal Technical Memorandum, Results of Aquifer Tests Performed on the Exposition 'A' and 'B' Groundwater Zones*, December 2001;

- T N & Associates, Inc. (10/02) *Final Technical Memorandum, Results of Groundwater Monitoring Activities*, May 2001 through April 2002;

- T N & Associates, Inc. (3/03) *Final Technical Memorandum, Results of High-Vacuum Dual-Phase Extraction Pilot Test Performed on the Perched Groundwater Zone and Exposition 'A' and 'B' Groundwater Zones,* December 2002;

- T N & Associates, Inc. (8/03) *Final Technical Memorandum, Baseline Risk Assessment*;

- T N & Associates, Inc. (11/03) *Final Remedial Investigation Report*;

- T N & Associates, Inc. (2/04) *Final Feasibility Study Report*;

- T N & Associates, Inc. (2/04) *Technical Memorandum: Groundwater Data Gap Assessment 2003, Exposition 'A', 'B', 'C', and 'D' Zones*;

- T N & Associates, Inc. (3/04) *Technical Memorandum: Results of the Source Area Investigation Using a Cone Penetration Testing Rig (CPT) Equipped with a Membrane Interface Probe (MIP)*; and

- T N & Associates, Inc. (11/04) *Technical Memorandum: Pemaco Data Evaluation for Natural Attenuation and Biodegradation of Chlorinated Ethenes*.

1.8.2 Nature and Extent of Contamination

Analytical results of the environmental samples collected during the RI/FS confirmed that chemical concentrations originating from past industrial practices at the Pemaco property have impacted soil and groundwater at the Site, as well as offsite, below adjacent industrial and nearby residential properties. Based on the operational and land use history of Pemaco and the adjacent industrial properties, contamination sourced to Pemaco has been delineated from contamination sourced to the neighboring former industrial properties. In addition, contaminant plumes have been delineated to levels indicative of background [soil to levels below background data for California soils (Bradford et al., 1996) and groundwater to levels below USEPA and CalEPA drinking water standards (e.g., maximum contaminant levels)].

Fifty-six chemicals of concern (COCs) have been identified at the Site based on the comparison of analytical results to USEPA Region IX Preliminary Remediation Goals (PRGs) and State of California and USEPA Maximum Contaminant Levels (MCLs). COCs include various species of metals, solvents/non-halogenated volatile organic compounds (NHVOCs), semi-volatile organic compounds (SVOCs) and volatile organic compounds (VOCs). Tables 01115-3 through Table 01115-4 list COCs per media zone.

The following sections describe the nature and extent of contamination based on analytical data for the following environmental media: surface and near-surface soil, upper vadose zone soil, lower vadose zone soil, perched groundwater and Exposition Zone groundwater.

1.8.2.1 Surface and Near-Surface Soil

A total of 150 samples were obtained within a collection of discrete-sample grids (approximately 25 ft by 25 ft) and 5 composite-sample grids (approximately 50 ft by 100 ft) laid across the Pemaco Site and adjacent railroad right-of-way. Samples were analyzed for SVOCs and metals and indicated elevated concentrations of both within the two soil zones.

Four metals and seven SVOCs were detected above site cleanup criteria for surface and near-surface soils, or Region IX PRGs for residential soils (with the exception of iron, for which the cleanup criteria is background (83,100 mg/kg)) (Bradford et al., 1996) (see Table 01115 - 3). Polyaromatic hydrocarbons (PAHs) were the most prevalent SVOCs detected above PRGs for Residential Soil in both surface and near-surface samples. Although there was no indication of historical use of PAHs at Pemaco or adjacent industrial properties, the compounds were detected throughout the Pemaco Site. A possible source of the PAH concentrations could be from creosote treated railroad ties located along the LAJR property and the associated spurs branching off each property, or from the warehouse fire that occurred on the Pemaco Site in 1993. However, PAHs were also detected during previous environmental assessments of adjacent properties in areas distant from the railway and former warehouse. It is likely that PAHs can be found in shallow soil throughout the Maywood area due to vehicle exhaust, previous fires and paving activities that have occurred over the years. These concentrations appear to be only surficial phenomena.

Metals exceeding PRGs for residential soil in surface soils include iron, lead and manganese. Iron and arsenic concentrations exceed PRGs in near-surface soils. It is unlikely that the elevated metal concentrations are a result of previous activities on the Pemaco property. The elevated metal concentrations could be associated with the historical use of railcars and the presence of the train tracks. However, concentrations may also be contributed to high naturally-occurring background levels in the soil.

As concentrations of SVOC and metals in surface and near-surface soils indicate, the majority of surficial soil contamination appears to lie along the periphery of the Pemaco Site. This would be consistent with the fact that clean fill was placed over much of the Site during previous removal actions of the former warehouse foundation, UST excavation and soil removal within the central portion of the Site.

1.8.2.2 Upper Vadose Zone Soil

A total of 173 discrete soil samples were collected from upper vadose zone soils (approximately 2.5 ft to 35 ft bgs) from three depth intervals – approximately 5 feet bgs, near the capillary fringe (25 feet bgs) and at the top of the perching clay (approximately 35 feet bgs). Samples were analyzed for VOCs, SVOCs, NHVOCs and metals.

Analytical results were compared to site cleanup criteria for upper vadose zone soils, or USEPA Region IX Soil Screening Levels (SSLs), which are used to screen subsurface soil as a threat to groundwater (see Table 011115 - 4). The Dilution Attenuation Factor (DAF) 20 SSLs were selected for comparison because these soils are not directly adjacent to a drinking water source and dilution of the contaminant is occurring before it reaches the source. Principal analytical data are bulleted below:

- Arsenic and total chromium were the only target metals detected above DAF 20 SSLs. Samples that reported these concentrations were collected from borings located offsite. The distance of these samples from the Pemaco Site and the sporadic distribution of concentrations suggest that detected concentrations are likely background levels and not from a Pemaco release.

- Trace to low concentrations of NHVOCs were detected in the southwest portion of the Pemaco Site. Acetone was the only solvent that exceeded an SSL.

- The most prevalent SVOCs within the upper vadose zone soils were polyaromatic hydrocarbons (PAHs), the majority of which were located within 5 to 6 feet bgs adjacent to the central-west part of the Pemaco Site. As stated in the surface/near-surface soil section, there was no indication of historical use of PAHs at the Pemaco facility or the adjacent industrial properties.

- VOCs that exceeded Region IX DAF 20 PRGs included the following: 1,1-DCE, acetone, benzene, cis-1, 2-DCE, ethylbenzene, methylene chloride, PCE, toluene, TCE, vinyl chloride, and xylenes. The most prevalent and widespread concentrations consisted of chlorinated VOCs, although several “hot spots” of non-chlorinated VOCs (BTEX) are present within the upper vadose zone soils.

As discussed above, VOCs are the most prevalent and widespread contaminants within upper vadose zone soils at the Pemaco Site and surrounding area. The release of VOCs at Pemaco is likely a result of leaking USTs and spills associated with the loading area located in the southwest corner of the Site and leaking aboveground storage tanks and drum storage in the north-central portion of the Site. Five primary areas of VOC contamination have been identified in the upper vadose zone, these are:

1. Below the central part of Pemaco Site and extending approximately 80 ft offsite (to the west) between 25 and 35 ft bgs, primarily comprised of chlorinated VOCs;

2. A small area below the central part of the Pemaco around 15 ft bgs, primarily comprised of toluene, ethylbenzene and xylenes;

3. A small area below and adjacent to the central-west part of the Pemaco Site (below the rail tracks) around 5 ft bgs, primarily comprised of SVOCs;

4. Below the south part of Pemaco Site and extending approximately 200 ft offsite (to the west/southwest) between 25 and 35 ft bgs, primarily comprised of chlorinated VOCs; and

5. An offsite area resulting from releases at the adjacent former W.W. Henry-owned property, consisting primarily of benzene, toluene and hexane.

1.8.2.3 Lower Vadose Zone Soil

A total of 112 discrete soil samples were collected from vadose zone soils between approximately 35 and 65 ft bgs. Soil samples were collected at 10-foot intervals beginning at 35 feet bgs and continuing to approximately 65 feet bgs and analyzed for VOCs, SVOCs, NHVOCs and metals.

Analytical results were compared to site cleanup criteria for lower vadose zone soils, or USEPA Region IX DAF 20 SSLs for soils to 50 ft bgs and USEPA Region IX DAF 1 SSLs for soils 50 ft or greater (see Tables 011115 - 5A and 5B). The DAF 1 SSLs assume that the contaminated soil source is directly adjacent to a drinking water source, such as a regional aquifer, and no dilution is occurring along the migration pathway between the source soil and the drinking water source. Due to the saturated zone present between approximately 55 and 65 feet bgs and the potential future use of the Exposition Aquifer as a viable water source, lower vadose zone soils present at 50 feet bgs or greater were also compared to DAF 1 SSLs. Primary analytical data are bulleted below by analyte group:

- All 24 metal target analytes were detected above method detection limits, although only total chromium was detected above DAF 20 SSLs. Upon comparison of lower vadose zone soils greater than 50 feet bgs with DAF 1 SSLs, the following metals were filtered: antimony, arsenic, barium, cadmium, total chromium, and nickel. Total chromium exceeded the DAF 1 SSL for chromium at every boring where samples were collected below 50 feet. With exception to antimony, all other metals were detected at concentrations exceeding their applicable SSLs at all borings sampled below 50 feet except for one to two locations. The widespread presence of metals within lower vadose zone soils suggests that these metals are likely background and not from a Pemaco release.

- Trace to low concentrations of SVOCs and NHVOCs were detected; however, no concentrations exceeded DAF 20 or DAF 1 SSLs.

- VOCs that exceeded Region IX DAF 20 SSLs include: benzene, cis-1, 2-DCE, 1,2-DCA, methylene chloride, TCE, and vinyl chloride. Upon comparison of lower vadose zone VOC concentrations greater than 50 feet bgs with DAF 1 SSLs, all VOCs discussed above reported concentrations exceeding DAF 1 SSLs with exception of vinyl chloride. This comparison also revealed additional offsite contamination, although maximum exceedances remain concentrated within the southwest corner of the Pemaco Site between the depths of 55 and 60 feet bgs.

Like upper vadose zone soils, VOCs are the most prevalent and widespread contaminant within lower vadose zone soils. Two areas of contamination have been identified in the lower vadose zone (between 35 and 65 ft bgs). One area is located along the southern boundary of the Pemaco Site, which extends offsite to the south/southwest and is comprised of chlorinated VOCs. The other area is related to the W.W. Henry free product plume and was detected along 59th Place adjacent to the W.W. Henry property. The extent of this contamination was not fully evaluated, as it is not part of the Pemaco RI/FS scope.

1.8.2.4 Perched Groundwater
A total of 42 groundwater monitoring wells have been installed within the perched groundwater zone. Utilizing this network, eight quarterly groundwater sampling events (to date) have enabled the complete delineation of contaminant “plumes”, which originate from the Pemaco property.

PCE, TCE and vinyl chloride are the most prevalent and widespread compounds detected within the perched groundwater zone. “Hot spot” areas within the plumes have had groundwater concentrations exceeding 1,000 µg/L. The dissolved-phase portions of the plumes extend offsite and have migrated beneath adjacent properties extending up to 250 ft to the south and up to 200 ft southwest of the Pemaco property. Contaminant plumes originating from the Pemaco property have also co-mingled with other chlorinated and non-chlorinated contaminant plumes that have resulted from historical industrial uses of neighboring properties (former W.W. Henry and Lubricating Oil Services properties).

A more detailed description of the individual plumes is provided below:

- There appears to be three separate areas where PCE was released including the north-central portion of the Pemaco property, the northeast portion of the W.W. Henry property and in District Blvd (approximately half a block south of the Pemaco property). The highest concentrations (>500 µg/L) are found in the north-central portion of the Pemaco property in the vicinity of wells B-01 and SV-2. This area coincides with the former aboveground storage tanks and drum storage areas. The northern extent of this plume is approximately where the northern Pemaco property boundary lies. The western extent of this plume appears to co-mingle with another separate PCE plume that probably originated from the W.W. Henry property. This is indicated by the increase in concentrations going from northeast to southwest across the Pemaco and Railway properties onto the W.W. Henry property. This W.W. Henry hot spot also coincides with a documented release of PCE in soil adjacent to the former rail spur that ran along the northern boundary of the W.W. Henry property. The third identified perched zone PCE plume is located in a small area around well B-25. This small plume is likely to have originated from a release on the former Lubricating Oil Services property.

- TCE is the most prevalent VOC in the perched zone. The perched TCE plume extends throughout most of the Pemaco Site and adjacent areas. The highest concentrations (>100 µg/L) are found in the extreme southern portion of the Pemaco Site and to the south and southwest of the Pemaco Site. The "hot spot" of the perched TCE plume appears to be limited to an area between the 59th Place and Walker Avenue intersection, and the portion of District Blvd. north of B-25. This plume may have originated from the former loading dock located in the extreme southwest of the Pemaco property or from spills that could have occurred along the railway. *In-situ* groundwater samples were collected from selected residential lots in July 2001 to delineate the TCE plume in the residential area. The TCE plume is truncated to the west by the floating free product plume originating from the W.W. Henry property, as identified during RI activities and confirmed by environmental investigations performed by W.W. Henry environmental contractors (LFR, 2001). A second area of elevated concentrations (>50 µg/L) coincides with the north-central portion of the Pemaco Site in the SV-2 and B-01 areas. This TCE plume may be associated with the dechlorination of the PCE plume in that area.

- Vinyl chloride is one of the end daughter products in the degradation process of PCE and TCE. The vinyl chloride plume in the perched zone is probably due to the degradation of PCE and TCE (and subsequently DCE) and not from a release of vinyl chloride, which is a gas at room temperature and pressure. The "hot spot" (>100 µg/L) of the vinyl chloride plume appears to be in a small area near B-21. This well has elevated levels of toluene, which may be aiding in the degradation process of TCE and PCE causing the elevated vinyl chloride concentrations. The vinyl chloride plume terminates west of the Pemaco Site at the free product plume originating from the W.W. Henry property.

1.8.2.5 Exposition Groundwater Zones

A total of 36 groundwater monitoring wells have been installed in the five Exposition groundwater zones present in the vicinity of the Pemaco Site. Eight quarterly groundwater sampling events (to date) have been conducted using this well network. The most extensive contaminant plumes are found in the upper Exposition groundwater zones ('A' and 'B') are primarily comprised of TCE and its daughter products. The plume of largest lateral extent is approximately 1,300 ft long and 750 ft wide within the Exposition 'B' Zone. The dissolved-phase portion of this plume extends towards the southwest of the Pemaco property and underlies a two-block area that is used for residential housing. The "hot spot' area of this plume is directly below the southernmost portion of the Pemaco property and contains TCE at concentrations exceeding 20,000 µg/L.

A more detailed summary of contamination within each Exposition groundwater zone is bulleted below by zone.

'A' Zone:

- The compounds PCE, TCE and their associated daughter products (1,1-DCE, cis-1,2-DCE, trans-1,2-DCE and vinyl chloride) are the only chlorinated compounds that are widespread and consistently detected in the 'A' Zone above regulatory levels. Detections of hexane and cyclohexane are the only non-chlorinated compounds that are consistently detected in the Exposition 'A' Zone, although concentrations are below regulatory levels. Chloroform has been consistently detected over the PRG of 0.16 µg/L, but it only appears in one well (MW-5-85).

- TCE is the prevalent compound in the 'A' zone indicated by its high concentrations (21,000 µg/L) and large spatial area. PCE is consistently detected in the 'A' zone, but the concentrations are relatively low (<10 µg/L) compared to the TCE concentrations (>20,000 µg/L). The "hot spot" concentrations (>10,000 µg/L) of the Exposition 'A' Zone TCE plume is limited to the southernmost portion of the Pemaco property and extends southward to the south side of 59th Place and westward to the 59th Place and Walker Avenue intersection. This "hot spot" area is consistent with a release in the southernmost portion of the Pemaco Site possibly from the former loading dock, former drum storage area or one of the southernmost former USTs. The farthest that the dissolved-phase fringes of the plume extend offsite is southward where it terminates before 60th Place. The 'A' Zone TCE plume does not appear to extend in the southwest direction consistent with its gradient. This is likely due to the irregular geometry and discontinuous nature of the 'A' Zone sand lenses.

- There were no SVOCs detected above California MCLs or PRGs in the Exposition 'A' Zone.

- There were only two NHVOCs detected in the 'A' Zone that exceeded PRG screening levels, these were acetone and acrylonitrile. These concentrations above PRGs were only detected during the first sampling event following the installation of wells and have been attributed to bentonite pellets (see note below) used during well installation (TN&A, 2002b). Furthermore, these two wells are the furthest down-gradient wells from the Pemaco property. The spatial distribution of the detected acetone concentrations supports the premise that these concentrations are anomalous.

  > Note: During the first sampling event (May-June 2001), several of the newly installed Exposition Aquifer wells had elevated acetone and isopropyl alcohol concentrations. Due to these high concentrations appearing in the down-gradient wells, it was believed that a large acetone and isopropyl alcohol plume existed that was not fully delineated. Due to the documented historical uses and storage of these two chemicals on the Pemaco and other adjacent industrial sites (W.W. Henry property, Catellus property, Dunn-Edwards property), it was plausible that a large plume could exist. A second round of in-situ CPT groundwater sampling was performed in November 2001 to delineate this apparent plume. The additional CPT investigation results showed trace concentrations (4 to 12 ug/L) that were likely due to the ambient sampling conditions. During the time of the CPT investigation, the results of the September-October 2001 sampling event were received and it was found that the acetone and isopropyl alcohol concentrations had decreased by an

order of magnitude from the May-June 2001 sampling results in each of the newly installed wells. This anomalous decrease caused other possible reasons for the concentrations to be researched. It was found through discussions with drilling companies and well construction materials manufacturers that food-grade isopropyl alcohol is sometimes used for the time release coatings of bentonite pellets. This was confirmed by the Occupational Safety and Health Administration (OSHA) material safety data sheet (MS/DS) for the "Coating for Pel Plug TR30/60". This coating occasionally contains acetone as an impurity according to the sources consulted. These time-release pellets were used to seal the saturated annulus space between the well casings and the borehole walls for the Exposition Zone wells.

During the November 2001 well installation activities for the aquifer test wells (MW-14-80 through MW-19-85 and RW-01-85), TN&A personnel placed several of the coated bentonite pellets in a certified clean glass jar filled with laboratory grade de-ionized water. The pellets were allowed to soak in the container for approximately four hours; a sample was then collected from the water in the glass jar and analyzed for VOCs by EPA Method 8260. The results indicated that acetone was detected in this water at 310 ug/L. This test validated the hypothesis that the elevated acetone levels were caused by the coated bentonite pellets.

- Metal concentrations in the Exposition 'A' Zone exceeded screening levels (MCLs and PRGs) for arsenic and hexavalent chromium. The spatial distributions of these concentrations appear to coincide with chlorinated VOC plume "hot spot" and could possibly be associated with a release or could be a byproduct of the chlorinated VOC release. Changing native state geochemical parameters could have caused acidic conditions that may cause metal concentrations to be leached from the soil and cause higher than native background metals in solution. These elevated metal concentrations could also be high natural background levels.

'B' Zone:

- The groundwater concentrations of VOCs are similar to the concentrations found in the 'A' zone with TCE being the most prevalent and widespread compound. The dissolved-phase fringes of the TCE plume extend over a much greater area in the 'B' Zone than in the 'A' Zone. Less prevalent concentrations that are consistently detected in the 'B" Zone include: hexane, cyclohexane, and benzene.

- The "hot spot" concentrations (>10,000 µg/L) of the Exposition 'B' Zone TCE plume mirrors the 'A' Zone "hot spot" area. The farthest that the dissolved-phase fringes of the 'B' Zone TCE plume extend offsite is southwestward where it terminates near the Alamo Avenue and 60th Place intersection. The total size of this elliptical plume is estimated to be 1,290 feet long and 750 feet wide in map view. The geometry of the 'B' Zone TCE plume appears to be consistent with the southwest groundwater gradient indicated by the groundwater measurements in the 'B' Zone wells. The estimated surface area of the 'B' Zone TCE plume is approximately 17.7 acres (771,004 sq. ft). This larger plume size is further indication that the 'B' Zone sand lenses are more uniform and continuous than the 'A' Zone sands.

- The consistent detections of elevated benzene, hexane and cyclohexane in samples from well MW-06-85 indicate that the non-chlorinated contamination, which is prevalent in the perched zone underlying the eastern portion of the W.W. Henry property (free product area), has migrated down to the Exposition groundwater zones. Further evidence of this migration is indicated by the benzene concentrations found in each of the soil samples collected from 25 to 65 feet bgs from the MW-06 boring.

- There were only two NHVOCs detected in the 'B' Zone that exceeded PRG screening levels, these were acetone and acrylonitrile. The same discussion applies for these two compounds as discussed in the Exposition 'A' Zone section above.

- There were no SVOCs detected above California MCLs or PRGs in the Exposition 'B' Zone during any of the quarterly groundwater sampling events.

- Metal concentrations in samples from the Exposition 'B' Zone exceeded screening levels (MCLs and/or PRGs) for aluminum, arsenic, hexavalent chromium, manganese, and thallium. The spatial distributions of the arsenic concentrations are not consistent with a release based on the fact that the highest concentrations are found in samples from wells outside of the Pemaco "hot spot" area. The hexavalent chromium concentrations appear to coincide with chlorinated VOC plume "hot spot" and could possibly be associated with a release or could be a byproduct of the chlorinated VOC release. The spatial distribution and limited occurrences of elevated aluminum, manganese and thallium concentrations indicate that these are likely high natural background levels.

'C' Zone:

- There are six wells screened in the Exposition 'C' Zone (MW-10-110 and MW-11-100 and MW-05-105, MW-23-110, MW-24-110 and MW-25-110, which were installed in July 2003 as part a data gap assessment). No VOCs exceeding California MCLs have been detected within the Exposition 'C' Zone wells. However, three VOCs (benzene, TCE and vinyl chloride) have been detectd at concentations which exceed the more stringent Region IX PRGs for tap water. In addition, 1,4-dioxane has been detected in a sample collected from monitoring well MW-23-110 at a concentration of 5.0 µg/L, exceeding the California Department of Health Services Action Level of 3.0 µg/L. There is currently no promulgated California MCL for 1,4-dioxane.

'D' and 'E' Zones:

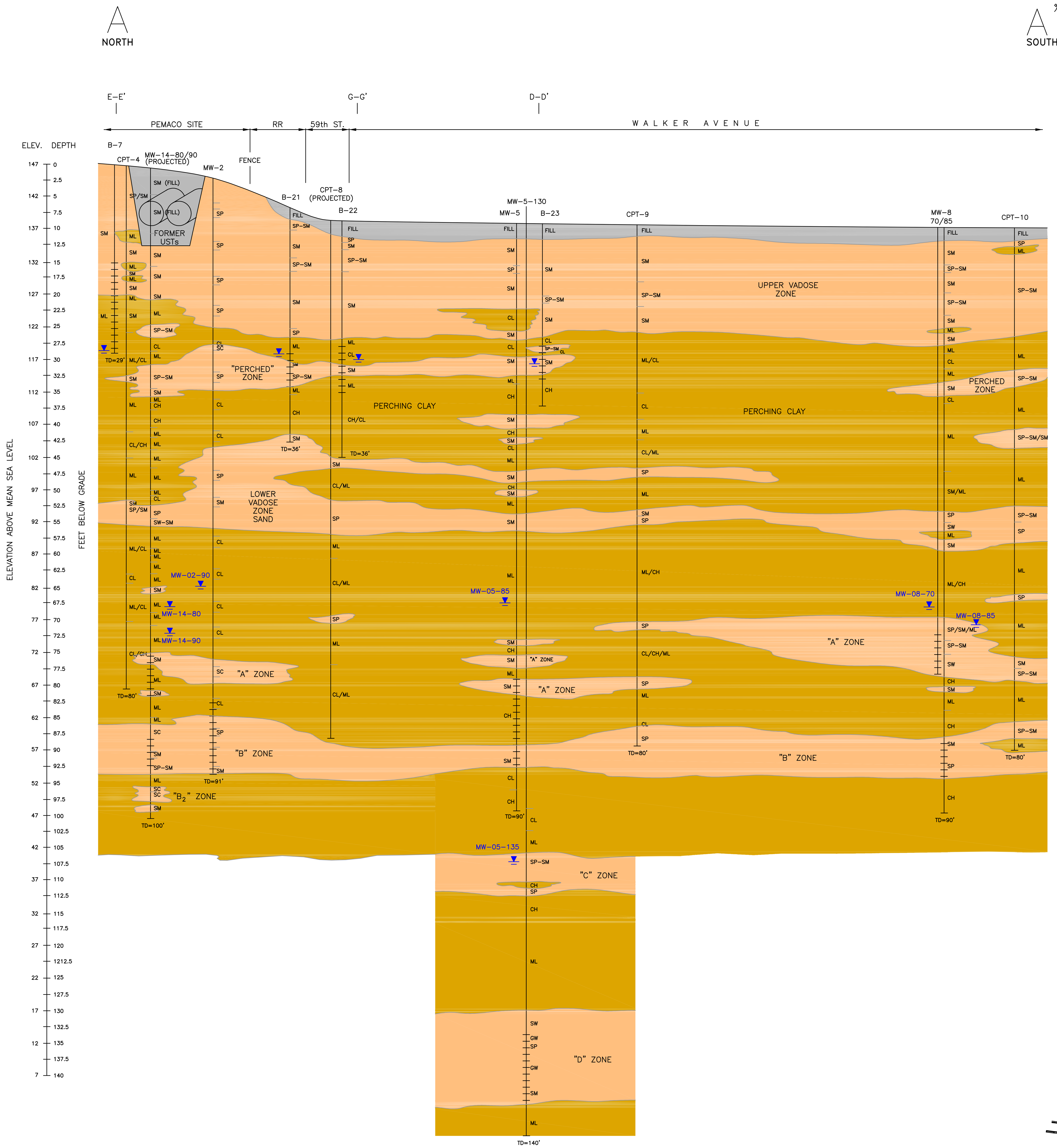
- There are six wells screened in the Exposition 'D' Zone (MW-05-135, MW-07-130, MW-12-150 and MW-23-145, MW-24-140 and MW-25-130, which were installed in July 2003 as part a data gap assessment, and only one well screened in the Exposition 'E' Zone (MW-10-170). No wells within the 'D' Zone have reported VOCs in exceedance of California MCLs with exception to MW-24-140. This well has reported TCE at concentrations up to 120 µg/L. Although no other VOCs were detected above MCLs, three VOCs (bromodichloromethane, chloroform and vinyl chloride) have exceeded the more stringent Region IX PRGs for tap water.

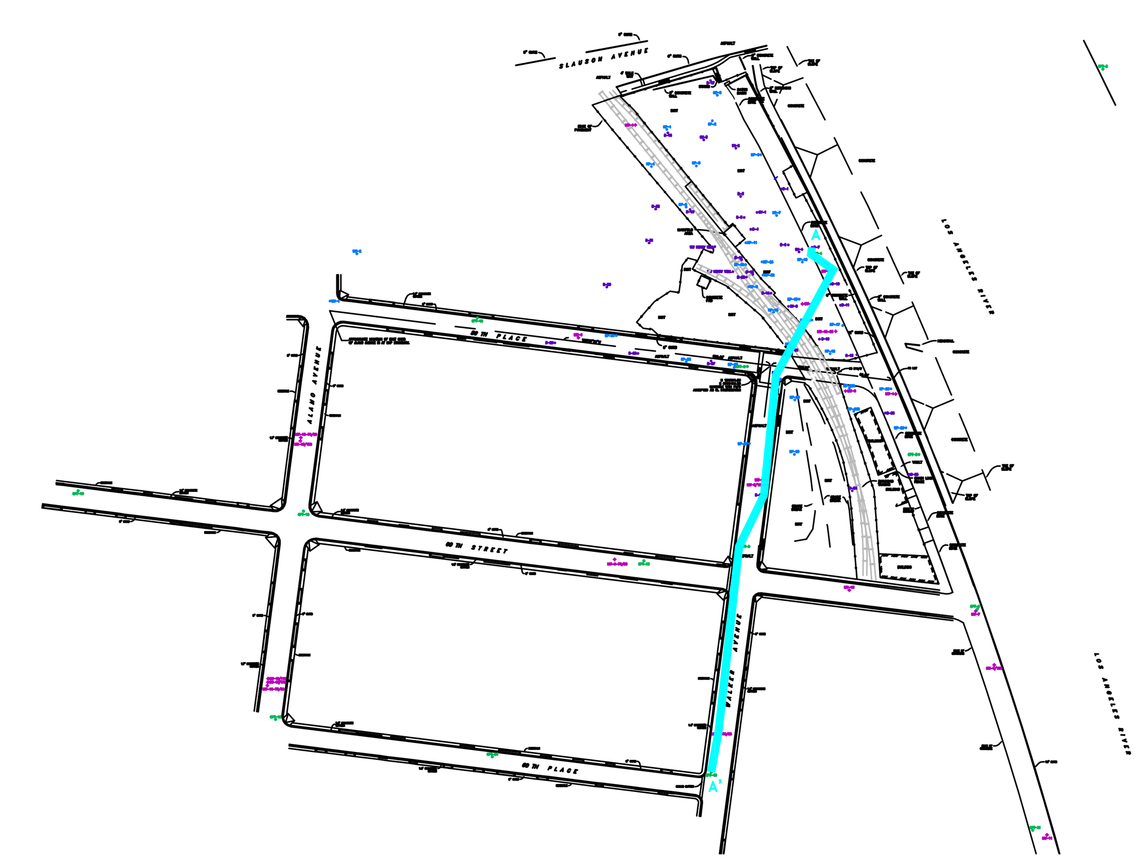
PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

Appendix 01115





CROSS SECTION INDEX MAP

LEGEND

WELL SCREEN INTERVAL

COARSE-GRAINED LITHOSOMES

FINE-GRAINED LITHOSOMES

FILL MATERIAL

MW-05-85 POTENTIOMETRIC SURFACE LEVEL JANUARY 2002

NOTES:

1.) PERCHED ZONE GROUNDWATER DATA FROM WELLS GAUGED 6/5/01 AND FROM DEPTH OF FIRST WET SEDIMENTS ENCOUNTERED IN BORING MW-8 DURING DRILLING ON 3/28/01.

2.) EXPOSITION 'A', 'B', 'C' AND 'D' ZONE GROUNDWATER DATA FROM WELLS GAUGED 5/21/01. ALL OF THESE LEVELS ARE PRESSURE LEVELS AND REPRESENT THE PEIZOMETRIC SURFACE.

3.) MW-2 SAMPLED APPROXIMATELY EVERY FIVE FEET. ALL OTHER BORINGS WERE CONTINUOUSLY CORED.

4.) 'PROJECTED' = ACTUAL WELL LOCATION IS OFFSET FROM CROSS SECTION LINE. THE LITHOLOGY IS 'PROJECTED' ONTO THE CROSS SECTION.

5.) LITHOLOGIC ACRONYMS:

SP = POORLY GRADED SANDS
SW = WELL GRADED SANDS
SM = SILTY SANDS
SP-SM = POORLY GRADED SANDS WITH SILT
SW-SP = WELL GRADED SANDS WITH SILT
ML = SILT
CH = FAT CLAY (HIGHLY PLASTIC CLAY)
CL = LEAN CLAY (LOW PLASTICITY CLAY)

10 / 0 / 60

APPROX. SCALE IN FEET
6x VERTICAL EXAGGERATION

DATE: 1/13/2003	FILE NAME: PEM-C-SEC.DWG	APPROVED BY:

CROSS SECTION A-A'

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE
MAYWOOD, CALIFORNIA

TN&A T N & Associates, Inc. Engineering and Science

FIGURE 1

Table 01115-1 – Site Stratigraphy
Pemaco Superfund Site, Maywood, California

STRATIGRAPHIC ZONE	AVERAGE DEPTH INTERVAL	GENERAL LITHOLOGY	GENERAL GEOTECHNICAL CHARACTERISTICS
Upper Vadose Zone	Surface to 25' bgs	Surficial fill from 2' to 6' deep. Underlying native soils are predominately fine SM sands from 1' to 20' thick interbedded with fine SP and SP-SM sands from 2" to 6' thick. Local discontinuous lenses of silt/clay ranging from 3" to 4' thick are also present within upper vadose zone interval.	▪ Total Porosity: 40% to 47% ▪ TOC: 1.15% to 2.12% ▪ Less than 200 Sieve: 14% to 33%
Perched Zone	25' to 30' bgs	Fine silty sand ranging from 6" to 4' thick. Locally, perched zone is comprised of sandy silts or silt with sand ranging from 1' to 3' thick.	▪ Total Porosity: 42% to 48% ▪ TOC: 0.92% to 1.14% ▪ Less than 200 Sieve: 21% to 25%
"Perching" Clay	Top of clay ranges from 28' to 40' bgs	Silty Lean and Fat clays ranging from 1' to 15' thick comprise top of perching unit and are underlain and interbedded with clayey and sandy silts ranging from 1' to 8' thick. Perching lithosome ranges from 10' to 20' total thickness.	▪ Total Porosity: 32% to 50% ▪ TOC: 0.48% to 3.71% ▪ Less than 200 Sieve: 77% to 90%
Lower Vadose Zone Sand	40' to 50' bgs	Predominately fine to medium SP sands and gravelly SW sands from 1' to 14' thick with local intervals of SM and SP-SM sands from 6" to 3' thick. Local interbeds of silt lenses from 6" to 4' thick are within this unit. Coarser units are derived from granitic source rocks.	▪ Total Porosity: 46% to 54% ▪ TOC: 0.2% to 5% ▪ Less than 200 Sieve: 1% to 4%
Lower Vadose Zone (Fine-Grained interval)	50' to 65' bgs	Lean and Fat Clays ranging from 6" to 5' thick interbedded with Sandy and Clayey Silts ranging from 2' to 20' thick. Local discontinuous lenses of unsaturated SP and SM sands are present from 6" to 2" thick within interval.	▪ Total Porosity: 47% to 68% ▪ TOC: 2.4% to 5.5% ▪ Less than 200 Sieve: 57% to 97%
Exposition 'A'	65' to 75' bgs	Fine SM and SP sands locally interbedded with SW sands. Thickness is highly variable ranging from 3" to 10' thick. Interval is comprised of a series of discontinuous saturated sand lenses.	▪ Total Porosity: 44% to 69% ▪ TOC: 0.66% to 3% ▪ Less than 200 Sieve: 1.0% to 46% ▪ K range: 2.277E-03 ft/min to 8.281E-04 ft/min
'A' – 'B' Fine-Grained	75' to 80' bgs	Fat and Lean Clays with local interbeds of Clayey Silt with sand. Interval ranges from 5' to 10' thick and is continuous where both "A" and "B" aquifer zones are present.	▪ Total Porosity: 46% to 49% ▪ TOC: 2.63% ▪ Less than 200 Sieve: 88% to 94%
Exposition 'B_1' **Exposition 'B_2'**	80' to 90' bgs 90' to 92' bgs	Fine SM, SP and SM-SP sands ranging from 1.5' to 10' thick. Some of the thicker portions of the unit have interbeds of silt/clay to 1' thick. The "B" zone is continuous throughout site vicinity. Fine SM, SC and SP-SM sands ranging from 1.5' to 2' thick. This secondary unit has only been observed underlying the southernmost portion of the site where it is separated by the overlying B_1 unit by 1' to 3' of fat clay. This unit has not been observed offsite in any of the locations sampled below 90' bg.	▪ Total Porosity: 55% to 56% ▪ TOC: 0.6% to 0.64% ▪ Less than 200 Sieve: 4% ▪ K range: 1.046E-01 ft/min to 6.56E-03 ft/min
'B' – 'C' Fine-Grained	90' to 100' bgs	Predominately Fat and Lean Clays from from 8' to 10' thick with local interbeds Sandy Silts from 1' to 5' thick. Total thickness of unit ranges from 7' to 12'.	▪ Total Porosity: 40% to 47% ▪ TOC: 0.92% to 2.12% ▪ Less than 200 Sieve: 14% to 33%
Exposition 'C'	100' to 110' bgs	Fine SM, SP and SP-SM sands ranging from 2' to 6' thick. Appears to be continuous throughout the site vicinity within the 95' to 110' depth interval.	▪ Total Porosity: 40% to 47% ▪ TOC: 0.92% to 2.12% ▪ Less than 200 Sieve: 14% to 33%

Table 01115-1 – Site Stratigraphy
Pemaco Superfund Site, Maywood, California

STRATIGRAPHIC ZONE	AVERAGE DEPTH INTERVAL	GENERAL LITHOLOGY	GENERAL GEOTECHNICAL CHARACTERISTICS
'C' – 'D' Fine-Grained	110' to 125' bgs	Lean and Fat Clays form 3' to 6' thick interbedded with Sandy and Clayey Silts from 4' to 12' thick. Total unit thickness ranges from 18' to 30'.	▪ Total Porosity: 40% to 47% ▪ TOC: 0.92% to 2.12% ▪ Less than 200 Sieve: 14% to 33%
Exposition 'D'	125' to 140' bgs	Interbedded fine SM, SP and SP-SM sands, SW sands and gravelly sands and local GW intervals. Total thickness rages from 6' to 15'.	▪ Total Porosity: 40% to 47% ▪ TOC: 0.92% to 2.12% ▪ Less than 200 Sieve: 14% to 33%
'D' – 'E' Fine-Grained	140' to 160' bgs	Predominately Clayey Silt with local interbeds of Lean Clays. Thickness ranges from 12' to 18'. Local saturated SM sand lenses to 2' thick located within interval.	▪ Total Porosity: 40% to 47% ▪ TOC: 0.92% to 2.12% ▪ Less than 200 Sieve: 14% to 33%
Exposition 'E'	160' to 175' bgs	Alternating intervals of 1' thick fine SM sands and SW sands.	▪ Total Porosity: 40% to 47% ▪ TOC: 0.92% to 2.12% ▪ Less than 200 Sieve: 14% to 33%
Lower Exposition Fine-Grained	175' to ???	Clay with Silt finely laminated with Silt. Local lenses of medium SP sand 6" thick.	▪ Total Porosity: 40% to 47% ▪ TOC: 0.92% to 2.12% ▪ Less than 200 Sieve: 14% to 33%

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
Active Leak Testing, Inc. (ALT)	12/26/90	*Subject Site Assessment Investigation Report* • 16 soil borings (B-1 through B-16) drilled from 30' to 40' below ground surface (bgs), sampled every 5'. • Locations of the borings were determined from a previous soil vapor survey performed by ALT. • Each soil sample analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) and non-halogenated volatiles, 2 samples from each boring analyzed for volatile organic compounds (VOCs) as determined by photo ionization detector (PID) readings. • Contaminants detected in every boring, toluene and paraldehyde were the most prevalent, but benzene, tetrachloroethene (PCE), 1,1-Dichloroethene (1,1-DCE) and trichloroethene (TCE) were the only chemicals exceeding regulatory levels. • Each boring converted to shallow monitoring well (B-1 through B-16). • No indication in report of any water sampling performed.
Ecology and Environment, Inc. (E&E)	2/25/94	*Final Site Assessment Report* • Describes visual site characterization activities performed by E&E (contracted by the USEPA) to assess whether federal involvement was warranted. The site had been abandoned and the warehouse burnt down in December 1993, 31 underground storage tanks (USTs), 4 aboveground storage tanks (ASTs), 6 drums and one 15'-diameter open borehole remained onsite. • The borehole was grouted and a fence was placed around the site as an initial security measure. • The six remaining drums were sampled and removed and all the UST fill pipes were locked.
Bechtel	6/95	*Preliminary Site Investigation Report* • Led to listing of Pemaco into CERCLIS (ID No. CAD980737092).
Ecology and Environmental, Inc.	03/10/98	*Pemaco Maywood Expanded Site Inspection* • Details Expanded Site Assessment activities performed by the E&E's Emergency Response team over the time period between February – May 1997. • 118 shallow soil samples (5' bgs), 102 collected beneath concrete pad (former drum storage) and 19 others collected in UST and AST areas. All samples analyzed for VOCs. Majority of detects were BTEX, 1,1,1-Trichloroethane (1,1,1-TCA), PCE and acetone mainly found in northern portion of former drum storage pad.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		• 6 soil borings (SSB-1 through SSB-4, SMW-1 and SMW-2) completed to 90' bgs, samples collected approx. every 10' and analyzed for VOCs. • Acetone, 1,1- DCE, 1,1-Dichloroethane (1,1-DCA) and TCE were main detects. SSB-3 and SSB-4 had majority of hits [(TCE up to 1,200,0000 parts per billion (ppb) at 15' (SSB-3)] and 990 ppb at 80' (SSB-4). • Two of these borings converted to deep monitoring wells and 2 more deep (80') monitoring wells (MW-3 and MW-4) installed downgradient with no soil sampling. • Groundwater samples collected from all perched wells (B-1 through B-16) and analyzed for VOCs, product found in 3 of the wells (B-2, B-6 and B-9). • Product wells sampled and analyzed and found to be 20% - 30% gasoline range hydrocarbons. • Chlorinated VOCs found in all perched wells sampled from <10 to 180 ppb. • TCE found in groundwater samples from MW-2 through MW-4 from 430 (MW-2) to 11,000 ppb (MW-4), MW-1 was non-detect (ND).
Ecology and Environmental, Inc.	05/99	*Pemaco Removal Site Final Report, Maywood, California* • All USTs were removed in August through September 1997 except for one UST that was abandoned in place and all above ground structures were demolished and removed by the Emergency Response group. Horizontal screened piping was laid down in tank pits before backfilling to be hooked up to a future soil vapor extraction (SVE) system. • 44 surface (0.5') and near surface samples (2.5') were collected from 22 locations spread throughout the site in the UST, AST and warehouse areas in October 1997. • Also, 6 samples from 3 locations in former sump area (south of existing SVE manifolding). • All soil samples were analyzed for VOCs. • PCE and 1,1,1-TCA were most prevalent (up to 927 ppb). • 22 soil vapor locations (10' – 15' bgs) and 14 locations (18' – 25' bgs) were field screened using a flame ionization detector/photoionization detector (FID/PID), flame-out occurred due to lack of oxygen at 18 locations and 15 of the locations had reading >10,000 parts per million in volume (ppmv). • 15 soil vapor samples were collected from selected locations mentioned above and analyzed for VOCs. Toluene, 1,1,1-TCA, PCE, methylene chloride and xylenes were the most prevalent (up to 1,280 ppmv). • 44 sub-surface soil samples from the 22 locations were collected (co-located with the soil vapor and near surface locations) from 12' and 22' bgs.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		• All 44 samples were analyzed for VOCs and a selected 10 samples were analyzed for semivolatile organic compounds (SVOCs). • 1,1-DCE, TCE, BTEX, 1,2,4-Trimethybenzene, 1,3,5-Trimethylbenzene, 4-Methyl-2-pentanone were the prevalent VOCs (up to 237 ppm). • Phenol and naphthalene were most prevalent SVOCs (up to 11 ppm). • Deep wells MW-1 through MW-4 were re-sampled and analyzed for VOCs in November 1997. • MW-2 through MW-4 had hits of TCE from 1,090 ppb (MW-2) to 8,590 ppb (MW-3), MW-1 was ND results lower than the May 1997 sampling. • Report concludes that in general the VOCs detected in all media consisted of: acetone, 4-methyl-2-pentanone, BTEX, methylene chloride, 2-butanone, TCE, PCE, 1,1-DCE, 1,1-DCA and 1,1,1-TCA. Some levels were above USEPA Region IX Residential Preliminary Remediation Goals (PRGs) and Soil Screening Levels (SSLs) (threat to groundwater); no SVOCs exceeded PRGs or SSLs. • Groundwater gradients calculated for the perched zone and Exposition groundwater zone(s) from data collected during the water sampling. • Perched zone characterized as discontinuous and sporadic with overall flow north towards the LA River with many localized mounds and sinks causing varying flow directions. • Exposition groundwater zone(s) flow calculated to be towards the south.
CET Environmental Services, Inc.	03/98	*Design Report* • Document is a design report for the SVE system with several schematics and discussion of design parameters for the SVE system.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
CET Environmental Services, Inc.	2/4/99 1/4/99 11/12/98 10/29/98 9/2/98 8/5/98 7/8/98 6/8/98 5/11/98 4/4/98	*Vapor Extraction Reports* • Each of these documents is a monthly SVE system report with field PID measurements of influent and effluent concentrations, system parameter measurements and mass removal calculations. • Documents also give details of system adjustments and carbon usage • The February 1999 document (last report before system shut-down) reported that a total of 144,412 pounds (lbs) of hydrocarbons were removed from the site through vapor extraction and natural degrading.
CET Environmental Services, Inc.	5/6/98	*Pemaco Stack Test* • Stack test results for thermal oxidation unit.
Ecology and Environmental, Inc.	05/99	*Pemaco Removal Site Final Report* • Report summarizes work listed above by CET and also summarizes pilot testing (SVE, in-situ respiration and bio-slurping) of remedial techniques. • A soil vapor well (SV-1) was installed in the former UST area along with three vapor monitoring points (VMP-1 – VMP-3) to monitor the SVE system. • A 2-day in-situ respiration test concluded that a mass destruction of 300 lbs per month of VOCs was possible. • A 2-day bio-slurping test was conducted, it was concluded that this was not effective in removing free product in the perched zone. • The soil vapor extraction pilot test concluded that 33,000 lbs per month of VOCs could be removed from the site. • Ultimately the SVE system with 5 “SV” wells (SV-1 – SV-5), all the existing ALT wells, (B-1, B-3 – B-16) and the horizontal wells placed in the tank pit backfills were plumbed into a system with carbon canisters and a thermox unit, which were operated by CET as documented above. • SVE system operates from March 1998 to March 1999 when it was shut down due to community concerns. • From the weekly monitoring readings and measurements, it was calculated that the SVE system removed 67,610 lbs of contaminants.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		• An additional 82,294 lbs of hydrocarbons were destroyed by natural degradation during the 1 year SVE operation according to calculations.
T N & Associates, Inc. TN & Associates, Inc. (continued)	12/00	*Preliminary Summary of Groundwater and SVE System Sampling Events* • **This is an internal draft document that was not formally submitted outlining sampling activities performed to assess current site conditions (current in 2000).** • Scope included testing of lo-flo sampling equipment, sampling of perched wells and Exposition groundwater zone(s) wells, and sampling of the dormant vapor extraction system by connecting a mobile blower to it, applying vacuum and collecting samples out of the sampling ports located on the manifold. • Perched wells B-1, B-3, B-4, B-5, B-10, B-13, SV-1 and SV-5 were lo-flo sampled (other wells were dry or obstructed) and analyzed for total petroleum hydrocarbons-gasoline range (TPH-g), VOCs, SVOCs and non-halogenated VOCs (NHVOCs). • Well B-15 was found to contain 6' of floating free product; the product was sampled and was characterized as kerosene range organics by the USEPA Region IX lab. • Every perched well sampled had detectable concentrations of TPH-g at 60 ppb (B-10) to 2,600 ppb (B-13). • VOCs in the perched wells were predominately acetone (up to 6,200 ppb) and BTEX (up to 100 ppb). The chlorinated compounds 1,1,1-TCA, 1,1-DCA, 1,1-DCE, PCE, TCE and vinyl chloride were semi-prevalent and ranged from 0.3 ppb to 750 ppb. • SVOCs were detected in the perched wells from 19 ppb (naphthalene) to 150 ppb (4-methyl phenol) and were not as prevalent as the VOCs. • NHVOCs were detected in the perched wells from 0.16 ppm to 7.53 ppm (acetone, 1,4-dioxane, MEK and isopropanol). • The 4 Exposition groundwater zone(s) wells (MW-1 – MW-4) were lo-flo sampled and also analyzed for TPH-g, VOCs, SVOCs and non-halogenated volatile organic compounds (NHVOCs). • TPH-g ranged from 2,200 ppb (MW-2) to 10,000 ppb (MW-3) in MW-2 through MW-4, MW-1 was ND. • VOCs detected in the wells MW-1 through MW-4 were TCE, cis-1,2-DCE, TCE, methylene chloride and cyclohexane ranging from 0.2 ppb to 13,000 ppb. The predominant VOC in the Exposition wells is TCE. Well MW-1 had only trace hits of VOCs, none more than 2.1 ppb. • SVOCs above detection limits in the Exposition wells were 4-Methylphenol (12 ppb to 190 ppb) and naphthalene (19 ppb).

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		• The only NHVOC detected in the Exposition wells was acetone on MW-2 at 200 ppb. • The gradient of the perched groundwater zone measured during this event indicated that no prevalent gradient direction existed and the potentiometric surface was highly irregular. • Based on the three data points (MW-2, MW-3 and MW-4), the groundwater gradient direction in the upper Exposition groundwater zones was toward the west. • It was concluded that the vertical and lateral extent of groundwater contamination in the perched zone, Exposition groundwater zones and deeper aquifers is not defined. • Summa sampling of the dormant vapor system indicated trace to low concentrations of BTEX, 1,1-DCE, cis-1,2-DCE, vinyl chloride, methylene chloride, 1,1-DCA, 1,1,1-TCA TCE; PCE; acetone; chloroethane; propylene; hexane; and cyclohexane ranged from <0.5 ppbv to 4,400 ppbv (cis-1,2-DCE in well B-3).
T N & Associates, Inc.	3/02	*Final Technical Memorandum, Results of Aquifer Tests Performed on the Exposition 'A' and 'B' Groundwater Zones, December 2001, Pemaco Superfund Site* • An aquifer pumping test was performed between December 12th and December 24th, 2001, primarily targeting the Exposition 'B' Zones ('B_1' and 'B_2'), which lie approximately 80 to 90 ft below the study area. The test was also performed to determine if a hydraulic connection between the 'A' (approximately 65 to 75 ft bgs) and 'B' groundwater zones exists. • Four types of aquifer tests, slug, step-drawdown, constant rate, and recovery, were performed to evaluate the hydrogeologic characteristics of the upper Exposition Aquifer system. • Results of data analysis/assumptions for remedial design are: – Sustainable pumping rates from the 'B' Zone are approximately 1 gallon per minute (gpm) and approximately 0.5 gpm from the 'A' Zone. – Calculated hydraulic conductivity (K) values for the 'A' Zone range from 8.3 E-04 to 2.3 E-03 feet per minute (ft/min). – Calculated hydraulic conductivity (K) values for the 'B_1' Zone range from 1.3 E-03 to 7.1 E-02 ft/min. – Calculated hydraulic conductivity (K) values for the 'B_2' Zone range from 1.1 E-03 to 2.7 E-02 ft/min.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		– Pump test data indicated that the 'A' and 'B' Zones are hydraulically connected in a way consistent with a composite/leaky-confined aquifer. – Average linear groundwater velocity (B_1 and B_2 Zones combined) is 0.47 feet/day (171 feet/year).
T N & Associates, Inc.	10/02	*Final Technical Memorandum, Results of Groundwater Monitoring Activities, May 2001 through April 2002, Pemaco Superfund Site* • *see Final Remedial Investigation Report (Nov 2003) summary below.*
T N & Associates, Inc.	3/03	*Final Technical Memorandum, Results of High-Vacuum Dual-Phase Extraction Pilot Test Performed on the Perched Groundwater Zone and Exposition 'A' and 'B' Groundwater Zones, December 2002 Pemaco Superfund Site* • A pilot test for high-vacuum dual-phase extraction (HVDPE) was performed in November and December 2002 for both the perched and Exposition 'A' and 'B' groundwater zones. • During the tests, the following data and samples were collected from the vacuum pump and influent and discharge ports: water flow, air/vapor flow, inlet vacuum level, inlet vapor concentration, discharge vapor concentrations from the carbon treatment system, inlet water to the separation tanks, discharge water in the storage tanks, total water flow, drop tube depth and pump depth. • The performance of the system was evaluated based on the samples and data collected. Items evaluated or calculated per zone as follows: **– Perched Zone** (continual test time = 4.4 hrs day 1, 8.5 hrs day 2, total = 12.9 hours) • HVDPE allowed for a sustained flow rate of 0.8 gpm; • Vapor radius of influence (ROI) estimated at 54 feet; • Groundwater extract ROI estimated at 72 feet; • Wellhead vacuum at 14-inches of mercury (Hg) and flow measurement of 68 cfm; • Tedlar flow tests – 10 ft away from SV-01 = 0.14 cfm with 1-ft screen; • Tedlar flow tests – 50 ft from SV-01= 0.024 cfm with 15-ft screen; and • Influent vapor concentrations = <10 ppm, probably due to prior remediation of this zone.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		– 'A' Zone (downhole-pump test time = 24 hours, drop-tube time = 3.6 hours) • HVDPE allowed for a sustained flow rate of 0.6 to 0.8 gpm (pumping) and1.1 gpm (drop-tube); • Vapor ROI estimated at 37 feet; • Groundwater extract ROI estimated at 175 feet; • Wellhead vacuum at 20.58-inches of Hg with downhole pump and 15- to 17-inches of Hg with drop-tube; • Tedlar flow tests during drop tube, 10 ft away from RW-01-70 = 0.10 cfm with 1.13 ft screen exposed to air; • Influent vapor concentration = 700 to 1,000 ppm; and • Drop tube method produced higher sustainable yield and presumably higher vapor flow because of the lower vacuum pressures. Drop tube produced more drawdown than pumping. Full potential of drop-tube not known due to short duration of test, water levels were still dropping after the 4 hours of testing. **– 'B' Zone** (total test time = 21 hours, down-hole pump shut-off overnight for 11.5 hours of the testing, actual dual phase test = 9.5 hours) • HVDPE allowed for a sustained flow rate between of 2 to 2.5 gpm, almost doubling non-vacuum sustained maximum yield of 1.2 gpm estimated from Aquifer Test data; • Vapor ROI effectively 0 due to saturated screens of observation wells; • Groundwater extract ROI estimated at 69 feet, actual ROI probably higher as the outlying well MW-14-90 was not used for this estimation; • Wellhead vacuum at 25- to 25.5-inches of Hg; and • Influent vapor concentration = <10 ppm, only part of formation exposed to vacuum was 'A' and 'B' fine-grained (which is probably semi-saturated thus further reducing permeability to air).
T N & Associates, Inc.	8/03	*Final Technical Memorandum, Baseline Risk Assessment, Pemaco Superfund Site* • A baseline risk assessment was performed to quantify potential risks to human health that may be caused by chemicals in soil and groundwater identified during RI activities at and adjacent to the Pemaco site. • Five models of human exposure consisting of: (1) a current trespasser model, (2) a future park user model, (3) a future excavation worker model, (4) a future onsite residential exposure model and (5) a current offsite residential model were considered based on current, proposed and possible future land uses.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		• Under current land-use conditions, when the only site use is by occasional trespassers, the estimated carcinogenic risks using reasonable maximum exposure (RME) parameters falls at the lower end of the USEPA target risk range of 10^{-4} and 10^{-6}. The carcinogenic risk was primarily due to potential exposure to benzo(a)pyrene and dibenzo(a,h)anthracene by ingestion and dermal exposure routes. Using central tendency (CT) parameters, the carcinogenic risk for the Trespasser was below the target range. The total noncarcinogenic hazard index was well below the target level of 1.0. • The estimated carcinogenic risks using the future park user scenario with either the RME or CT parameters falls in the middle of the USEPA target risk range. The carcinogenic risk was primarily due to potential exposure to benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene by ingestion and dermal exposure routes. The total noncarcinogenic hazard index was well below the target level of 1.0. • The estimated carcinogenic risks using the future excavation worker scenario with RME parameters falls in the lower end of the USEPA target risk range and falls below the target range using CT parameters. The carcinogenic risk was primarily due to potential exposure to arsenic, benzo(a)pyrene, and dibenzo(a,h)anthracene by the ingestion exposure route. The total noncarcinogenic hazard index was well below the target level of 1.0. • The estimated carcinogenic risks using the future onsite resident exposure scenario, with either RME or CT parameters, falls well above the upper end of the USEPA target risk range. The estimated carcinogenic risks were primarily due to exposure to contaminants in the Exposition groundwater zones. The estimated carcinogenic risks were greatest for inhalation exposure, but also exceeded the upper end of the USEPA target risk range due to ingestion and dermal exposure. The carcinogenic risk was primarily due to potential exposure to arsenic, benzene, chloroform, TCE and vinyl chloride. The total noncarcinogenic hazard index also greatly exceeded the target level of 1.0. The elevated noncarcinogenic hazard index was primarily due to potential exposure to acetone, arsenic, benzene, chloroform, cis-1,2-dichloroethene, manganese, TCE, and vinyl chloride. • The estimated carcinogenic risks based on measured indoor and outdoor air concentrations, using the current offsite resident exposure scenario falls within the target risk range using either RME or CT exposure parameters. The carcinogenic risk was primarily due to potential exposure to chloroform, benzene, methyl tert-butyl ether, and tetrachloroethene. The total noncarcinogenic hazard index also exceeded the target level of 1.0 with either RME or CT parameters. The elevated noncarcinogenic hazard index was primarily due to potential exposure to chloroform, 1,2,4-trimethylbenzene and benzene. Risk estimates, based on background air sample data, also resulted in carcinogenic estimates within the USEPA target risk range and the noncarcinogenic hazard quotient also exceeded the target level of 1.0 using RME parameters.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
T N & Associates, Inc.	Nov 2003	*Final Remedial Investigation Report, Pemaco Superfund Site* • **The following is a summary of Remedial Investigation (RI) activities that were performed at the Pemaco site and adjacent areas between January 2001 through April 2002.** • 66 soil gas samples from 66 different locations were collected from 5' bgs and analyzed for VOCs. • Completion of soil borings including the following: - 14 borings to 90' bgs via Cone Penetrometer Test (CPT); - 46 borings to 25'-35' bgs via Geoprobe; - 9 borings to 90'-100' bgs and 1 boring to 130' bgs via hollow stem auger; and - 4 borings to 110'-175' bgs via mud-rotary rig. • Collection of soil samples from soil borings, including the following: - 152 upper vadose zone samples for VOCs, SVOCS, solvents, and metals; - 19 samples for total organic carbon (TOC) analysis; - 150 surface and near-surface samples via Geoprobe rig for SVOCs and metals; - 71 lower vadose zone samples for VOCs, SVOCs, solvents, and metals; - 25 lower vadose zone samples for TOC analysis; - 38 lower vadose zone samples for geotechnical parameters; and - 5 lower vadose zone samples for TOC and geotechnical parameters. • Conversion of 14 soil borings to 18 monitoring wells (4 were double-nested). Soil borings ranged in depth from approximately 68 feet to 174 feet bgs. • Installation of 16 perched zone monitoring wells via a Geoprobe rig. • Groundwater monitoring: - May 2001 (34 new wells, 23 existing wells)

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		- Samples collected from 51 wells for VOCs, solvents, SVOCs, metals, cyanide, CrVI, CO_2, TOC, methane, ethane, and ethene; - 3 wells (B-7, B-14, and B-16) were dry; - 3 wells (B-15, B-28, and B-29) had free product. - September 2001 (54 existing wells) - Samples collected from 37 wells for VOCs; - 8 additional samples collected for ferrous iron, sulfate, chloride, sulfide, and alkalinity; - 5 wells (B-7, B-11, B-12, B-14, and B-16) were dry; - 4 wells (B-08, B-15, B-28, and B-29) had free product. - January 2002 (21 new wells, 54 existing wells) - Samples collected from 43 wells for VOCs and NHVOCs; - 6 wells (B-07, B-08, B-11, B-14, B-16, and B-34) were dry; - 3 wells (B-15, B-28, and B-29) had free product. - April 2002 (75 existing wells) - Samples from 57 wells for VOCs and NHVOCs; - 7 wells (B-07, B-08, B-11, B-14, B-16, B-30, and B-34) were dry; - 3 wells (B-15, B-28, and B-29) had free product. • Collection of groundwater level measurements: - 35 perched zone wells in October 2000, June 2001, September 2001, January 2002 and April 2002 (quarterly gauging on-going since April 2002); - 22 Exposition groundwater zone(s) wells weekly for the month of May 2001, and monthly from June 2001 to present (measurements were used to evaluate the effects of the active Maywood production wells on the Exposition groundwater zones. • Quarterly monitoring has been on-going since April 2002.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		• Groundwater aquifer testing: - Conducted in December 2001 on Exposition 'A' and 'B' groundwater zones (slug, step- drawdown and 72-hour continuous test). • Soil vapor and Summa canister samples of indoor/outdoor air were collected from private residences adjacent to Pemaco in July 2001 and March 2002. • Analytical results of the above activities were not summarized due to the large amount of data produced. Results of the RI activities may be referenced in the *Final Remediation Investigation Report, Pemaco Superfund Site, Maywood, California* (TN&A, March 2004) and the *Final Technical Memorandum: Results of Groundwater Monitoring Activities, May 2001 through April 2002, Pemaco Superfund Site*.
T N & Associates, Inc.	Feb 2004	*Final Feasibility Study Report, Pemaco Superfund Site* • **The following is a summary of Feasibility Study (FS) activities that were performed at the Pemaco site between January 2002 and August 2003.** • Remedial action objectives (RAOs) were developed for each media identified at the Site (i.e., surface and near-surface soils, upper vadose zone soils, perched groundwater, lower vadose zone soils and Exposition groundwater zones). • 263 potentially applicable technologies/process options were identified and screened. • 91 remedial technologies were identified and screened. • 5 media zones were grouped into 3 "remediation zones" consisting of: – Surface and Near-Surface Soil Remediation Zone (0-3 ft bgs), – Upper Vadose Soil and Perched Groundwater Remediation Zone (3-35 ft bgs), and – Lower Vadose Soil and Exposition Groundwater Remediation Zone (35-100 ft bgs).

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		• The most promising technologies and process options were assembled into remedial alternatives for each remediation zone. • Remedial alternatives were screened based on effectiveness, implementability and cost. • The assembled remedial alternatives retained for detailed evaluation for each remediation zone are outlined below. – <u>Surface and Near-surface Soil (0 to 3 ft bgs) Remediation Zone Alternatives</u> • No Action • Soil Cover/Revegetation • Excavation/Offsite Disposal – <u>Upper Vadose Soil and Perched Groundwater (3 to 35 ft bgs) Remediation Zone Alternatives</u> • No Action • High-Vacuum Dual-Phase Extraction/Ultraviolet Oxidation/Flameless Thermal Oxidation (FTO)/Granular Activated Carbon (GAC) • High-Vacuum Dual-Phase Extraction/Ultraviolet Oxidation/GAC • *In-situ* Chemical Oxidation • Enhanced *In-situ* Bioremediation • Monitored Natural Attenuation – <u>Lower Vadose Soil and Exposition Groundwater (35 to 100 ft bgs) Remediation Zone Alternatives</u> • No Action • *In-situ* Chemical Oxidation/*In-situ* Chemical Reduction/Groundwater Pump and Treat/Monitored Natural Attenuation/Ultraviolet Oxidation • Enhanced *In-situ* Bioremediation/Groundwater Pump and Treat/Monitored Natural

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		Attenuation/Ultraviolet Oxidation • Vacuum-Enhanced Groundwater Extraction/Groundwater Pump and Treat/Monitored Natural Attenuation/Ultraviolet Oxidation/FTO/GAC • Vacuum-Enhanced Groundwater Extraction/Groundwater Pump and Treat/Monitored Natural Attenuation/Ultraviolet Oxidation/GAC • Electrical Resistance Heating with Vapor Extraction/Vacuum-Enhanced Groundwater Extraction/Groundwater Pump and Treat/Monitored Natural Attenuation/Ultraviolet Oxidation/FTO/GAC • Electrical Resistance Heating with Vapor Extraction/Vacuum-Enhanced Groundwater Extraction/Groundwater Pump and Treat /Monitored Natural Attenuation/Ultraviolet Oxidation/GAC • The remedial alternatives were evaluated individually against the 9 USEPA evaluation criteria (i.e., overall protection of human health and the environment; compliance with ARARs; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; cost; state acceptance; and community acceptance). • The alternatives were then compared (comparative analysis) against one another to determine their respective strengths and weaknesses. • The preferred remedial alternatives for each remediation zone were N2 - Soil Cover/Revegetation (surface and near-surface soil remediation zone), SP2a – High-Vacuum Dual-Phase Extraction/Ultraviolet Oxidation/FTO/GAC (upper vadose soil and perched groundwater remediation zone) and SG5a – Electrical Resistance Heating with Vapor Extraction/Vacuum-Enhanced Groundwater Extraction/Groundwater Pump and Treat/ Monitored Natural Attenuation/Ultraviolet Oxidation/ FTO/GAC (lower vadose soil and Exposition groundwater remediation zone).

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
T N & Associates, Inc.	Feb 2004	*Technical Memorandum: Groundwater Data Gap Assessment 2003, Exposition 'A', 'B', 'C', and 'D' Zones, Pemaco Superfund Site* • 13 additional groundwater wells were installed and sampled in the Summer and Fall of 2003 to further define the northern and western extent of CVOC concentrations in the Exposition 'A' and 'B' Zones and to assess the vertical extent of CVOC concentrations in the immediate release area located in the southern portion of the Pemaco property. • The following bullets summarize the activities performed: – Drilled 10 boreholes at 7 separate "nested" locations using HSA, mud rotary and reverse air percussion drilling techniques. – Logged and field screened (using a PID) continuous soil cores from borings at 6 of the 7 locations. – Collected and submitted soil samples for VOC, SVOC and metal analyses for 3 of the borings (HSA borings only). – Converted the 10 borings into 13 groundwater monitoring wells (3 of the wells are nested in the same borehole) equating to 3 new 'A' Zone wells, 3 new 'B' Zone wells, 4 new 'C' Zone wells and 3 new 'D' Zone wells. – Developed and collected screening samples for each of the 13 wells. – Gauged and sampled each new well using the definitive techniques described in the site specific SAP. • The data produced from these activities indicated the following conclusions: – No previously unidentified significant contaminant concentrations were detected in any of the soil samples. – CVOC concentrations in the Exposition 'A' Zone extends to the northwest portion of the Pemaco property, but is limited in its western extent to the immediate site area. – CVOC concentrations in the Exposition 'B' Zone do not extend to the northeast portion of the site (like in the 'A' Zone), but do extend westward beyond the immediate site area.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		– CVOC concentrations detected in the 'C' and 'D' Zones exceeding State of California MCLs are limited to the immediate site vicinity near the postulated release point (extreme southwest corner of Pemaco property) and do not extend down-gradient to any significant extent. – Groundwater gradient data and contaminant concentration data from some of the new wells have identified some anomalous apparent groundwater flow directions and vertical concentration distributions that may be due to hydrogeological complexities associated with the multi-zoned and heterogenous nature of the saturated sand units underlying the site area. Continued monitoring of these wells will confirm or deny the permanent existence of these anomalies.
T N & Associates, Inc.	Mar 2004	*Technical Memorandum: Results of the Source Area Investigation Using a Cone Penetration Testing Rig (CPT) Equipped with a Membrane Interface Probe (MIP), Pemaco Superfund Site* • 16 borings were completed by the USACE SCAPS team to total depths ranging from 80 to 100 feet bgs. The drill rig used was a conventional CPT rig equipped with an MIP probe and an on-board IT/MS used to detect and speciate VOCs in soil, soil vapor and groundwater. • Continuous chemical screening data was collected at each of the 16 boring locations. • Discreet interval samples were also collected at selected depths from 10 of the boring locations. • Data from the continuous and discrete sampling program confirmed that the TCE soil plume, which is the source of the large groundwater plume in the Exposition 'A' and 'B' Zones underlying the area, is located in the extreme southern portion of the Pemaco site. • The CPT/MIP source area data has delineated the highest TCE concentrations in soil and groundwater at an increased resolution as compared with interpretations from soil sampling and groundwater data from the borings and wells installed in the area. • The CPT/MIP data has led to a better understanding of the depths, thicknesses and continuities of the hydrogeologic units in the source area as illustrated by the cross sections produced from the data.

Table 01115 - 2
Summary of Environmental Investigations at the Pemaco Property
5050 East Slauson Avenue, Maywood, California

Company	Report Date	Scope and Summary of Investigation
		• The majority of the TCE mass in soil is located between 35 and 90 feet bgs in the southern portion of the site. Three areas were identified where TCE concentrations were more continuously detected throughout the soil column. These areas generally coincide with the historic drum storage areas. • The majority of the hydrocarbon mass is located between 25 and 60 feet bgs in the southern portion of the site. Two areas were identified where hydrocarbon concentrations were more continuously detected throughout the soil column. These areas generally coincide with the former UST locations.
T N & Associates, Inc.	Nov 2004	*Technical Memorandum: Pemaco Data Evaluation for Natural Attenuation and Biodegradation of Chlorinated Ethenes, Pemaco Superfund Site* • Groundwater data generated during the RI was reviewed in order to evaluate the natural attenuation and biodegradation of chlorinated ethenes in groundwater. The evaluation process was conducted for both the perched groundwater zone and the Exposition groundwater zones, and consisted of two steps: 1. Evaluation of the Environmental Conditions, and 2. Screening of Analytical Parameters. • The two-step Pemaco data evaluation process for evaluation of natural attenuation and biodegradation of chlorinated ethenes in the Perched and Exposition zones indicated that: 1. Anaerobic conditions are present in the both Perched and Exposition zones. 2. Reductive dechlorination is the predominant intrinsic bioremediation process at the Site. 3. There is strong/adequate evidence that natural bioattenuation of chlorinated ethenes is occurring in both the perched and Exposition groundwater zones. • Based on the evaluation and screening results, enhanced in-situ bioremediation (EISB) and Monitored Natural Attenuation (MNA) should be evaluated in detail as remedial alternatives for the Pemaco Superfund Site within these groundwater zones.

Table 011115 - 3
Chemicals Exceeding USEPA Region IX Residential Soil PRGs
Surface and Near Surface Soil (0 - 2.5 feet bgs)
Pemaco Superfund Site, Maywood, California

Chemical	USEPA PRG (unit indicated below)	Maximum Concentration Found in Surface Soil	Maximum Concentration Found in Near Surface Soil
SVOCs (µg/kg)			
Benzo (a) anthracene	620	22,000 (GP-SS-14)	950 (GP-SS-31)
Benzo (a) pyrene	62	33,000 (GP-SS-14)	1,100 (GP-SS-31)
Benzo (b) fluoranthene	620	38,000 (GP-SS-14)	1,000 (GP-SS-11, GP-SS-31)
Benzo (k) fluoranthene	6,200/380*	28,000 (GP-SS-14)	760 (GP-SS-11)
Chrysene	62,000/3,800*	24,000 (GP-SS-14)	--
Dibenzo (a,h) anthracene	62	5,300 (GP-SS-14)	130 (GP-SS-31)
Indeno (1,2,3-cd) pyrene	620	19,000 (GP-SS-14)	670 (GP-SS-30)
Metals (mg/kg)			
Arsenic	22/0.39*	--	40.4 (GP-SS-45)
Iron	23,000	73,200 (GP-SS-75)	71,500 (GP-SS-61)
Lead	150	952 (GP-SS-87)	--
Manganese	1,800	1,940 (GP-SS-51)	--

Notes:

(1.) 'µg/kg' - microgram per kilogram.

(2.) 'mg/kg' - milligram per kilogram.

(3.) "--" data not available

(4.) Maximum concentration followed in parentheses by the sample location.

(5.) USEPA Region IX Preliminary Remediation Goals (PRGs) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations combining exposure information and EPA toxicity data for each environmental media; in this case, residential soil. PRGs should be viewed as Agency guidelines, not legally enforceable standards.

(6.) '*' - State of California modified PRG.

Table 01115 - 4
Chemicals Exceeding USEPA Region IX DAF 20 PRGs
Upper Vadose Zone Soil (2.5 - 35 feet bgs)
Pemaco Superfund Site, Maywood, California

Chemical	USEPA PRG (unit indicated below)	Maximum Concentration Found in Upper Vadose Zone Soil
VOCs (µg/kg)		
1,1-Dichloroethene	60	400 (WWH-2, 25-25.5')
Acetone	16,000	19,000 (MW-16, 25-25.5')
Benzene	30	4,100 (MW-06, 25-25.5')
cis-1,2-Dichloroethene	400	3,300 (MW-18, 25-25.5')
Ethylbenzene	13,000	61,000 (GP-VS-10, 16-16.5')
Methylene Chloride	20	530 (MW-06, 25.5-26')
Tetrachloroethene	60	2,000 (GP-VS-06, 29-29.5')
Toluene	12,000	98,000 (GP-VS-10, 16-16.5')
Trichloroethene	60	3,300 (GP-VS-18, 32-32.5')
Vinyl Chloride	10	280 (MW-15, 25-25.5')
Xylenes (total)	210,000	430,000 (GP-VS-10, 16-16.5')
SVOCs (µg/kg)		
Benzo (a) anthracene	2,000	32,000 (GP-VS-09, 5-5.5')
Benzo (a) pyrene	8,000	27,000 (GP-VS-09, 5-5.5')
Benzo (b) fluoranthene	5,000	40,000 (GP-VS-09, 5-5.5')
Carbazole	600	1,900 (GP-VS-09, 5-5.5')
Dibenzo (a,h) anthracene	2,000	5,200 (GP-VS-09, 5-5.5')
Indeno (1,2,3-cd) pyrene	14,000	15,000 (GP-VS-09, 5-5.5')
Isophorone	500	630 (GP-VS-09, 34.5-35')
NHVOCs (µg/kg)		
Acetone	16,000	22,000 (RW-01, 25-25.5')
Metals (mg/kg)		
Arsenic	29	29.2 (MW-13, 34.5-35')
Chromium (total)	38	48.4 (MW-13, 34.5-35')

Notes:

(1.) 'µg/kg' - microgram per kilogram.

(2.) 'mg/kg' - milligram per kilogram.

(3.) Maximum concentration followed in parentheses by the sample location and depth.

(4.) USEPA Region IX Preliminary Remediation Goals (PRGs) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations combining exposure information and EPA toxicity data for each environmental media; in this case, subsurface soil. PRGs should be viewed as Agency guidelines, not legally enforceable standards. PRGs are used to screen subsurface soil as a threat to groundwater. Dilution Attentuation Factor (DAF) 20 PRGs are used when the contaminated soil is not directly adjacent to a drinking water source and dilution of the contaminant is occurring before it reaches the drinking water source.

Table 01115 - 5A
Chemicals Exceeding USEPA Region IX DAF 20 PRGs
Lower Vadose Zone Soil (35 - 65 feet bgs)
Pemaco Superfund Site, Maywood, California

Chemical	USEPA PRG (unit indicated below)	Maximum Concentration Found in Lower Vadose Soil Zone
VOCs (µg/kg)		
Benzene	30	520 (MW-06, 54.5-55')
1,2-Dichloroethane	20	400 (MW-17, 55-55.5')
cis-1,2-Dichloroethene	400	730 (RW-01, 55-55.5')
Methylene chloride	20	450 (MW-18, 55-55.5')
Trichloroethene	60	2,100 (MW-17, 45-45.5')
Vinyl Chloride	10	22 (GP-VS-32, 39.5-40')
Metals (mg/kg)		
Chromium (total)	38	39.3 (MW-19, 65-65.5')

Notes:

(1.) 'µg/kg' - microgram per kilogram.

(2.) 'mg/kg' - milligram per kilogram.

(3.) Maximum concentration followed in parentheses by the sample location and depth.

(4.) USEPA Region IX Preliminary Remediation Goals (PRGs) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations combining exposure information and EPA toxicity data for each environmental media; in this case, subsurface soil. PRGs should be viewed as Agency guidelines, not legally enforceable standards. PRGs are used to screen subsurface soil as a threat to groundwater. Dilution Attenuation Factor (DAF) 20 PRGs are used when the contaminated soil is not directly adjacent to a drinking water source and dilution of the contaminant is occurring before it reaches the drinking water source.

Table 011115 - 5B
Chemicals Exceeding USEPA Region IX DAF 1 PRGs
Lower Vadose Zone Soil (> 50 feet bgs)
Pemaco Superfund Site, Maywood, California

Chemical	USEPA PRG (unit indicated below)	Maximum Concentration Found in Lower Vadose Zone Soils > 50 feet bgs
VOCs (µg/kg)		
Benzene	2.0	520 (MW-06, 54.5-55')
1,2-Dichloroethane	1.0	400 (MW-17, 55-55.5')
cis-1,2-Dichloroethene	20	730 (RW-01, 55-55.5')
Methylene chloride	1.0	450 (MW-18, 55-55.5')
Trichloroethene	0.7	1,400 (MW-17, 55-55.5')
Metals (mg/kg)		
Antimony	0.3	1.5 (MW-11, 64.5-65')
Arsenic	1.0	24.58 (MW-14, 55-55.5')
Barium	82	337 (MW-18, 55-55.5')
Cadmium	0.4	0.52 (MW-05, 59.5-60')
Chromium (total)	2.0	39.3 (MW-19, 65-65.5')
Nickel	7.0	35.3 (MW-11, 64.5-65')

Notes:

(1.) 'µg/kg' - microgram per kilogram.

(2.) 'mg/kg' - milligram per kilogram.

(3.) Maximum concentration followed in parentheses by the sample location and depth.

(4.) USEPA Region IX Preliminary Remediation Goals (PRGs) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations combining exposure information and EPA toxicity data.for each environmental media; in this case, subsurface soil. PRGs should be viewed as Agency guidelines, not legally enforceable standards. PRGs are used to screen subsurface soil as a threat to groundwater. Dilution Attenuation Factor (DAF) 1 PRGs assume that the contaminated soil is directly adjacent to a drinking water source and no dilution of the contaminant is occurring along the pathway between the source soil and the drinking water source.

Table 011115 - 6
Chemicals Exceeding USEPA PRGs and/or California MCLs for Drinking Water
Perched Groundwater Zone

Pemaco Superfund Site, Maywood, California

Chemical	Primary MCL (µg/L)	USEPA PRG (µg/L)	Maximum Concentration Found in Perched Groundwater (µg/L)
VOCs			
1,1-Dichloroethane	5.0	810/0.2*	410 (B-01)
1,1-Dichloroethene	6.0	340	2,000 (B-01)
1,2-Dibromo-3-chloropropane	0.2	0.048/0.0016*	2 (B-38)
1,2-Dichloroethane	0.5	0.12	18 (B-27)
1,1,2-Trichloroethane	5.0	0.2	9 (SV-04)
Acetone	--	610	1,500 (B-22)
Benzene	1.0	0.34	1,600 (B-30)
Chloroform	--	0.53	41 (B-23)
Chloroethane	--	4.6	50 (B-21)
cis-1,2-Dichloroethene	6.0	61	780 (B-21)
Dibromochloromethane	--	0.13	2.4 (B-17)
Ethylbenzene	700	2.9	1200 (B-08)
Methyl tert-butyl Ether	13	13/6.2*	30 (B-04)
Tetrachloroethene	5.0	0.66	1,100 (B-01)
Toluene	150	720	2,000 (B-13)
trans-1,2-Dichloroethene	10	120	59 (B-21)
Trichloroethene	5.0	0.028	680 (B-22)
Vinyl Chloride	0.5	0.02	240 (B-08, B-21)
NHVOCs			
Acetonitrile (Coelute w/MIBK)	--	100	223 (B-13)
Acrylonitrile	--	0.039	340 (B-21)
Methyl isobutyl ketone (MIBK)	--	160	223 (B-13)
SVOCs			
1,4-Dioxane	3.0*	6.1	920 (B-01)
bis(2-Ethylhexyl)phthalate	--	4.8	11 (B-10)
Naphthalene	--	6.2	25 (B-04)
Metals			
Aluminum	1,000	36,000	52,700 (B-10)
Arsenic	50	0.045	676 (B-10)
Chromium (total)	50	--	72 (B-10)
Iron	--	11,000	377,000 (B-10)
Lead	15*	--	115 (B-25)
Manganese	--	880	4,130 (B-20)
Selenium	50	180	279 (B-25)
Thallium	2.0	2.4	55.5 (B-10)

Notes:

(1.) ' µg/L' - microgram per liter.

(2.) "--" data not available

(3.) Maximum concentration followed in parentheses by the sample location.

(4.) USEPA Region IX Preliminary Remediation Goals (PRGs) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations combining exposure information and EPA toxicity data for each environmental media; in this case, groundwater. PRGs should be viewed as Agency guidelines, not legally enforceable standards.

(5.) State of California Maximum Contaminant Levels (MCLs) are legally enforceable drinking water standards. These MCL levels are primarily risk-based levels similar to PRGs where it is assumed that a person will drink water with the specified chemical concentrations.

(6.) '*' - State of California Action Level, no available MCL.

Table 011115 - 7
Chemicals Exceeding USEPA PRGs and/or California MCLs for Drinking Water
Exposition Groundwater Zones

Pemaco Superfund Site, Maywood, California

Chemical	Primary MCL (µg/L)	USEPA PRG (µg/L)	Maximum Concentration Found in Exposition Groundwater (µg/L)
VOCs			
1,1-Dichloroethene	6.0	340	30 (MW-17-85)
1,2-Dibromo-3-chloropropane	0.2	0.048/0.0016*	5 (MW-12-70, MW-12-90)
1,2-Dichloroethane	0.5	0.12	0.4 (MW-13-85)
Acetone	--	610	20,000 (MW-09-85)
Benzene	1.0	0.34	1,600 (MW-06-85)
Chloroform	--	6.2/0.53*	36 (MW-05-85)
cis-1,2-Dichloroethene	6.0	61	14,000 (MW-17-85)
Dibromochloromethane	--	0.13	16 (MW-03-85)
Methylene Chloride	5.0	4.3	6 (MW-10-175)
Methyl tert-butyl Ether	13	13/6.2*	30 (B-04)
Tetrachloroethene	5.0	0.66	8.1 (MW-03-85)
trans-1,2-Dichloroethene	10	120	53 (MW-17-70)
Trichloroethene	5.0	0.028	22,000 (MW-17-70)
Vinyl Chloride	0.5	0.02	780 (MW-18-85)
NHVOCs			
Acetone *(different analytical method)*	--	610	8,620 (MW-17-85)
Metals			
Aluminum	1,000	36,000	4,020 (MW-02-95)
Arsenic	50	0.045	52.7 (MW-10-110)
Manganese	--	880	1,410 (MW-09-85)
Thallium	2.0	2.4	7.4 (MW-03-85)
Anions			
Sulfide	--	110^{+}	9,500 (MW-09-85)

Notes:

(1.) ' µg/L' - microgram per liter.

(2.) "--" data not available

(3.) Maximum concentration followed in parentheses by the sample location.

(4.) USEPA Region IX Preliminary Remediation Goals (PRGs) are tools for evaluating and cleaning up contaminated sites. They are risk-based concentrations combining exposure information and EPA toxicity data for each environmental media; in this case, groundwater. PRGs should be viewed as Agency guidelines, not legally enforceable standards.

(5.) State of California Maximum Contaminant Levels (MCLs) are legally enforceable drinking water standards. These MCL levels are risk-based levels similar to PRGs where it is assumed that a person will drink water with the specified chemical concentrations.

(6.) '*' - California modified PRG.

(7.) '+' 110 µg/L is the PRG for hydrogen sulfide.

T N & Associates, Inc.
Engineering and Science

BORING LOG
PEMACO, INC.
MAYWOOD, CALIFORNIA

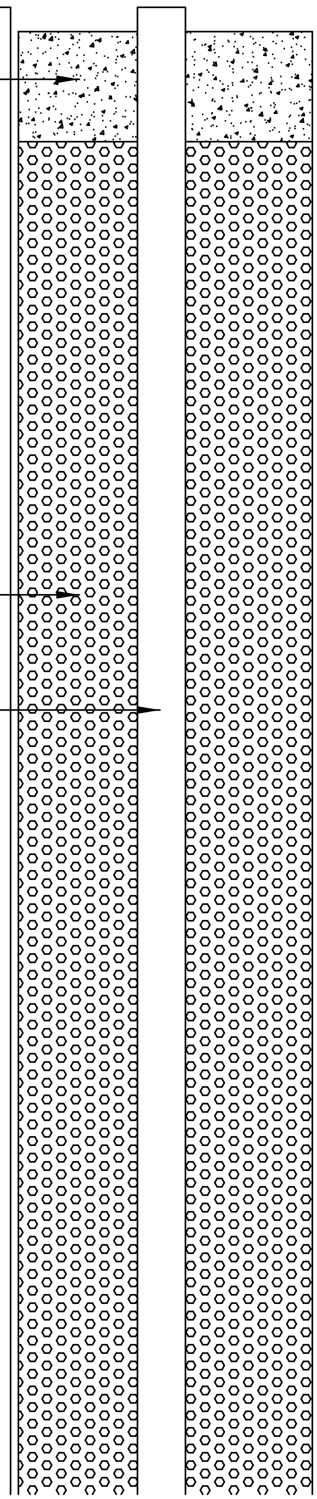
PROJECT No.: 2000126
TOP OF CASING ELEVATION: 150.30
DRILLER: Darryl
DATE BEGAN: 4/16/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

LOCATION: 10' West of stairway, 16' south of fence
PAGE: 1 of 2
DATE COMPLETED: 4/16/01
GWL DATE/TIME: 6/5/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-17
LOGGED BY: Jacques Marcillac
GWL DEPTH: 39.21
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH MACROCORE
0		0		SM	0–1.5' Topsoil		
					Burnt concrete debris.		
		0		SM	SILTY SAND, 70% fine sand; 30% silt; trace clay; moderate olive brown (5Y 4/4); moist; faint sweet odor.		
5			X	SM	SILTY SAND, 55% fine sand; 35% silt; 10% clay; moderate olive brown (5Y4/4); moist; faint sweet odor.		(Chemical Analysis @ 5–5.5')
		0					
10					Blackened (burnt?) at 11.0–11.5'.		
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% sub–angular to angular fine to medium sand; 10% silt; trace subangular gravel; light olive gray (5Y 5/2); damp; no odor.		
					Concrete rubble 14–14.5'		
15		0.9		SM	SILTY SAND, 85% fine sand; 15% silt; dark yellow brown (10YR 4/2); damp; no odor.		
				SM	SILTY SAND, 85% fine sand; 15% silt; moderate olive brown; damp; no odor.		
					Concrete from 17–17.3'		
		0.9					
20		0		CL	LEAN CLAY, 60% semi–plastic clay; 35% silt; 5% fine sand; moderate olive brown (5Y 4/4); moist; no odor.		
		0		CL	LEAN CLAY, 55% semi–plastic clay; 35% silt; 10% fine sand; moderate olive brown (5Y 4/4); moist; no odor.		

WELL CONSTRUCTION



BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

T N & Associates, Inc.
Engineering and Science

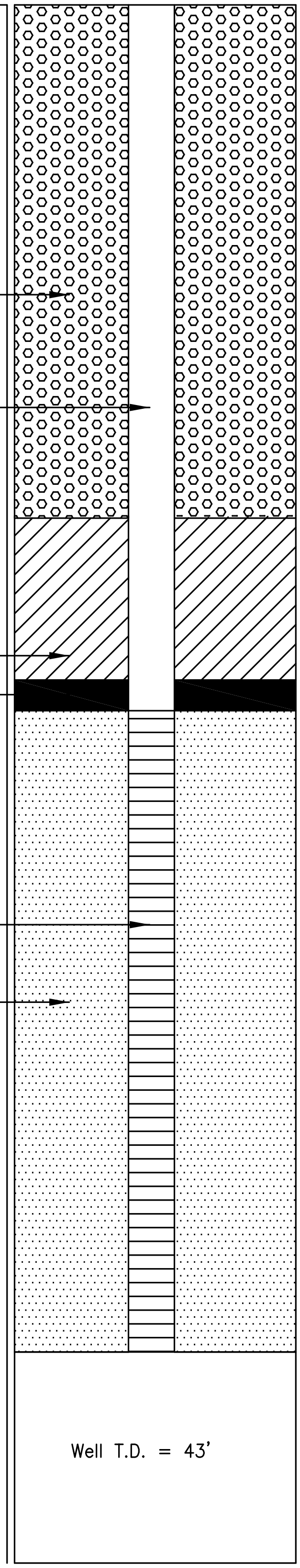
PROJECT No.: 2000126
DATE COMPLETED: 4/16/01

LOCATION: 10' West of Stairway, 16' south of fence

BORING No.: B-17

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH MACROCORE
		0		CL	LEAN CLAY, 55% semi-plastic clay; 35% silt; 10% fine sand; moderate olive brown; moist; no odor.		
25		4.7		SM	SILTY SAND, 75% fine sand; 25% silt; moderate olive brown (5Y 4/4); moist; no odor.		
		0.9		SM	SILTY SAND, 80% fine sand; 20% silt; light olive gray (5Y 5/2); moist; faint sweet odor.		
		0.9		ML	SANDY SILT, 65% silt; 30% sand; 5% clay; moderate olive brown (5Y 4/4); moist; faint sweet odor.		
30		2.8	X	SP-SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); moist to wet; faint sweet odor.		(Chemical Analysis @ 31-31.5') Wet at 31.7'
		4.7		SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; moderate olive brown (5Y 4/4); moist to wet; no odor.		
		0.9	X	SP	POORLY GRADED SAND, 95% subangular fine to medium sand; 5% silt; light olive gray (5Y 5/2); saturated; faint sweet odor.		(Chemical Analysis @ 33-33.5')
		0.9		CL	LEAN CLAY, 70% semi-plastic clay; 30% silt; olive gray (5Y 4/1); moist; no odor.		
35		0.9		ML	SANDY SILT, 50% silt; 40% fine sand; 10% clay; light olive gray (5Y 5/2); moist; no odor.		
		2.8	X	SW	WELL GRADED SAND, 95% subangular fine to coarse sand; 5% silt; light olive gray (5Y 5/2); saturated; no odor.	▽	(Chemical Anaylsis @ 38.5-39.0')
		0.9		ML	SANDY SILT, 50% silt; 40% sand; 10% clay; light olive gray (5Y 5/2); wet; no odor.		
40		6.6		SW	WELL GRADED SAND, 95% subangular fine to coarse sand; 5% silt; light olive gray (5Y 5/2); saturated; no odor.		
		0		ML	SILT WITH SAND, 50% silt; 35% clay; 15% fine sand; trace subrounded 5mm gravel; moderate olive brown (5Y 4/4); moist; no odor.		
45					Total Depth = 44'		

WELL CONSTRUCTION



3/8" Bentonite Chips
Blank 1.5" PVC Pipe
Pre-Pack Bentonite
4" Foam Packer
Slotted 0.010" 1.5" PVC Pipe
20/40 Lone Star sand enclosed in size 65 stainless steel mesh
Well T.D. = 43'

BORING LOG

T N & Associates, Inc.
Engineering and Science

PEMACO, INC.
MAYWOOD, CALIFORNIA

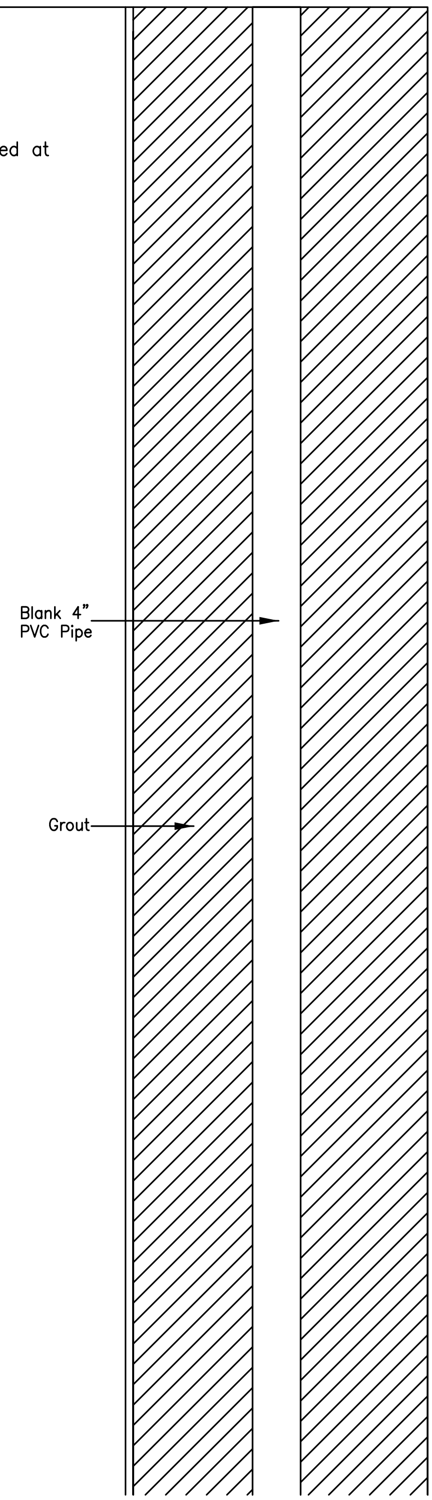
PROJECT No.: 2000126
TOP OF CASING: 137.57'
DRILLER: Dino
DATE BEGAN: 4/02/01
DRILLING METHOD: Mud Rotary
CONTRACTOR: Gregg Drilling

LOCATION: Walker St. midway between 59th and 60th St.
PAGE: 1 of 3
DATE COMPLETED: 04/03/01
GWL DATE/TIME: 5/01/01
DRILL EQUIPMENT: Versa Drill, 12" bit

BORING No.: MW-5-135
LOGGED BY: Tim Garvey
GWL DEPTH: 92.30'
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH WIRELINE CORE BARREL
90					Lithology for 0–90' same as MW–5.		
				CL	LEAN CLAY, 70% semi–plastic clay; 30% silt; light olive gray (5Y 5/2); moist.	∇	MW–5–135 gauged at 92.30' bgs.
				ML	SANDY SILT, 65% silt; 30% well rounded fine sand; 5% clay; light olive gray (5Y 6/2); moist.		
95				SP–SM	POORLY GRADED SAND WITH SILT, 80% sub–rounded medium to coarse sand; 10–20% silt; light olive gray (5Y 5/2) to moderate yellow (5Y 6/5); wet.		
					No Recovery		
100				CH	SILTY FAT CLAY, 50% plastic clay; 40% silt; 10% fine sand; light olive gray (5Y 5/2).		
				SP	POORLY GRADED SAND, 100% subrounded medium sand; moderate yellowish brown (10YR 5/5); saturated.		
				CH	SILTY FAT CLAY, 50% clay; 40% silt; 10% subrounded fine sand; light olive gray (5Y 5/2).		
105				CL	LEAN SILTY CLAY, 65% semi–plastic clay; 30% silt; 5% gravel; light olive gray (5Y 5/2); stiff; moist; gravel in clay from 106–107'–tuff fragments?		
				ML	CLAYEY SILT WITH SAND, 50% semi–plastic silt; 30% clay; 20% subrounded fine to medium sand; moderate yellowish brown (10YR 5/5); well graded; stiff; moist.		
110					110–111' had higher sand percentage (to 35%) medium grain		

WELL CONSTRUCTION



T N & Associates, Inc. Engineering and Science	**BORING LOG** PEMACO, INC. MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 04/03/01

LOCATION: Walker St. midway between 59th and 60th St.

BORING No.: MW-5-135

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH WIRELINE CORE BARREL	WELL CONSTRUCTION
115					ML	SILT WITH CLAY, 75% semi-plastic silt; 25% clay; moderate yellowish brown (10YR 5/5); stiff; moist.			Bentonite Seal
120									Bentonite Seal
									Filter Pack 0/30 Sand
					SM	SILTY SAND WITH GRAVEL, 45% subrounded to subangular coarse sand; 35% subrounded to subangular gravel to 1cm; 15% silt; 5% clay; light olive gray (5Y 6/2); well graded; friable; saturated.			Blank 4" PVC Pipe
					SM	SILTY SAND, 80% subrounded sand; 10% silt; 5% clay; moderate yellowish brown (10YR 5/5); well graded; saturated.			Filter Pack 2/16 Sand
125					GW	WELL GRADED GRAVEL WITH SAND, 75% sub-coarse gravel to 3cm; 20% subrounded medium to coarse sand; 5% silt; dusky yellow (5Y 6/4); moderately graded; loose; saturated.			
			X		SP-SM	POORLY GRADED SAND, 80% subrounded sand; 10% subrounded gravel; 10% silt; dusky yellow (5YR 6/4); poorly graded; saturated.		Geotech Sample collected from 126-126.5'.	
130						128-132'-No Recovery-(Driller said gravelly (?))			Slotted .010" 4" PVC Pipe
					SM	SILTY SAND, 75% subangular fine sand; 25% non-plastic silt; dark yellowish brown (10YR 4/2); medium stiff to stiff; moist.			
135					ML	SILT, 80% semi-plastic silt; 20% clay; <5% sand; dusky yellow (5Y 6/4) to light olive gray (5Y 5/2); stiff; moist.		Well Total Depth = 136 ft.	

T N & Associates, Inc.
Engineering and Science

BORING LOG
PEMACO, INC.
MAYWOOD, CA

PROJECT No.: 2000126
DATE COMPLETED: 4/03/01

LOCATION: Walker St. midway between 59th and 60th St.

BORING No.: MW-5-135

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH WIRELINE CORE BARREL	WELL CONSTRUCTION
					ML	SILT, 80% semi-plastic silt; 20% clay; <5% sand; dusky yellow (5Y 6/4) to light olive gray (5Y 5/2); stiff; moist. Laminated silt and clay.		Geotech Sample collected from 137-137.5'.	
140						Boring Total Depth = 140 ft.			
145									
150									
155									
160									

T N & Associates, Inc.
Engineering and Science

BORING LOG
PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2002191
TOP OF CASING: 137.50' above MSL
DRILLER: Arlen Meyer
DATE BEGAN: 7/24/2003
DRILLING METHOD: Mud Rotary
CONTRACTOR: Gregg Drilling

LOCATION: Walker St. midway between 59th and 60th St.
PAGE: 1 of 1
DATE COMPLETED: 7/24/2003
GWL DATE/TIME: 10/20/2003
DRILL EQUIPMENT: Mud Rotary, Versa Drill V-100

BORING No.: MW-5-105
LOGGED BY: Tim Garvey
GWL DEPTH: 92.14' below casing
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet): 90, 95, 100, 105, 110

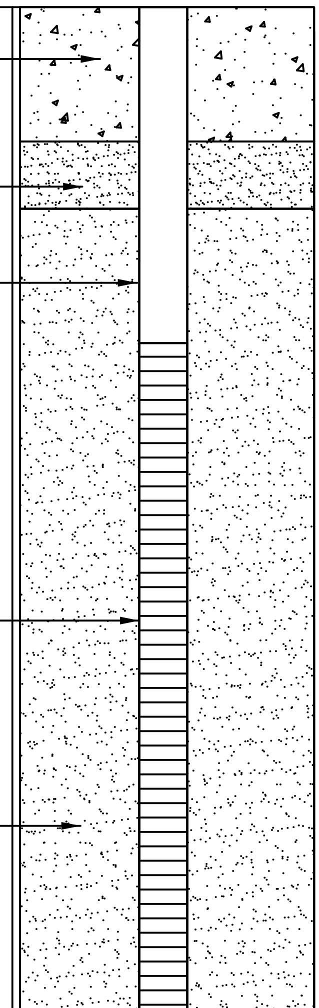
BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.
					Lithology for 0–90' same as MW–5–85.
				CL	LEAN CLAY, 70% semi–plastic clay; 30% silt; light olive gray (5Y 5/2); moist.
				ML	SANDY SILT, 65% silt; 30% well rounded fine sand; 5% clay; light olive gray (5Y 6/2); moist.
				SP–SM	POORLY GRADED SAND WITH SILT, 80% sub–rounded medium to coarse sand; 10–20% silt; light olive gray (5Y 5/2) to moderate yellow (5Y 6/5); wet.
					No Recovery
				CH	SILTY FAT CLAY, 50% plastic clay; 40% silt; 10% fine sand; light olive gray (5Y 5/2).
				SP	POORLY GRADED SAND, 100% subrounded medium sand; moderate yellowish brown (10YR 5/5); saturated.
				CH	SILTY FAT CLAY, 50% clay; 40% silt; 10% subrounded fine sand; light olive gray (5Y 5/2).

GW ELEVATION

REMARKS
CONTINUOUSLY CORED WITH WIRELINE CORE BARREL

Water level as gauged on 10/20/03.

WELL CONSTRUCTION



T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

BORING No.: MW-5

PROJECT No.: 2000126
TOP OF CASING ELEVATION: 137.30
DRILLER: Craig Winegarner
DATE BEGAN: 3/21/01
DRILLING METHOD: Hollow Stem Auger
CONTRACTOR: Gregg Drilling

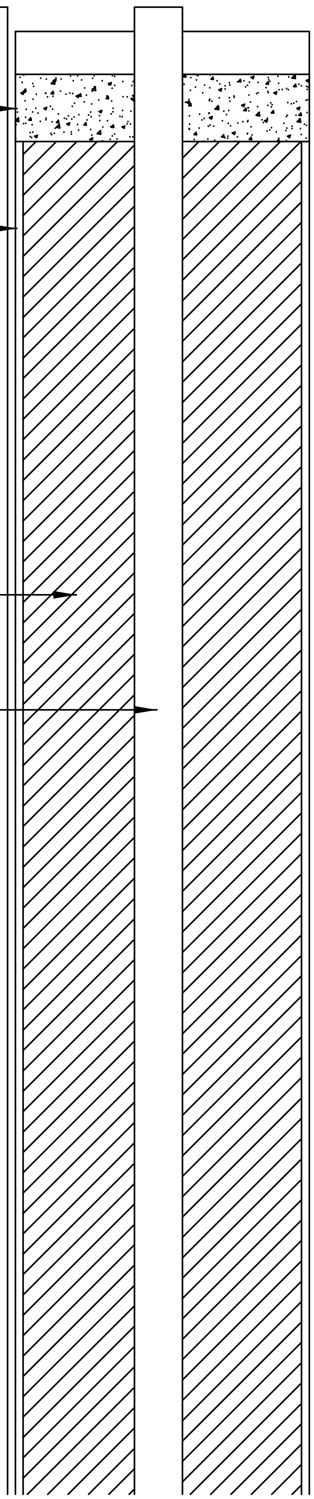
LOCATION: Adjacent to Park on Walker Ave.

DATE COMPLETED: 3/23/01
GWL DATE/TIME: 3/23/01-1640
DRILL EQUIPMENT: CME 95, 18" Augers/12" Augers

LOGGED BY: Jacques Marcillac
GWL DEPTH: 60.55'
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russel, R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 5'x4" ID CORE BARREL
0					0"–3" Asphalt		
		0		SM	SILTY SAND, 75% fine sand; 25% silt; dark yellowish brown (10YR 4/2); damp: no odor.		Cement 12" Diameter Steel Conductor Casing 1'–26'
5		0	X				(Chemical Analysis @ 5–5.5')
		0		SP	POORLY GRADED SAND, 100% subrounded to subangular fine sand; pale yellowish brown (10YR 6/2); moist; no odor.		
		0		SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; light olive gray (5Y 5/2); moist; no odor.		Bentonite/Cement Grout
10		0		SM	SILTY SAND, 60% fine sand; 40% silt; grayish olive (10Y 4/2); moist; no odor.		Blank 4" PVC Pipe
				CL	LEAN CLAY, 60% semi–plastic clay; 35% silt; 5% fine sand; olive gray (5Y 4/1) slightly mottled with moderate brown; moist; no odor; increasing silt/ sand content with depth.		
15		0	X				(Chemical Analysis @ 14.5–15')
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% sub–angular fine sand; 10% silt; light olive gray (5Y 5/2); moist to wet; no odor.	▽	Wet at 17' bgs.
		0		CL	LEAN CLAY, 50% semi–plastic clay; 45% silt; 5% fine sand; olive gray (5Y 4/1); moist; no odor.		
20					SILTY SAND, 60% fine sand; 40% silt; light olive gray (5Y 5/2); moist to wet; no odor; increased sand content with depth (70%).		

WELL CONSTRUCTION



T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 3/21/01

LOCATION: Adjacent to Park on Walker Ave.

BORING No.: MW-5

CONTINUOUSLY CORED WITH MACROCORE

ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	USCS	DESCRIPTION	REMARKS
		0	ML	SILT, 55% silt; 35% clay; 10% subangular fine to medium sand; olive gray (5Y 4/1), slightly mottled with moderate brown; moist; no odor.	(Chemical Analysis @ 23–23.5')
25		0	CH	FAT CLAY, 50% very plastic clay; 45% silt; 5% subangular fine sand; moderate brown (5YR 4/4); mottled with dark greenish gray; damp; no odor.	Steel Conductor Casing from 1'–26'
					No core from 25–30'
					Grout
30		0	SM	SILTY SAND WITH GRAVEL, 40% fine to coarse sand; 25% silt; 25% angular 10mm gravel; moderate yellowish brown (5YR 5/4); mottled with white; moist; no odor; semi-indurated; very angular vesicular gravel throughout interval; volcanic (?) or well-cemented sandstone.	
		0	ML	SILT WITH SAND, 60% silt; 20% fine sand; 10% clay; 10% angular 10mm gravel; moderate olive brown (5Y 4/4); slightly mottled with white; moist; no odor; very angular well-cemented sandstone gravel.	
		0	SM	SILTY SAND, 70% fine sand; 30% silt; moderate olive brown (5Y 4/4); moist; no odor.	Blank 4" PVC Pipe
35		0	CL	LEAN CLAY, 50% semi-plastic clay; 45% silt; 5% fine sand; light olive gray (5Y 5/2); heavily mottled with yellowish gray; trace charcoal fragments; moist; no odor.	
		0	ML	SANDY SILT, 50% silt; 40% fine sand; 10% clay; light olive gray, heavily mottled with light olive brown; moist; no odor; abundant charcoal fragments.	
		0	ML	SANDY SILT, 50% silt; 30% fine sand; 20% clay; light olive gray (5Y 5/2) mottled with moderate brown; moist; no odor; trace charcoal fragments and white calcite veining.	
		0	SM	SILTY SAND, 80% sand; 20% silt; moderate olive brown (5Y 4/4); moist; no odor.	(Chemical Analysis @ 39–39.5')
40		0	CH	FAT CLAY, 50% plastic clay; 45% silt; 5% fine sand; moderate olive brown mottled with light olive brown; moist; no odor.	
		0	SM	SILTY SAND, 60% subangular fine to medium sand; 35% silt; 5% clay; moderate olive brown (5Y 4/4); moist; no odor.	
		0	ML	SILT, 55% silt; 35% clay; 10% sand; light olive gray; occasional 2–3mm intervals with medium to coarse sand in clay matrix.	
45		2.8	SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; moderate olive brown (5Y 4/4); moist; no odor.	
		2.8	SM	SILTY SAND, 70% fine sand; 30% silt; moderate olive brown (5Y 4/4); moist; no odor.	

WELL CONSTRUCTION

T N & Associates, Inc. Engineering and Science

BORING LOG
PEMACO, INC.
MAYWOOD, CA

PROJECT No.: 2000126
DATE COMPLETED: 3/21/01

LOCATION: Adjacent to Park on Walker Avenue

BORING No.: MW-5

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 5'x4" ID CORE BARREL
		2.8		SM	SILTY SAND, 70% fine sand; 30% silt; moderate olive brown (5Y 4/4); moist; no odor.		
		12.5		ML	SANDY SILT, 60% silt; 30% clay; 10% subangular fine sand; moderate olive brown (5Y 4/4) slightly mottled with black; moist; no odor; abundant charcoal rootlets causing veining some empty veins filled with fine sand.		
50		6.6	X	ML	SILT, 55% silt; 35% clay; 10% sand; light olive gray (5Y 5/2); mottled with moderate brown and white; moist; no odor.		(Chemical Analysis @ 49.5–50')
		4.2					
55		10.2					Blank 4" PVC Pipe
		4.7					Grout
60		4.7	X			∇	(Chemical Analysis @ 59.5–60') Water Level Gauged at 60.55' 1 hour after grouting was complete.
		6.6					Bentonite Seal
		2.8		SM	SILTY SAND, 85% subangular fine sand; 15% silt; light olive gray (5Y 5/2); wet; no odor.		
65		4.8		CH	FAT CLAY, 50% plastic clay; 40% silt; 10% sand; light olive gray (5Y 5/2).	∇	Wet at 65' bgs.
				SM	SILTY SAND, 70% fine sand; 30% silt; light olive gray (5Y 5/2); wet; no odor.		
		0		CH	FAT CLAY, 70% plastic clay; 30% silt; light olive gray (5Y 5/2) mottled with yellowish gray; moist; no odor; semi-lithified at 65.5'.		Filter Pack 0/30 Sand
		0		SM	SILTY SAND, 60% fine sand; 30% silt; 10% clay; light olive gray (5Y 5/2); moist; no odor.		Lonestar 2/16 Sand
70		0	X	ML	SILT WITH SAND AND CLAY, 60% silt; 20% clay; 20% fine sand; grayish olive (10Y 5/2); moist; no odor.		(Chemical Analysis @ 69.5–70') Slotted 0.010" PVC Pipe

WELL CONSTRUCTION

T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 03/21/01
LOCATION: Adjacent to Park on Walker Avenue

BORING No.: MW-5

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 5'x4" ID CORE BARREL	WELL CONSTRUCTION
70		0			SM	SILTY SAND, 70% fine sand; 30% silt; light olive gray (5Y 5/2); saturated; no odor; increasing silt content with depth.	▽	Saturated from 70–72'.	
					CH	FAT CLAY, 70% plastic clay; 30% silt; trace fine sand; light olive gray (5Y 5/2) mottled with moderate olive brown; moist; no odor.			Slotted 0.010" 4" PVC pipe
75		0							Lonestar 2/16 Sand
80		0			SM	SILTY SAND, 80% subangular fine sand; 20% silt; grayish olive (10Y 4/2); saturated; no odor.	▽	Saturated from 80'–83'.	
		0			CL	LEAN CLAY, 70% semi–plastic clay; 30% silt; light olive gray (5Y 5/2); moist; no odor.			
85									Well TD = 85'
		0			CH	FAT CLAY, 70% hard clay; 30% silt; dusky yellow green (5GY 5/2); moist; no odor; semi–indurated.			
90						Boring Total Depth = 90 ft.		Borehole Diameter = 18" from 0–26' and 12" from 26–90'.	

T N & Associates, Inc.
Engineering and Science

BORING LOG
PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
TOP OF CASING ELEVATION: 140.08'
DRILLER: Mike
DATE BEGAN: 11-8-01
DRILLING METHOD: DPT
CONTRACTOR: Vironex

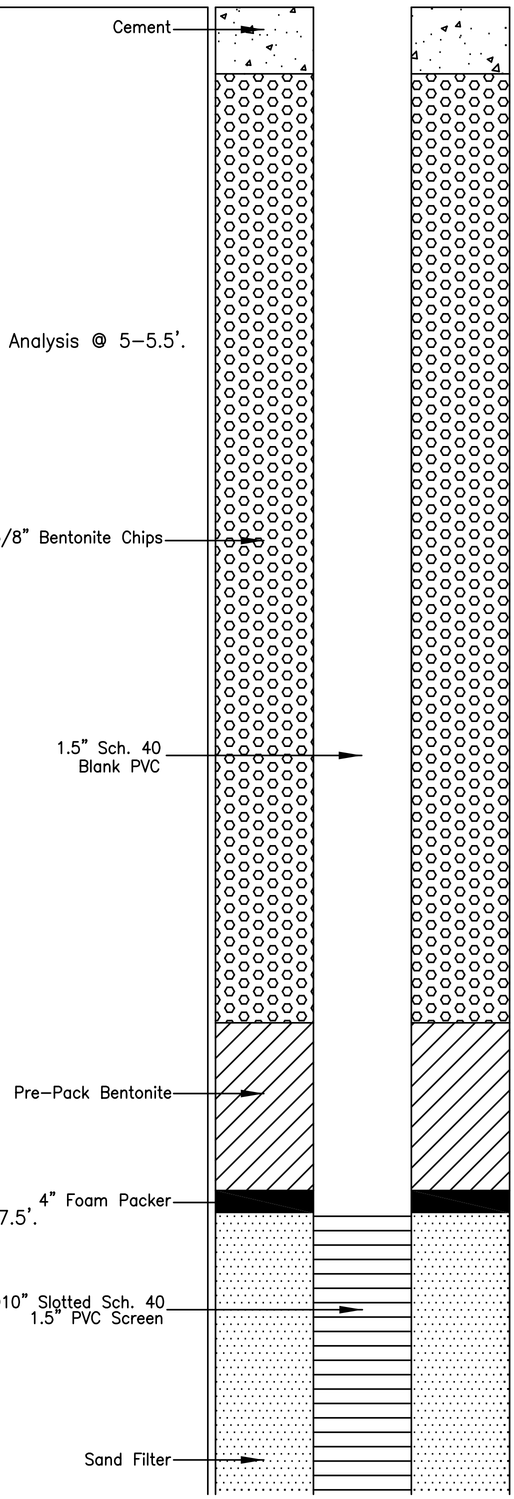
LOCATION: North central portion of WW Henry Property

DATE COMPLETED: 11-8-01
GWL DATE/TIME: -
DRILL EQUIPMENT: Geoprobe 6600

BORING No.: B-39
LOGGED BY: Jacques Marcillac
GWL DEPTH: -
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell, R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL
0					0–1' Gravelly Fill		
		0		SP	POORLY GRADED SAND, 100% subangular fine sand; light olive gray (5Y 5/2); damp; no odor.		
5		0	X	SM	SILTY SAND, 80% fine sand; 20% silt; dark yellow brown (10YR 4/2); moist; no odor.		Chemical Analysis @ 5–5.5'.
		1.1		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); damp; no odor.		
10		0		SM	SILTY SAND, 70% fine sand; 30% silt; trace clay; dark yellowish brown (10YR 4/2); moist; no odor.		
		0		SM	SILTY SAND, 70% fine sand; 30% silt; dark yellowish brown (10YR 4/2); moist; no odor.		
15		0		ML	SANDY SILT, 60% silt; 40% fine sand; trace clay; light olive gray (5Y 5/2); moist to wet; no odor.		
		0		SM	SILTY SANDY, 70% fine sand; 30% silt; light olive gray (5Y 5/2); wet; no odor.	▽	Wet @ 17.5'.
20		0		ML	SILT WITH CLAY AND SAND, 70% silt; 15% silt; 15% clay; olive gray (5Y 4/1); moist; odor.		

WELL CONSTRUCTION



TN&A T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
DATE COMPLETED: 11/8/01

LOCATION: North Central Portion of WW Henry Property

BORING No.: B-39

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL	WELL CONSTRUCTION
					ML	SILT WITH CLAY AND SAND, 70% silt; 15% clay; 15% sand; olive gray (5Y 4/1); moist; odor.		0.010" Slotted Sch.40 1.5" PVC Screen	
		1.1			CL	LEAN SILTY CLAY, 60% semi-plastic clay; 35% silt; 5% fine sand; olive black (5Y 2/1); possible faint solvent odor.			
25		4.4			ML	CLAYEY SILT WITH SAND, 60% silt; 30% clay; 10% sand; olive gray (5Y 4/1); wet; no odor.		Sand Filter	
		2.1			ML	SANDY SILT, 60% silt; 35% sand; 5% clay; olive gray (5Y 4/1) slightly mottled with moderate olive brown; moist to wet; no odor.			
		1.1			CL	SILTY LEAN CLAY, 60% semi-plastic clay; 40% silt; olive gray (5Y 4/1) mottled with moderate olive brown; moist; soft; no odor.			TD of Well = 28'.
30		1.1	X		CL	SILTY LEAN CLAY, 70% semi-plastic clay; 30% silt; dark greenish gray (5GY 4/1); moist; no odor.		Chemical Analysis @ 30-30.5'	
35		0			OL/OH	ORGANIC CLAY WITH SILT, 80% non-plastic clay; 20% silt; olive gray (5Y 4/1); moist; soft; no odor.			
						TD of Boring = 38'.			
40									
45									

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

T N & Associates, Inc.
Engineering and Science

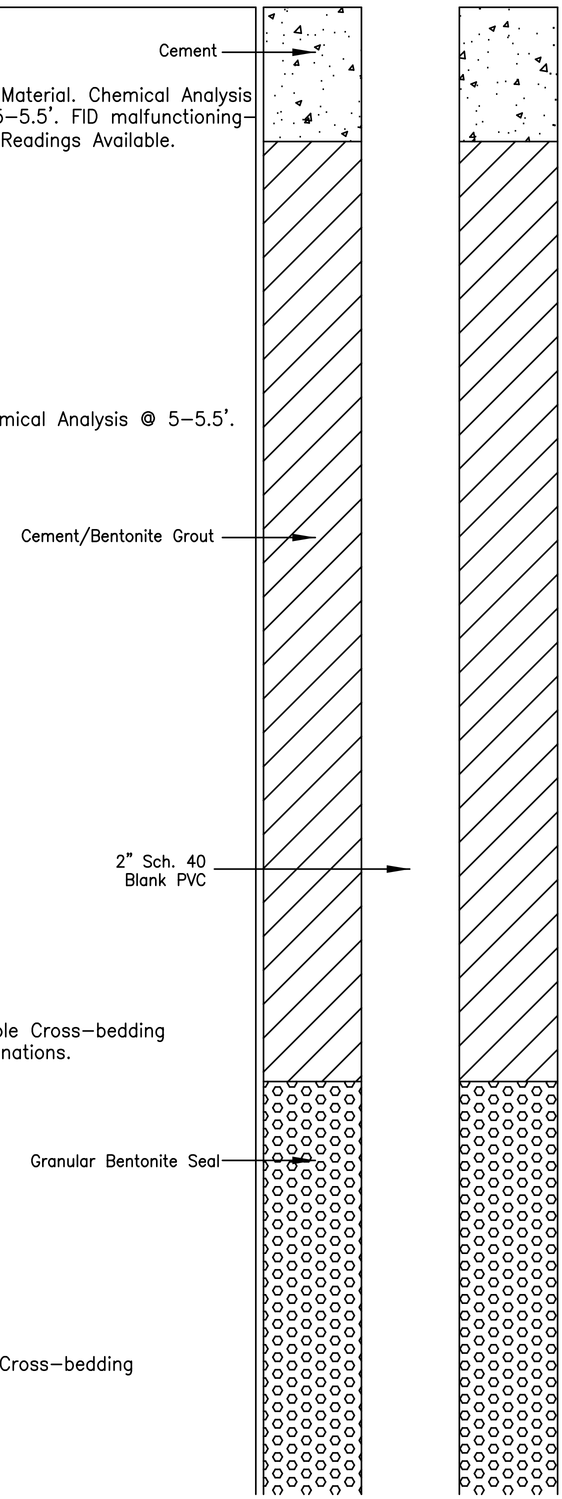
PROJECT No.: 2001206
TOP OF CASING ELEVATION: 153.33'
DRILLER: Juan Sifuentes
DATE BEGAN: 1-10-02
DRILLING METHOD: Hollow Stem Auger
CONTRACTOR: Gregg Drilling

LOCATION: North Side of Slauson Ave.between RR Tracks and LA River
PAGE: 1 of 2
DATE COMPLETED: 1-10-02
GWL DATE/TIME: -
DRILL EQUIPMENT: Marl M5-T Limited Access Rig

BORING No.: B-38
LOGGED BY: Jacques Marcillac
GWL DEPTH: -
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell, R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL
0					0–0.5' Asphalt		
		0		SM	SILTY SAND, 65% fine sand; 35% silt; dark yellowish brown (10YR 4/2); moist; no odor.		Fill Material. Chemical Analysis @ 5–5.5'. FID malfunctioning–No Readings Available.
5		0	X	SM	SILTY SAND, 60% fine sand; 30% silt; 10% clay; dark yellowish brown; moist; no odor.		Chemical Analysis @ 5–5.5'.
		0			Concrete (Former District Boulevard)		
10		0		SM	SILTY SAND, 75% fine sand; 25% silt; moderate yellowish brown (10YR 5/4); damp; no odor.		
		0		SM	SILTY SAND, 85% fine sand; 15% silt; light olive gray (5Y 5/2); damp; no odor.		
		0		SP	POORLY GRADED SAND, 95% fine sand; 5% silt; light olive gray (5Y 5/2); damp; no odor.		
15		0		SP–SM	POORLY GRADED SAND WITH SILT, 100% subrounded to subangular fine sand; light olive gray (5Y 5/2); damp; no odor.		Visible Cross–bedding laminations.
20		0		SP–SM	POORLY GRADED SAND WITH SILT, 100% subrounded to subangular fine sand; light olive gray (5Y 5/2); damp; no odor.		No Cross–bedding
		0		SM	SILTY SAND, 65% fine sand; 30% silt; 5% clay; light olive gray (5Y 5/2); moist; no odor.		

WELL CONSTRUCTION



T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
DATE COMPLETED: 1-10-02

LOCATION: North Side of Slauson Ave.between RR Tracks and LA River
PAGE: 2 of 2

BORING No.: B-38

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION (ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.)	GW ELEVATION	REMARKS (CONTINUOUSLY CORED WITH 4' CORE BARREL)	WELL CONSTRUCTION
22.5–25		0		SM	SILTY SAND, 65% fine sand; 30% silt; 5% clay; light olive gray (5Y 5/2); moist; no odor.			2" Sch.40 PVC Blank
25		0		ML	SANDY SILT, 50% silt; 40% sand; 10% clay; light olive gray (5Y 5/2); moist; no odor.		Mottled with moderate brown organic debris	Granular Bentonite Seal
28		0	X	SP	POORLY GRADED SAND, 95% subangular fine sand; 5% silt; light olive gray (5Y 5/2); moist; no odor.	∇	abundant mica; Wet @ 31.5'; Chemical Analysis @ 31.5–32'	0.010" Slotted Sch.40 2" PVC Screen; 2/16 Monterey Sand Filter
33		0	X	CH	FAT CLAY, 80% plastic clay; 20% silt; trace fine sand; olive gray (5Y 4/1); moist; soft; no odor.		Chemical Analysis @ 33.5–34'	
34.5					TD of Boring = 34.5'.			TD of Well = 34'.

Depth scale: 25, 30, 35, 40, 45

BORING LOG

T N & Associates, Inc.
Engineering and Science

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
TOP OF CASING ELEVATION: 153.78
DRILLER: Mike
DATE BEGAN: 11-8-01
DRILLING METHOD: DPT
CONTRACTOR: Vironex

LOCATION: South Side of Slauson Ave., North of Pemaco Site
PAGE: 1 of 2
DATE COMPLETED: 11-8-01
GWL DATE/TIME: -
DRILL EQUIPMENT: Geoprobe 6600

BORING No.: B-37
LOGGED BY: Jacques Marcillac
GWL DEPTH: -
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell, R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINOUSLY CORED WITH 4' CORE BARREL	WELL CONSTRUCTION
0		0		SW	WELL GRADED GRAVELLY SAND, 50% subrounded fine to coarse sand; 40% rounded to subrounded gravel to 15mm; 10% silt; moderate yellowish brown (10YR 5/4); dry; no odor.		Fill Material.	Cement
5		0	X	ML	SANDY SILT, 50% silt; 45% subangular fine to medium sand; 5% clay; dark yellowish brown (10YR 4/2); damp; no odor.		possible fill material Sample collected 6–6.5'.	3/8" Bentonite Chips
		0		SM	SILTY SAND, 65% fine sand; 35% silt; moderate olive brown (5Y 4/4); moist; no odor.			
10		0		SM	SILTY SAND, 60% fine sand; 40% silt; trace clay; dark yellowish brown (10YR 4/2); moist; no odor.		Asphalt debris 11.5–15' or burnt soil fused together.	1.5" Sch. 40 Blank PVC
15		0		SP	POORLY GRADED SAND, 100% subrounded to angular fine sand; trace silt; dusky yellow (5Y 6/4); damp; no odor.			
		0		SW	WELL GRADED SAND, 100% subrounded to subangular fine to coarse sand; dusky yellow (5Y 6/4); damp; no odor.		Clean "beach sand"	
		0		SM	SILTY SAND, 60% fine sand; 40% silt; dark yellowish brown (10YR 4/2); moist; no odor.		micaceous	
20		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.			

TN & A	T N & Associates, Inc. Engineering and Science	BORING LOG PEMACO, INC. MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
DATE COMPLETED: 11/8/01

LOCATION: South Side of Slauson Ave., North of Pemaco Site

BORING No.: B-37

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL	WELL CONSTRUCTION
		0		SP-SM	POORLY GRADED SAND WITH SILT, 90% fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.			
		0		ML	SANDY SILT, 60% silt; 30% fine sand; 10% clay; light olive gray (5Y 5/2); moist; no odor.			1.5" Sch.40 PVC Blank
25		0		SM	SILTY SAND, 55% fine sand; 45% silt; moderate olive brown (5Y 4/4); moist; no odor.		2" SP-SM interval @ 25'	3/8' Bentonite Chips
30		0		SP-SM	POORLY GRADED SAND WITH SILT, 90% sand; 10% silt; light olive gray; moist; no odor.			Pre-Pack Bentonite; 4" Foam Packer; Sand Filter
		0		ML	SANDY SILT, 55% silt; 35% sand; 10% clay; moderate olive brown (5Y 4/4); moist; no odor.			0.010" Sch.40 1.5" PVC Screen
		0	X	SP-SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); moist to saturated; no odor.	▽	Wet @ 33.5'. Saturated 34–35.5'. Chemical Analysis @ 33.5–34'.	
35		0		CH	SILTY FAT CLAY, 60% plastic clay; 40% silt; trace fine sand; olive gray (5Y 4/1); moist; medium stiff; no odor.		Higher Silt content with depth clayey silt 38–40'.	TD of Well = 36'.
40					TD of Boring = 40'.			
45								

BORING LOG

TN &A T N & Associates, Inc.
Engineering and Science

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
TOP OF CASING ELEVATION: 139.78
DRILLER: Mike
DATE BEGAN: 11-7-01
DRILLING METHOD: DPT
CONTRACTOR: Vironex

LOCATION: 15' South of MW-3 and 40' West of District Blvd.

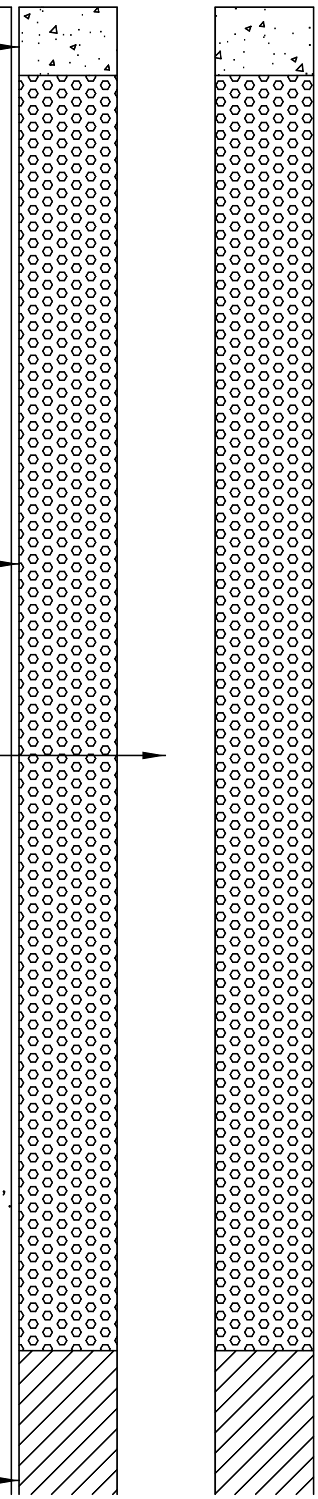
DATE COMPLETED: 11-7-01
GWL DATE/TIME: -
DRILL EQUIPMENT: Geoprobe 6600

BORING No.: B-36
LOGGED BY: Jacques Marcillac
GWL DEPTH: -
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell, R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINOUSLY CORED WITH 4' CORE BARREL
0		0		SP	POORLY GRADED SAND, 95% subangular fine sand; 5% silt; light olive gray (5Y 5/2); damp; no odor.		
5		0	X	SM	SILTY SAND, 80% subangular fine sand; 20% silt; moderate olive brown (5Y 4/4); moist; no odor.		Chemical Analysis @ 5–5.5'.
		0		SM	SILTY SAND, 65% subangular fine sand; 35% silt; light olive gray (5Y 5/2); moist; no odor.		
10		0		ML	CLAYEY SILT, 60% silt; 20% plastic clay; 20% sand; light olive gray (5Y 5/5) slightly mottled with moderate olive brown; moist; no odor.		
		0		SM	SILTY SAND, 55% fine sand; 35% silt; 10% clay; light olive gray (5Y 5/5); moist; no odor.		
15		0		ML	SANDY SILT, 60% silt; 30% fine sand; 10% clay; olive gray (5Y 4/1); moist; no odor.		
		0		SM	SILTY SAND, 55% fine sand; 40% silt; light olive gray (5Y 5/2); moist to wet; no odor.		
		0	X	SM	SILTY SAND, 80% subangular fine sand; 20% silt; moderate olive brown (5Y 4/4); saturated; no odor.		Chemical Analysis @ 17.5–18'.
		0		CL	SILTY LEAN CLAY, 60% semi-plastic clay; 40% silt; trace fine sand; olive gray (5Y 4/1); moist; no odor.		
20		0		SM	SILTY SAND, 55% subangular fine sand; 45% silt; olive gray (5Y 3/2); moist; no odor.		
		0		ML	CLAYEY SILT, 65% silt; 30% semi-plastic clay; 5% fine to medium sand; olive black (5Y 2/1); moist; possible faint unknown odor.		

WELL CONSTRUCTION

Cement
Bentonite
1.5" Sch. 40 Blank PVC
Pre-Pack Bentonite



T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
DATE COMPLETED: 11/7/01
LOCATION: 15' South of MW-3 and 40' West of District Blvd.

BORING No.: B-36

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL	WELL CONSTRUCTION
		0			ML	CLAYEY SILT, 65% semi–plastic silt; 30% clay; 5% fine to medium sand; olive black (5Y 5/2); moist; possible faint unknown odor.			Pre–Pack Bentonite; 4" Foam Packer
		0			SM	SILTY SAND, 70% subangular fine sand; 30% silt; olive gray (5Y 4/1); wet; no odor.			
25		0			SM	SILTY SAND, 70% subangular fine sand; 30% silt; olive gray (5Y 4/1); saturated; no odor.			0.010" Slotted Sch.40 1.5" PVC Screen
			X			FAT CLAY, 50% plastic clay; 35% silt; 15% fine to medium sand; dark yellowish brown (10YR 4/2) mottled with olive gray; moist; no odor.		Chemical Analysis collected @ 27–27.5'.	Sand Filter
		0			CH				
						TD of Boring = 28'.			TD of Well = 28'.
30									
35									
40									
45									

BORING LOG

T N & Associates, Inc.
Engineering and Science

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
TOP OF CASING ELEVATION: 138.03
DRILLER: Mike
DATE BEGAN: 11-7-01
DRILLING METHOD: DPT
CONTRACTOR: Vironex

LOCATION: 45' N of 60th St. and 70' W. of District Blvd.

DATE COMPLETED: 11-7-01
GWL DATE/TIME: -
DRILL EQUIPMENT: Geoprobe 6600

BORING No.: B-35
LOGGED BY: Jacques Marcillac
GWL DEPTH: -
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell, R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL	WELL CONSTRUCTION
0					0–1' Gravelly fill with Asphalt Chunks.			Cement
		0		SM	SILTY SAND, 80% fine sand; 20% silt; moderate olive brown (5Y 4/4); moist; no odor.			
		0		CL	SILTY LEAN CLAY, 60% non–plastic clay; 40% silt; trace fine sand; olive gray (5Y 4/1); wet; no odor.		Moisture due to rains last week.	
5		0	X	SM	SILTY SAND, 85% fine sand; 15% silt; dark yellowish brown (10YR 4/2); moist; no odor.		Chemical Analysis @ 5–5.5'	
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine to medium sand; 10% silt; light olive gray (5Y 5/2); moist; no odor.			
10		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine to medium sand; 10% silt; light olive gray (5Y 5/2); moist; no odor.			Cement/Bentonite Grout 1.5" Sch. 40 Blank PVC
		0		SM	SILTY SAND, 70% fine sand; 30% silt; dark yellowish brown (10YR 4/2); moist; no odor.			
15		0		ML	SANDY SILT, 55% silt; 40% fine sand; 5% clay; light olive gray (5Y 5/2); moist; no odor.			
		0		ML	SANDY SILT, 75% silt; 20% fine sand; 5% clay; olive gray (5Y 4/1); moist to wet; no odor.		Wet @ 17'.	
		0	X	SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); wet to saturated; no odor.	▽	Saturated @ 18'. Chemical Analysis @ 18–18.5'	
20		0		CL	SILTY CLAY WITH SAND, 50% semi–plastic clay; 40% silt; 10% fine sand; olive black (5Y 2/1); moist; no odor.			
		0		SM	SILTY SAND, 70% subangular fine sand; 30% silt; light olive gray (5Y 5/2); moist to wet; no odor.			

T N & Associates, Inc.
Engineering and Science

BORING LOG

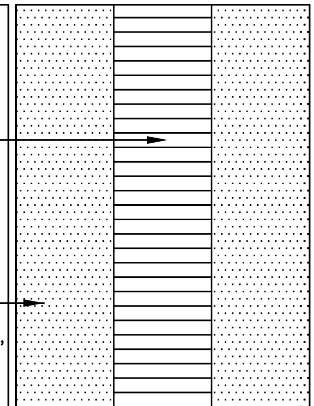
PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
DATE COMPLETED: 11/7/01

LOCATION: 45' N of 60th St. and 70' W of District Blvd.

BORING No.: B-35

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL	WELL CONSTRUCTION
		0			SM	SILTY SAND, 80% fine sand; 20% silt; light olive gray (5Y 5/2); wet; no odor.			
25		0			SM	SILTY SAND, 65% fine sand; 30% silt; 5% clay; light olive gray (5Y 5/2); saturated; no odor.		0.010" Sch.40 1.5" PVC Screen; Sand Filter; Chemical Analysis @ 27–27.5'	
		0			CH	FAT CLAY, 50% very plastic clay; 30% silt; 20% fine to medium sand; moderate brown (5YR 4/4) mottled with olive gray; moist; stiff; no odor.			TD of Well = 28'.
						TD of Boring = 28'.			
30									
35									
40									
45									



T N & Associates, Inc. Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

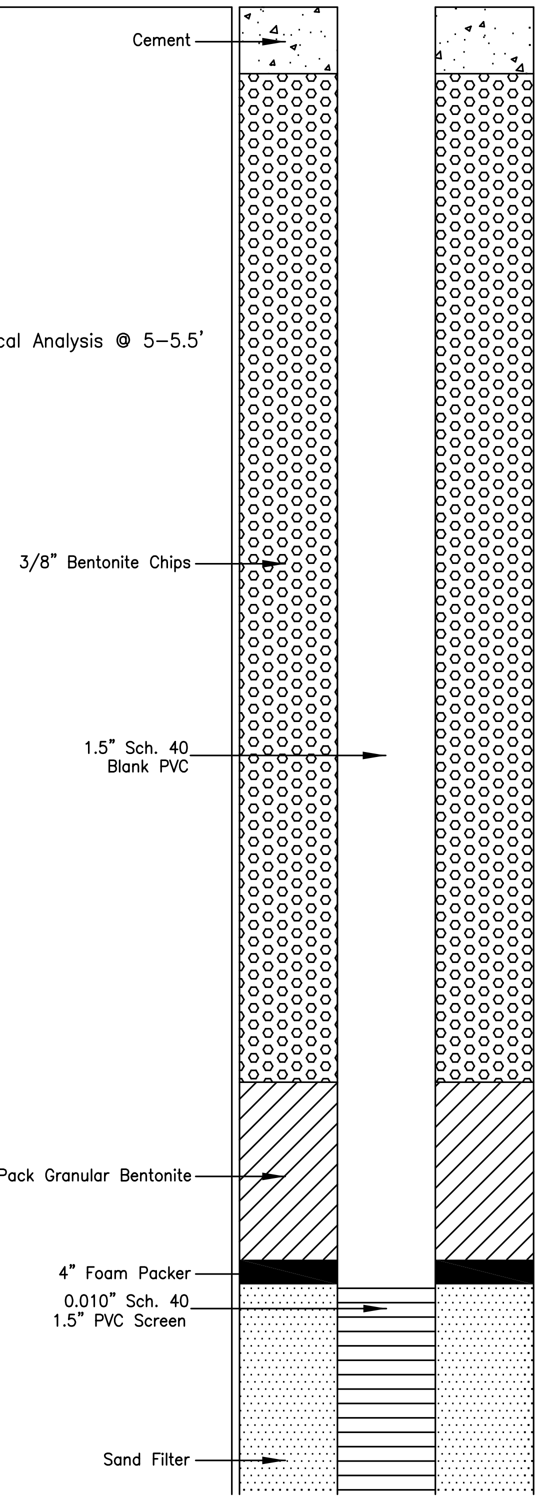
PROJECT No.: 2001206
TOP OF CASING ELEVATION: 137.21
DRILLER: Mike
DATE BEGAN: 11-8-01
DRILLING METHOD: DPT
CONTRACTOR: Vironex

LOCATION: NW Corner of District Blvd./ 60th St.
PAGE: 1 of 2
DATE COMPLETED: 11-8-01
GWL DATE/TIME: -
DRILL EQUIPMENT: Geoprobe 6600

BORING No.: B-34
LOGGED BY: Jacques Marcillac
GWL DEPTH: -
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell, R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL
0					0–4" Concrete		
		0		SP	POORLY GRADED SAND, 95% subangular fine sand; 5% silt; light olive gray (5Y 5/2); damp; no odor.		
		0.7		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; dark yellowish brown (10YR 4/2); moist; no odor.		
5		–	X	SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); moist; no odor.		Chemical Analysis @ 5–5.5'
10		1.1		SM	SILTY SAND, 60% subangular fine sand; 40% silt; dark yellowish brown (10YR 4/2); moist; no odor.		
		1.6		ML	SANDY SILT, 60% silt; 40% subangular fine sand; dark yellowish brown (10YR 4/2); moist; no odor.		
15		0		ML	SANDY SILT WITH CLAY, 60% silt; 25% subangular fine sand; 15% clay; dark yellowish brown (10YR 4/2); moist; no odor.		
		1.6		ML	CLAYEY SILT WITH SAND, 50% non–plastic silt; 35% clay; 15% fine sand; olive gray (5Y 4/1); wet; soft; no odor.		
		0.7		SM	SILTY SAND, 80% fine sand; 20% silt; light olive gray (5Y 5/2); damp; no odor.		
20		0.7		ML	CLAYEY SILT WITH SAND, 45% silt; 30% clay; 25% fine sand; dusky yellowish brown (10YR 2/2); moist to wet; no odor.		
		2.1		SM	SILTY SAND, 55% fine sand; 35% silt; 10% clay; olive gray (5Y 4/1); moist to wet; no odor.		

WELL CONSTRUCTION



T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
DATE COMPLETED: 11/8/01

LOCATION: NW Corner of District Blvd./ 60th St.

BORING No.: B-34

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL	WELL CONSTRUCTION
					SM	SILTY SAND, 55% fine sand; 35% silt; 10% olive gray (5Y 4/1); moist to wet; no odor.	▽		0.010" Slotted Sch. 40 1.5" PVC Screen
		1.1	X		ML/SM	SANDY SILT/SILTY SAND, 60% silt; 30% fine sand; 10% clay; olive gray (5Y 4/1); saturated; no odor.		Wet @ 22–23' Chemical Analysis @ 22.5–23'	Sand Filter
		–	X		CH	FAT CLAY, 50% very plastic clay; 35% silt; 15% fine to medium sand; moderate brown (5YR 3/4) mottled with olive gray; moist; stiff; no odor.		Chemical Analysis @ 23.5–24'	TD of Well = 24'.
25						TD of Boring = 24'.			
30									
35									
40									
45									

T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

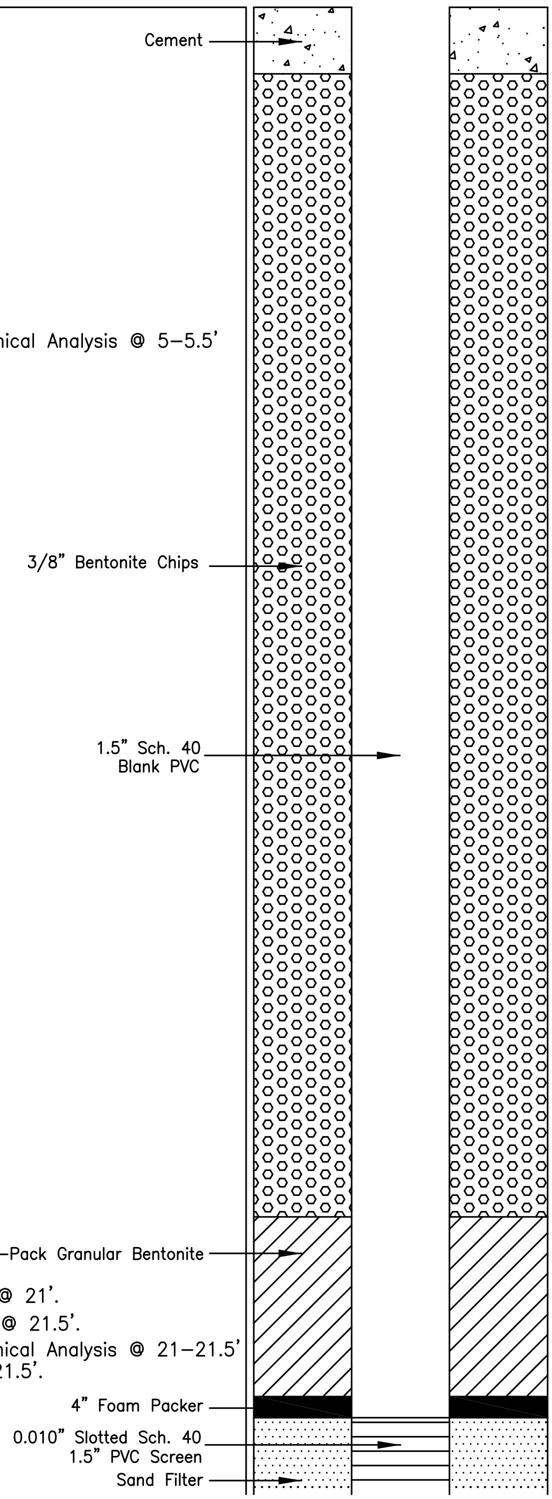
PROJECT No.: 2001206
TOP OF CASING ELEVATION: 137.59
DRILLER: Mike
DATE BEGAN: 11-7-01
DRILLING METHOD: DPT
CONTRACTOR: Vironex

LOCATION: In District Blvd. between 59th Place and 60th St.
PAGE: 1 of 2
DATE COMPLETED: 11-7-01
GWL DATE/TIME: -
DRILL EQUIPMENT: Geoprobe 6600

BORING No.: B-33
LOGGED BY: Jacques Marcillac
GWL DEPTH: -
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell, R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL
0					0–4" Concrete		
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); moist; no odor.		
		0		SM	SILTY SAND, 80% fine sand; 20% silt; dark yellowish brown (10YR 4/2); moist; no odor.		
5		0	X	SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.		Chemical Analysis @ 5–5.5'
		0		ML	SANDY SILT, 55% silt; 40% fine sand; 5% clay; olive gray (5Y 3/2); moist; no odor.		
10		0		SM	SILTY SAND, 70% fine sand; 30% silt; light olive gray (5Y 5/2); moist; no odor.		
		0		ML	SANDY SILT, 60% silt; 30% sand; 10% clay; light olive gray (5Y 5/2); moist; no odor.		
		0		SP	POORLY GRADED SAND, 95% fine sand; 5% silt; light olive gray (5Y 5/2); damp; no odor.		
15		0		ML	CLAYEY SILT, 50% silt; 30% clay; 20% fine sand; brownish gray (5YR 4/1); moist; no odor.		
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); moist to wet; no odor.		Wet @ 21'. Sat. @ 21.5'. Chemical Analysis @ 21–21.5' 21–21.5'.
20		0		CL	SILTY LEAN CLAY, 70% semi-plastic clay; 25% silt; 5% fine sand; olive gray (5Y 4/1); moist; no odor.		
		0	X	SM	SILTY SAND, 65% fine sand; 30% silt; 5% clay; olive gray (5Y 4/1); moist to saturated; no odor.	▽	

WELL CONSTRUCTION



T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2001206
DATE COMPLETED: 11/7/01

LOCATION: In District Blvd. between 59th Pl. and 60th St.
PAGE: 2 of 2

BORING No.: B-33

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH 4' CORE BARREL	WELL CONSTRUCTION
		0			SM	SILTY SAND, 65% fine sand; 30% silt; 5% clay; olive gray (5Y 4/1); moist to saturated; no odor.			
		0			ML	CLAYEY SILT, 70% silt; 20% clay; 10% fine sand; olive gray (5Y 4/1); moist; no odor.		0.010" Slotted Sch.40 1.5" PVC Screen	
25		0			SM	SILTY SAND, 65% fine sand; 35% silt; trace clay; light olive gray (5Y 5/2); saturated; no odor.		Sand Filter	
		0			CL	LEAN CLAY, 70% non-plastic clay; 30% silt; trace fine sand; olive black (5Y 2/1); moist; no odor.			TD of Well = 26'.
		0			CH	FAT CLAY, 50% very plastic clay; 35% silt; 15% fine to medium sand; moderate brown (5YR 3/4) mottled with olive gray; moist; stiff; no odor.			
						TD of Boring = 28'.			
30									
35									
40									
45									

TN & A	T N & Associates, Inc. Engineering and Science

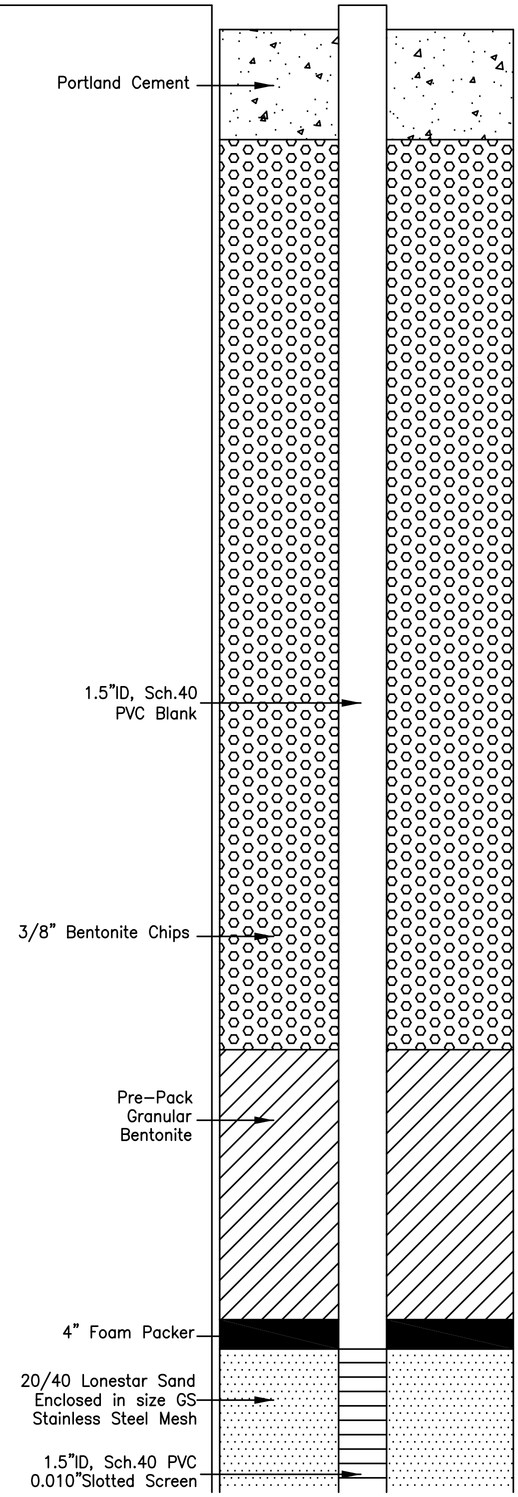
BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126	LOCATION: Precision Arrow Ppty near Rear Loading Docks, 28' S.W. of fence, 193' North of sidewalk	BORING No.: **B-32**
TOP OF CASING ELEVATION: 141.45'	PAGE: 1 of 2	
DRILLER: Darryl		LOGGED BY: Jacques Marcillac
DATE BEGAN: 04/17/01	DATE COMPLETED: 04/17/01	GWL DEPTH: 20.70'
DRILLING METHOD: Direct Push	GWL DATE/TIME: 6/5/01	GWL EQUIPMENT: water level meter
CONTRACTOR: Vironex	DRILL EQUIPMENT: Geoprobe	CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE
0						Gravelly fill		
		0 0			SP–SM	POORLY GRADED SAND WITH SILT, 90% sub–angular fine sand; 10% silt; moderate olive brown (5Y 4/4); damp; no odor.		
		0			SP	POORLY GRADED SAND, 100% fine to medium sand; dusky yellow (5Y 6/4); damp; no odor.		
5		0			SM	SILTY SAND, 75% fine sand; 25% silt; dark yellowish brown (5YR 4/2); moist; no odor.		
10		0			SP–SM	POORLY GRADED SAND WITH SILT, 90% sub–angular fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.		
		0			SM	SILTY SAND, 75% subangular fine sand; 25% silt; moderate olive brown (5Y 4/4); moist; no odor.		
15		0			SP–SM	POORLY GRADED SAND WITH SILT, 90% sub–angular fine sand; 10% silt; light olive gray (5Y 5/2); damp; no odor.		
		0			ML	SANDY SILT, 50% silt; 45% fine sand; 5% clay; light olive gray (5Y 5/2); moist to wet; no odor.		
20		0			SM	SILTY SAND, 65% fine sand, 35% silt; trace clay; moderate olive brown (5Y 4/4); moist; no odor.	∇	
		0			SP–SM	POORLY GRADED SAND WITH SILT, 90% sub–angular fine sand; 10% silt; light olive gray (5Y 4/4); slightly mottled with moderate brown (5YR 4/4); moist to wet.		

WELL CONSTRUCTION



T N & Associates, Inc.
Engineering and Science

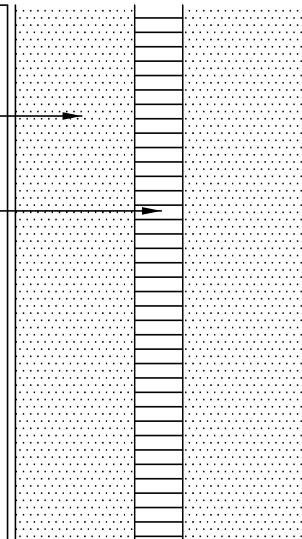
BORING LOG
PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/17/01

LOCATION: Precision Arrow Property near rear Loading Docks, 28' S.W. of fence, 193' N. of sidewalk

BORING No.: B-32

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH MACROCORE	WELL CONSTRUCTION
		0			SP-SM	POORLY GRADED SAND WITH SILT, 90% sub-angular fine sand; 10% silt; light olive gray (5Y 5/2) slightly mottled with moderate brown (5YR 3/4); moist to wet.			
		0			CL	LEAN CLAY, 65% semi-plastic clay; 35% silt; olive gray (5Y 4/1); moist; no odor.		20/40 Lonestar Sand Enclosed in size GS Stainless Steel Mesh	
25		0 0			CL	LEAN CLAY, 55% semi-plastic clay; 40% silt; 5% fine sand; olive gray (5Y 4/1); moist; no odor.		1.5"ID, Sch.40 PVC .010" Slotted Screen	
		0			ML	SANDY SILT, 55% silt; 35% fine sand; 10% clay; light olive gray (5Y 5/2); moist to wet; no odor.			
		0.9			ML	SANDY SILT, 55% silt; 40% fine sand; 5% clay; light olive gray (5Y 5/2); wet to saturated; no odor.			
30		0			CL	LEAN CLAY, 75% semi-plastic clay; 25% silt; olive gray (5Y 4/1); moist; no odor.			Well TD = 30'
35		0.9				ORGANIC SOIL, 75% non-plastic clay; 20% silt; 5% fine sand; olive black (5Y 2/1); moist; no odor; easily compressible, very soft.			
		0			CH	FAT CLAY, 50% plastic clay; 40% silt; 10% fine sand; olive gray (5Y 4/1) mottled with moderate yellowish brown (10YR 5/4) and white (N9); moist; no odor. abundant calcite veining			
40 45						Boring TD = 38'			



T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

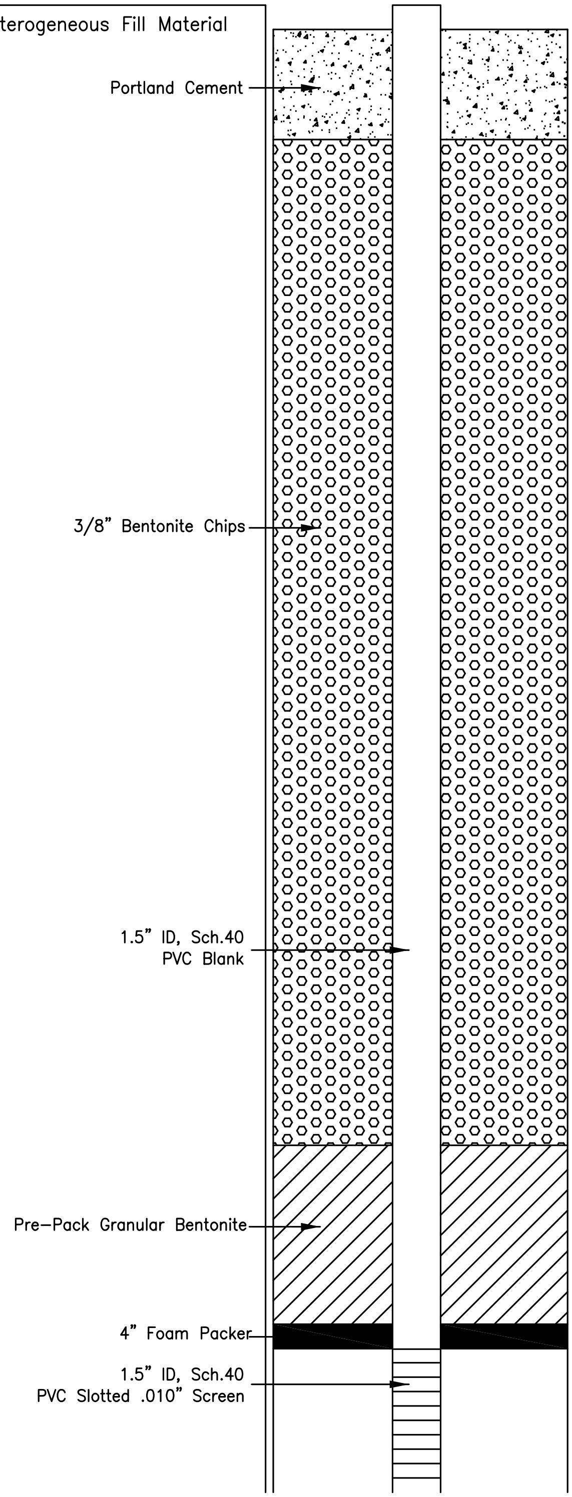
PROJECT No.: 2000126
TOP OF CASING ELEVATION: 140.38'
DRILLER: Craig
DATE BEGAN: 4/16/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

LOCATION: N.E. of W.W. Henry, near Arrow Property, 70' S.W. of RR row fence, 140' N. of sidewalk
PAGE: 1 of 2
DATE COMPLETED: 4/16/01
GWL DATE/TIME: 6/5/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-31
LOGGED BY: Jacques Marcillac
GWL DEPTH: 19.68'
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH MACROCORE
0		0		GM	SILTY GRAVEL WITH SAND, 40% subrounded 20mm gravel; 30% sand; 20% silt; 10% clay; well graded; moist; no odor.		Heterogeneous Fill Material
		0		SP–SM	POORLY GRADED SAND, 90% fine to medium sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.		
		0		CL	LEAN CLAY, 70% semi-plastic clay; 30% silt; olive gray (5Y 4/1); moist; no odor.		
5		0		SM	SILTY SAND, 80% fine sand; 20% silt; moderate olive brown (5Y 4/4); moist; no odor.		
10		0		SM	SILTY SAND, 65% fine sand; 35% silt; moderate olive brown (5Y 4/4); moist; no odor.		
		0		SM	SILTY SAND, 55% fine sand; 35% silt; 10% clay; light olive brown (5Y 5/6); moist; no odor.		
		0		SM	SILTY SAND, 85% subangular fine sand; 15% silt; light olive brown (5Y 5/2); moist; no odor.		
15		0		ML	SANDY SILT, 50% silt; 40% fine sand; 10% clay; olive gray (5Y 4/1); moist; no odor.		
		0		ML	SANDY SILT, 65% silt; 30% fine sand; 5% clay; moderate olive brown (5Y 4/4); moist to wet; no odor.		
		14.3		SM	SILTY SAND, 85% fine sand; 15% silt; light olive brown (5Y 5/2); wet; weak petroleum odor.	∇	
20		6.8		SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; light olive gray; moist; faint petroleum odor.		
		196		SM	SILTY SAND, 80% fine sand; 20% silt; moderate olive brown (5Y 4/4); saturated; strong petroleum odor.		

WELL CONSTRUCTION



T N & Associates, Inc. Engineering and Science	BORING LOG PEMACO, INC. MAYWOOD, CALIFORNIA

PROJECT No.: 2000126

DATE COMPLETED: 4/16/2001

LOCATION: N.E. portion of W.W. Henry, near Arrow Property, 70' S.W. of RR row fence, 140' N. of sidewalk

PAGE: 2 of 2

BORING No.: B-31

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH MACROCORE	WELL CONSTRUCTION
		196			SM	SILTY SAND, 80% fine sand; 20% silt; moderate olive brown (5Y 4/4); saturated; strong petroleum odor.		20/40 Lone Star Sand enclosed in size 65 Stainless Steel Mesh 1.5" ID Sch.40 PVC Slotted 0.010" Screen	
25		163			CL	LEAN CLAY, 70% semi-plastic clay; 30% silt; olive black (5Y 2/1); moist; moderate petroleum odor.			Well T.D. = 25'
		12.3			CL	LEAN CLAY, 55% semi-plastic clay; 40% silt; 5% sand; grayish olive (10Y 4/2); moist; faint petroleum odor.			
						Total Depth = 26'			
30									
35									
40									
45									

T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
TOP OF CASING ELEVATION:
DRILLER: Darryl
DATE BEGAN: 4/16/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

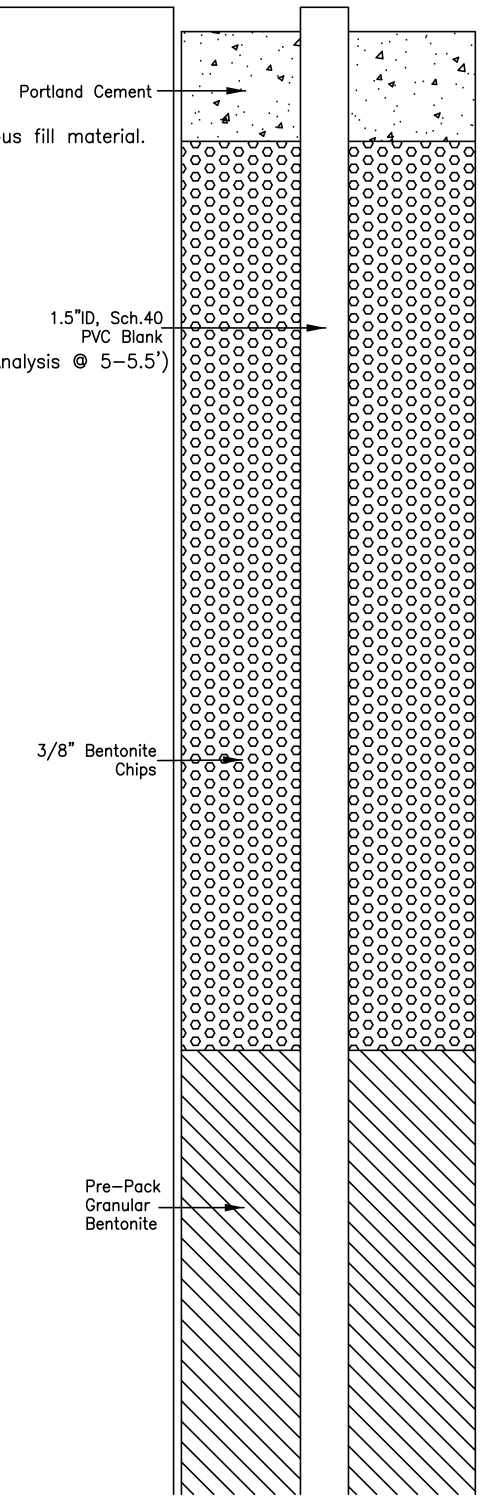
LOCATION: Center of W.W. Henry Site Center
PAGE: 1 of 2
DATE COMPLETED: 4/16/01
GWL DATE/TIME: 4/18/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-30

LOGGED BY: Jacques Marcillac
GWL DEPTH: 22.22
GWL EQUIPMENT: water level meter
CHECKED BY: Tim Garvey

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE
0		0		ML	GRAVELLY SILT WITH SAND, 35% silt; 30% clay; 20% subangular 20mm gravel; 15% sand; light olive brown (5Y 5/6); moist; no odor.		Heterogeneous fill material.
		0		SM	SILTY SAND, 60% fine to coarse sand; 40% silt; moderate olive brown (5Y 4/4); damp; no odor.		Fill Material
5		0	X	SP–SM	POORLY GRADED SAND WITH SILT, 90% fine sand; 10% silt; moderate olive brown (5Y 4/4); damp; no odor.		(Chemical Analysis @ 5–5.5')
		0		SM	SILTY SAND, 70% fine sand; 30% silt; dark yellowish brown (10YR 4/2); damp; no odor.		
		0		SM	SILTY SAND, 85% fine sand; 15% silt; dark yellowish brown; damp; no odor.		
10		0		SP	POORLY GRADED SAND, 95% subangular fine sand; 5% silt; dusky yellow (5Y 6/4); damp; no odor.		
15		0		SM	SILTY SAND, 65% fine sand; 30% silt; 5% clay; moderate olive brown (5Y 4/4); moist; no odor.		
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); damp; no odor.		
20		0		SM	SANDY SILT, 60% silt; 40% fine sand; 5% clay; olive gray; moist; no odor.		
		10.4		ML	SILT WITH SAND, 50% silt; 35% clay; 15% fine sand; olive gray (5Y 4/1); moist; weak petroleum odor.		

WELL CONSTRUCTION



TN & A — T N & Associates, Inc. Engineering and Science	**BORING LOG** PEMECO, INC. MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/17/2001
LOCATION: Center of W.W. Henry Site Center

BORING No.: B-30

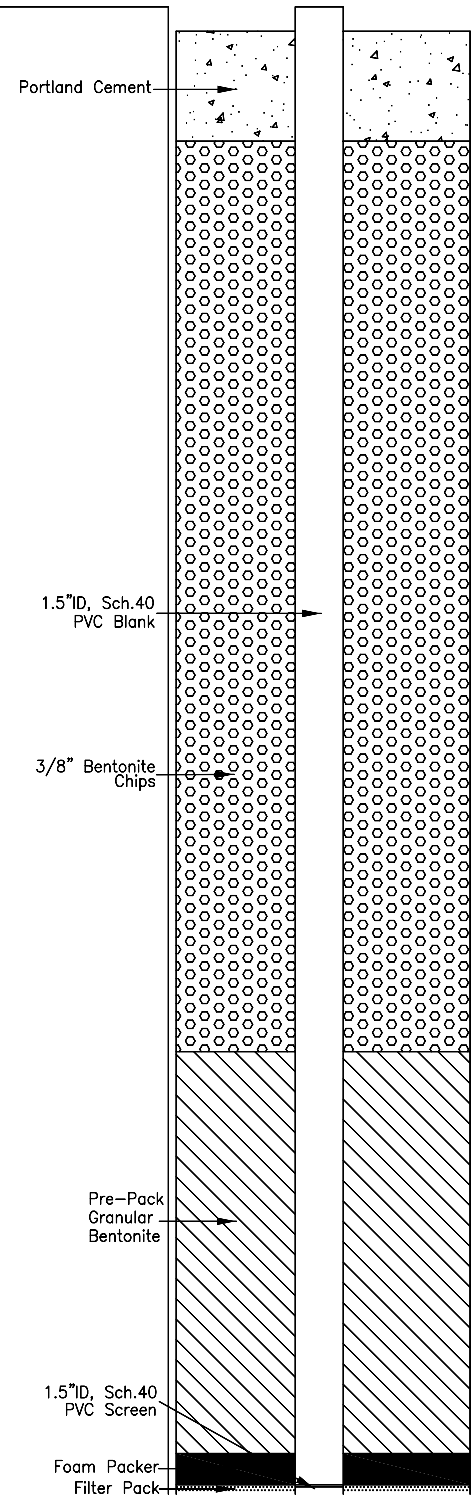
DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE	WELL CONSTRUCTION
		10.4			ML	SILT WITH SAND, 50% silt; 35% clay; 15% fine sand; olive gray (5Y 4/1); moist; weak petroleum odor.			1.5"ID, Sch.40 PVC Blank; Pre–Pack Granular Bentonite Foam Packer
		127			SP	POORLY GRADED SAND, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); wet to saturated; strong petroleum odor.			
25		45			SM	SILTY SAND, 85% subangular fine sand; 15% silt; moderate olive gray (5Y 4/4); saturated; moderate petroleum odor.			Filter Pack
		2.5			CL	LEAN CLAY, 80% semi–plastic clay; 20% silt; olive black (5Y 2/1); moist; faint petroleum odor.			1.5"ID, Sch.40 PVC Screen
						Boring TD = 28' bg			Well TD = 28' bg
30									
35									
40									
45									

TN&A T N & Associates, Inc. Engineering and Science	**BORING LOG** PEMACO, INC. MAYWOOD, CALIFORNIA

PROJECT No.: 2000126	LOCATION: In Front of 5114 59th Street.	**BORING No.: B-29**
TOP OF CASING ELEVATION:	PAGE: 1 of 2	
DRILLER: Darryl		LOGGED BY: Jacques Marcillac
DATE BEGAN: 4/17/01	DATE COMPLETED: 4/17/01	GWL DEPTH: 26.60
DRILLING METHOD: Direct Push	GWL DATE/TIME: 4/24/01	GWL EQUIPMENT: water level meter
CONTRACTOR: Vironex	DRILL EQUIPMENT: Geoprobe	CHECKED BY: Tim Garvey

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE
0						3" Asphalt		
		0			SP	POORLY GRADED SAND, 90% subangular fine sand; 5% silt; light olive gray (5Y 5/2); moist; no odor.		
		0			SM	SILTY SAND, 70% sand; 30% silt; dark yellow brown (10YR 4/2); moist; no odor.		
5		0			SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; moderate olive brown (5Y 4/4); damp; no odor.		
		0			SP–SM	POORLY GRADED SAND WITH SILT, 90% fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.		
		2.8			SP	POORLY GRADED SAND, 95% subangular fine sand; 5% silt; light olive gray (5Y 5/2); moist; no odor.		
10		0.9			SM	SANDY SILT, 55% silt; 40% subangular fine sand; 5% clay; light olive gray, slightly mottled with moderate brown; moist; no odor.		
15		0.9			CL	LEAN CLAY, 70% semi-plastic clay, 30% silt; light olive gray (5Y 5/2); moist; no odor.		
		0			ML	CLAYEY SILT, 50% silt; 35% clay; 15% fine sand; light olive gray (5Y 5/2); moist; no odor.		
		0			SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; light olive gray slightly mottled with moderate brown; moist; no odor.		
20		0.9			CL	LEAN CLAY, 55% semi-plastic clay; 40% silt; 5% fine sand; olive gray (5Y 3/2); moist; no odor.		

WELL CONSTRUCTION



T N & Associates, Inc.
Engineering and Science

BORING LOG
PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/17/2001
LOCATION: In Front of 5114 59th St.

BORING No.: B-29

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION (ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.)	GW ELEVATION	REMARKS (CONTINUOUS CORING WITH MACROCORE)	WELL CONSTRUCTION
		2.8			SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; light olive gray (5Y 5/2); moist; no odor.			
		213			CL	LEAN CLAY, 60% semi-plastic clay; 35% silt; 5% fine sand; dark greenish gray (5GY 4/1); moist; moderate petroleum odor.		1.5"ID Sch.40 PVC Screen	
25		66			SM	SILTY SAND, 70% fine sand; 30% silt; medium dark gray (N4); moist to wet; moderate petroleum odor.			
		21			SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; olive gray (5Y 4/1); saturated; faint petroleum odor.	▽	Filter Pack	
		2.8			CH	FAT CLAY, 50% plastic clay; 40% silt; 10% sand; moderate brown, heavily mottled with olive gray; moist; no odor.			Well TD = 27' bg
						Boring TD = 28'bg			
30									
35									
40									
45									

TN & A T N & Associates, Inc. Engineering and Science

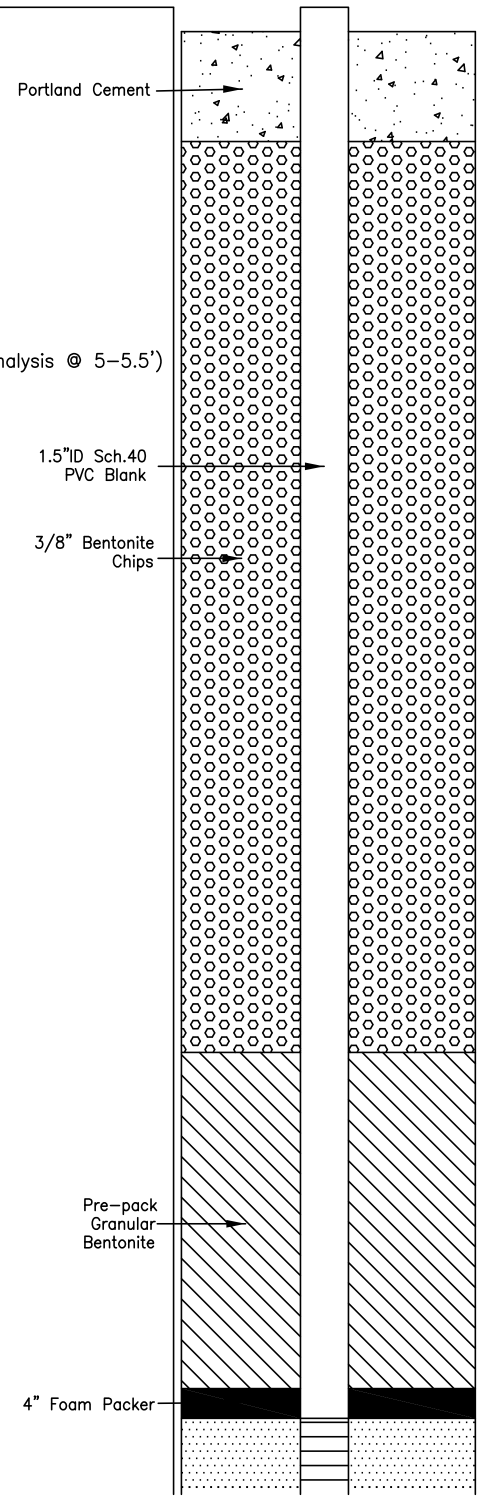
BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126	LOCATION: In Front of 5114 59th Street.	**BORING No.: B-28**
TOP OF CASING ELEVATION: 138.67	PAGE: 1 of 2	
DRILLER: Darryl		LOGGED BY: Jacques Marcillac
DATE BEGAN: 4/17/01	DATE COMPLETED: 4/17/01	GWL DEPTH: 25.01
DRILLING METHOD: Direct Push	GWL DATE/TIME: 4/24/01	GWL EQUIPMENT: water level meter
CONTRACTOR: Vironex	DRILL EQUIPMENT: 18" Augers/12" Augers	CHECKED BY: Tim Garvey

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE
0						3" Asphalt		
		0			SM	SILTY SAND, 75% subangular fine sand; 25% silt; moderate olive brown (5Y 4/4); damp to moist; no odor.		
		0			SM	SILTY SAND, 70% subangular fine sand; 30% silt; dark yellowish brown (10YR 4/2); damp; no odor.		
5			X					(Chemical Analysis @ 5–5.5')
		2.8			SM	SILTY SAND, 75% subangular fine sand; 25% silt; moderate olive brown (5Y 4/4); damp; no odor.		
					SP–SM	POORLY GRADED SAND WITH SILT, 90% sub-angular fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.		
10		2.8						
		0			SP	POORLY GRADED SAND, 95% fine sand; 5% silt; light olive brown (5Y 5/6); moist; no odor.		
15		4.7			ML	SANDY SILT, 60% silt; 30% fine sand; 10% clay; medium dark gray (N4); moist; faint sweet odor.		
		2.8			CL	LEAN CLAY, 55% semi-plastic clay; 40% silt; 5% fine sand; olive gray (5Y 4/1); moist; possible faint sweet odor.		
		86			SP–SM	POORLY GRADED SAND WITH SILT, 90% sub-angular fine sand; 10% silt; light olive brown (5Y 5/2); moist to wet; weak sweet odor.		
20		12.3			CL	LEAN CLAY, 65% semi-plastic clay, 30% silt; 5% fine sand; olive gray (5Y 4/1); moist; faint sweet odor.		
		170			CL	LEAN CLAY, 60% semi-plastic clay, 40% silt; trace sand; olive gray (5Y 4/1); moist; weak petroleum odor.		

WELL CONSTRUCTION



TN & A T N & Associates, Inc. Engineering and Science

BORING LOG

PEMECO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/17/2001

LOCATION: In Front of 5114 59th St.

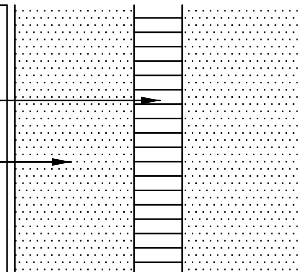
BORING No.: B-28

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	REMARKS CONTINUOUS CORING WITH MACROCORE
		8.5	SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; light olive gray (5Y 5/2); wet; faint petroleum odor.	(Chemical Analysis @ 22–22.5')
25		23	SM	SILTY SAND, 80% fine sand; 20% silt; light olive gray; wet to saturated; faint petroleum odor.	(Chemical Analysis @ 25–25.5')
		66	CL	LEAN CLAY, 60% semi–plastic clay; 40% silt; trace sand; olive gray (5Y 4/1) mottled with olive black; moist; weak petroleum odor.	Well found to contain free product during well development (4–24–01)
		31	CH	FAT CLAY, 50% plastic clay; 45% silt; 5% fine to medium sand; moderate brown (5YR 4/4) mottled with olive gray; moist; weak petroleum odor.	
				Boring TD = 28'bg	
30					
35					
40					
45					

WELL CONSTRUCTION

1.5"ID Sch.40 .010" Slotted PVC Screen

20/40 Lonestar Sand Enclosed in size 65 Stainless Steel Mesh



Well TD = 26'bg

T N & Associates, Inc. — Engineering and Science

BORING LOG
PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
TOP OF CASING ELEVATION: 138.67
DRILLER: Darryl
DATE BEGAN: 4/17/01
DRILLING METHOD: Direct Push
CONTRACTOR: Uronex

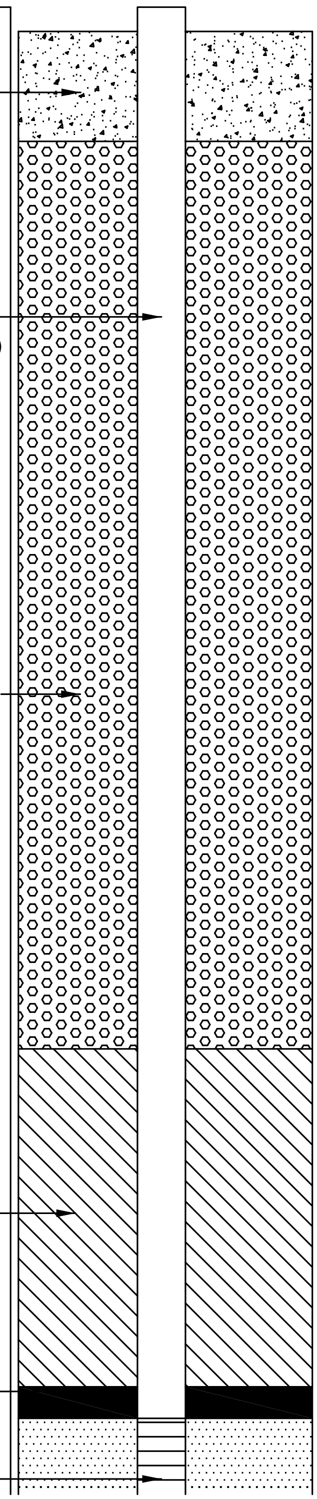
LOCATION: In Front of 5124 59th Street.
PAGE: 1 of 2
DATE COMPLETED: 4/17/01
GWL DATE/TIME: 4/24/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-27
LOGGED BY: Jacques Marcillac
GWL DEPTH: 21.51
GWL EQUIPMENT: water level meter
CHECKED BY: Tim Garvey

DEPTH (feet): 0, 5, 10, 15, 20

PID (ppm)	USCS	DESCRIPTION (ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.)	REMARKS (CONTINUOUSLY CORED WITH MACROCORE)
		3" Asphalt	
0	SM	SILTY SAND, 75% subangular fine sand; 25% silt; moderate olive brown (5Y 4/4); moist; no odor.	
0	SM	SILTY SAND, 70% fine sand; 30% silt; dark yellowish brown (10YR 4/2); moist; no odor.	(Chemical Analysis @ 5–5.5')
0	SM	SILTY SAND, 80% fine sand; 20% silt; light olive gray (5Y 5/2); moist; no odor.	
0	SM	SILTY SAND, 85% subangular fine sand; 15% silt; light olive gray (5Y 5/2); moist; no odor.	
0	SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); damp; no odor.	
2.8	ML	SILT WITH SAND, 75% silt; 15% fine sand; 10% clay; olive gray (5Y 4/1); moist; faint sweet odor.	
8.5	SM	SILTY SAND, 70% fine sand; 25% silt; 5% clay; light olive gray; moist; weak sweet odor.	
127	SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; moderate olive brown (5Y 4/4); moist; moderate petroleum odor.	
21	SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); moist; weak petroleum odor.	
213	CL	LEAN CLAY, 60% semi–plastic clay; 40% silt; olive black (5Y 2/1); moist; moderate petroleum odor.	(Chemical Analysis @ 20.5–21')
4.7	SM	SILTY SAND, 65% fine sand; 35% silt; trace clay; light olive gray (5Y 5/2); moist to wet; faint sweet odor.	

WELL CONSTRUCTION



TN &A T N & Associates, Inc. Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/17/2001

LOCATION: In Front of 5124 59th St.

BORING No.: B-27

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE	WELL CONSTRUCTION
		4.7			SM	SILTY SAND, 65% fine sand; 35% silt; trace clay; light olive gray (5Y 5/2); moist to wet; faint sweet odor.			1.5"ID PVC .010 Slotted Screen; 20/40 Lonestar Sand enclosed in size 65 stainless steel mesh
25		2.8	X		SP-SM	POORLY GRADED SAND WITH SILT, 90% sub-angular fine sand; 10% silt; light olive gray (5Y 5/2); wet; faint sweet odor.		(Chemical Analysis @ 25-25.5')	
		0.9			CL	LEAN CLAY, 65% semi-plastic clay; 30% silt; 5% fine sand; olive gray (5Y 4/1), slightly mottled; moist; faint sweet odor.			Well TD = 26'bg
		0.9			CH	FAT CLAY, 55% plastic clay; 40% silt; 5% fine sand; moderate brown (5YR 4/4), mottled with olive gray; moist; no odor.			
						Boring Total Depth = 28' bg			
30									
35									
40									
45									

T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
TOP OF CASING ELEVATION: 139.66'
DRILLER: Darryl
DATE BEGAN: 4/17/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

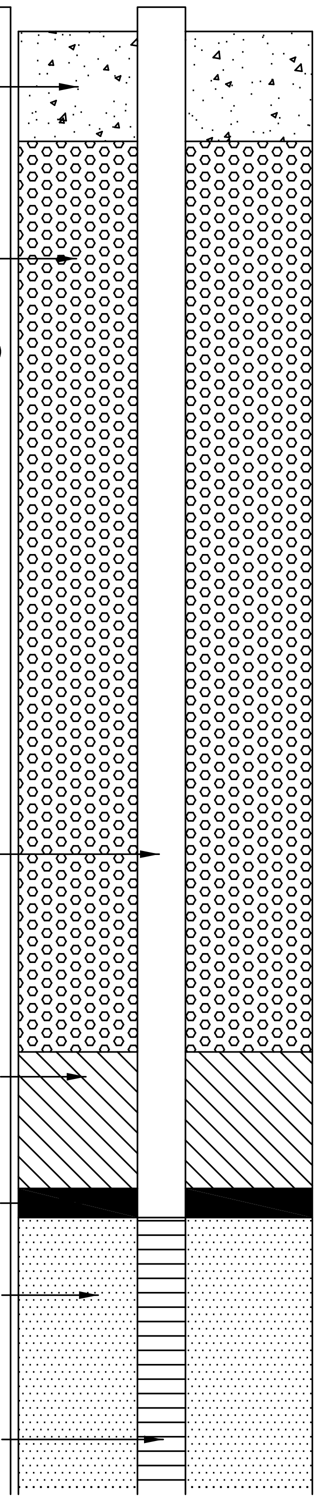
LOCATION: District Blvd; South of Pemaco Gate, 30' S.W. of concrete wall

DATE COMPLETED: 4/17/01
GWL DATE/TIME: 6/5/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-26
LOGGED BY: Jacques Marcillac
GWL DEPTH: 19.20'
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE
0					0'–1' Concrete.		
		2.8		SM	SILTY SAND, 85% angular fine sand; 15% silt; moderate olive brown (5Y 4/4); moist; no odor.		
5		0.9	X	SM	SILTY SAND, 70% fine sand; 30% silt; dark yellowish brown (10YR 4/2); moist; no odor. 2" clay interval at 4.5' bg		(Chemical Analysis @ 5–5.5')
		0.9		SM	SILTY SAND, 85% fine sand; 15% silt; moderate olive brown (5Y 4/4); moist; no odor.		
10		0		ML	SANDY SILT, 55% silt; 45% fine sand; trace clay; moderate olive brown (5Y 4/4) slightly mottled with moderate brown (5YR 4/4); moist; no odor.		
		0.9		SM	SILTY SAND, 60% fine sand; 40% silt; mod–erate olive brown (5Y 4/4); moist; no odor.		
15		2.8		ML	SANDY SILT, 55% silt; 40% fine sand; 5% clay; olive gray (5Y 4/1); moist; no odor.		
		0		SM	SILTY SAND, 55% fine sand; 45% silt; trace clay; moderate olive brown (5Y 4/4); moist; no odor.		
		0	X	SM	SILTY SAND, 65% fine sand; 35% silt; trace clay; light olive gray (5Y 5/2); moist to wet; no odor.		(Chemical Analysis @ 18–18.5')
		0		SM	SILTY SAND, 85% fine sand; 15% silt; moderate olive brown (5Y 4/4); wet; no odor.	∇	
20		0		CL	LEAN CLAY, 55% semi–plastic clay; 40% silt; 5% fine sand; olive gray (5Y 4/1); moist to wet; no odor.		
		0		ML	SILT, 55% silt; 40% clay; 5% fine sand; olive gray (5Y 4/1); wet; no odor.		

WELL CONSTRUCTION



T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/17/01

LOCATION: District Blvd; South of Pemaco Gate, 30' S.W. of concrete wall
PAGE: 2 of 2

BORING No.: B-26

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION (ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.)	GW ELEVATION	REMARKS (CONTINUOUS CORING WITH MACROCORE)	WELL CONSTRUCTION
		0.9			SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; light olive gray (5Y 6/1); wet; no odor.		1.5"ID, Sch.40 PVC .010" Slotted Screen; 20/40 Lonestar Sand Enclosed in size 65 Stainless Steel Mesh	Well TD = 23'
25		0.9			ML	SILT WITH SAND, 50% silt; 30% clay; 20% fine sand; dark yellow brown (10YR 4/2); wet to saturated; no odor.		(Chemical Analysis @ 25–25.5')	
		4.7			CH	FAT CLAY, 55% plastic clay, 30% silt; 15% sand; moderate brown (5YR 4/4); moist; no odor.			
		0			CH	FAT CLAY, 60% plastic clay; 35% silt; 5% fine sand; moderate brown (5YR 4/4) heavily mottled with olive gray (5Y 4/1); moist; no odor.			
						Boring TD = 28'			
30									
35									
40									
45									

TN & A T N & Associates, Inc. Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

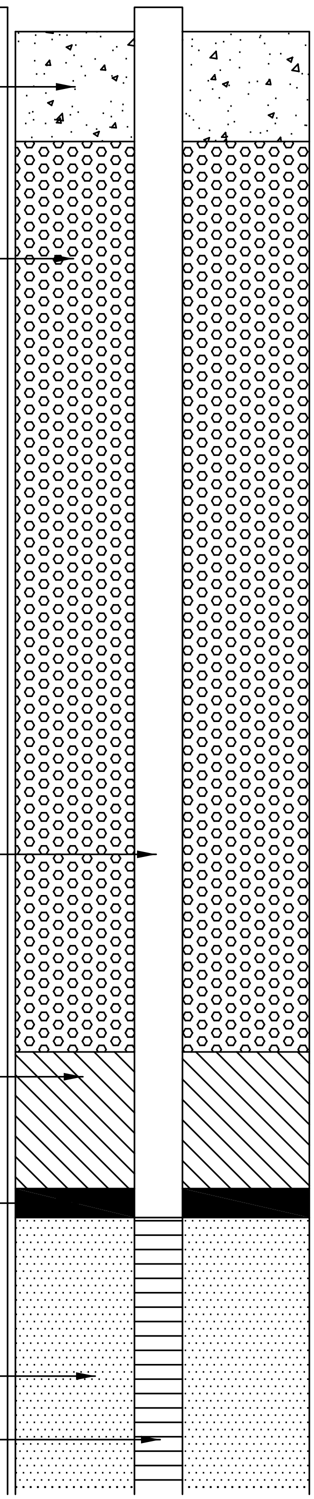
PROJECT No.: 2000126
TOP OF CASING ELEVATION: 137.84'
DRILLER: Darryl
DATE BEGAN: 4/17/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

LOCATION: District-Southernmost Shallow
PAGE: 1 of 2
DATE COMPLETED: 4/17/01
GWL DATE/TIME: 6/15/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-25
LOGGED BY: Jacques Marcillac
GWL DEPTH: 21.28'
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE
0					Concrete		
		0		SP-SM	POORLY GRADED SAND WITH SILT, 90% sub-angular fine sand; 10% silt; light olive gray (5Y 5/2); moist; no odor.		
5		6.6	X	SM	SILTY SAND, 70% fine sand; 30% silt; dark yellow brown (10YR 4/2); moist; no odor.		(Chemical Analysis @ 5–5.5')
10		2.8		SM	SILTY SAND, 55% fine sand; 45% silt; moderate olive brown (5Y 4/4); moist; no odor.		
		2.8		SM	SILTY SAND, 70% fine sand; 30% silt; moderate olive brown (5Y 4/4); moist; no odor.		
15		0.9		CL	LEAN CLAY, 60% semi-plastic clay; 35% silt; 5% fine sand; moderate olive brown (5Y 4/4); moist; no odor.		
		0		SM	SILTY SAND, 80% fine sand; 20% silt; moderate olive brown; moist; no odor.		
		0		CL	LEAN CLAY, 55% semi-plastic clay; 40% silt; 5% fine sand; moderate olive brown (5Y 4/4); moist; no odor.		
		0.9	X	SM	SILTY SAND, 75% fine sand; 25% silt; light olive gray (5Y 5/2); wet; no odor.		(Chemical Analysis @ 19–19.5')
20		0.9		CL	LEAN CLAY, 70% semi-plastic clay; 30% silt; olive gray (5Y 4/1); moist; no odor.		
		0.9		SM	SILTY SAND, 60% fine sand; 35% silt; 5% clay; light olive gray (5Y 5/2); wet; no odor.		

WELL CONSTRUCTION



T N & Associates, Inc.
Engineering and Science

BORING LOG
PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/17/01

LOCATION: District-Southernmost Shallow
PAGE: 2 of 2

BORING No.: B-25

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE	WELL CONSTRUCTION
		0.9			SM	SILTY SAND, 60% fine sand; 35% silt; 5% clay; light olive gray (5Y 5/2); wet; no odor.		1.5"ID, Sch.40 PVC .010" Slotted Screen (Chemical Analysis @ 23 23.5')	
25		2.8 0.9			CH	FAT CLAY, 60% plastic clay; 40% silt; moderate brown (5YR 4/4) mottled with olive gray (5Y 4/1); moist; no odor.		20/40 Lonestar Sand Enclosed in size 65 Stainless Steel Mesh	Well TD = 23'
						Boring TD = 28'			
30									
35									
40									
45									

TN &A T N & Associates, Inc. Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
TOP OF CASING ELEVATION: 138.20'
DRILLER: Darryl
DATE BEGAN: 4/16/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

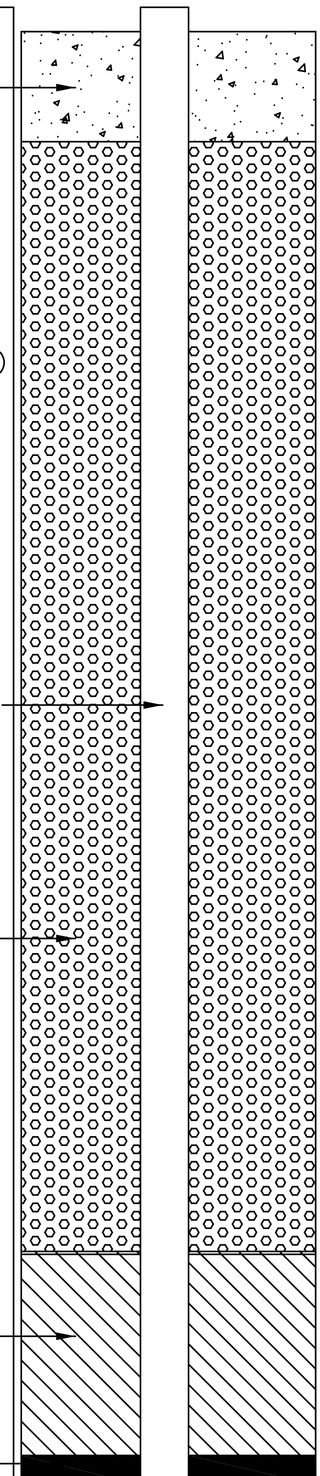
LOCATION: On RR row 140' N. of 60th St. and 130' E. of Walker Ave.

DATE COMPLETED: 4/16/01
GWL DATE/TIME: 6/5/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-24
LOGGED BY: Jacques Marcillac
GWL DEPTH: 23.25'
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE
0					Gravelly fill		
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% sub-angular fine sand; 10% silt; light olive gray (5Y 5/2); damp; no odor.		
5		0	X	ML	SANDY SILT, 50% silt; 40% fine sand; 10% clay; light olive gray (5Y5/2); moist; no odor.		(Chemical Analysis @ 5–5.5')
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% sub-angular fine sand; 10% silt; light olive gray (5Y 5/2); moist; no odor.		
		0		SM	SILTY SAND, 80% fine sand; 20% silt; light olive gray (5Y 5/2); moist; no odor.		
10		0		ML	SANDY SILT, 55% silt; 40% fine sand; 5% clay; olive gray (5Y 4/1); moist; no odor.		
15		0		ML	SANDY SILT, 50% silt; 40% fine sand; 10% clay; light olive gray (5Y 5/2); moist; no odor.		
		0.9		ML	SILT WITH SAND, 50% silt; 30% clay; 20% fine sand; light olive gray (5Y 5/2); moist to wet.		Wet @ 18'
		0	X	SP–SM	POORLY GRADED SAND WITH SILT, 90% sub-angular fine sand; 10% silt; light olive gray (5Y 5/2); wet; no odor.		(Chemical Analysis @ 18.5–19')
20		0		CL	LEAN CLAY, 60% semi-plastic clay; 40% silt; olive gray (5Y 4/1); moist; no odor.		
		0		MH	ELASTIC SILT, 50% silt; 40% clay; 10% fine sand; light olive gray (5Y 5/2); wet; no odor.		

WELL CONSTRUCTION



TN & A — T N & Associates, Inc. Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/16/01

LOCATION: On RR row 140' N. of 60th St. & 130' E. of Walker Ave.
PAGE: 2 of 2

BORING No.: B-24

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE	WELL CONSTRUCTION
					MH	ELASTIC SILT, 50% silt; 40% clay; 10% fine sand; light olive gray (5Y 5/2); wet; no odor.			
		0			SM				
					SM	SILTY SAND, 70% fine sand; 25% silt; 5% clay; light olive gray (5Y 5/2); saturated; no odor.	▽	1.5"ID, Sch.40 PVC .010" Slottled Screen	
						SILTY SAND, 85% subangular fine sand; 15% silt; light olive gray (5Y 5/2); wet; no odor.			
25					SM	SILTY SAND, 80% subangular fine sand; 15% silt; 5% clay; light olive gray (5Y 5/2); saturated; no odor.		20/40 Lonestar Sand Enclosed in size 65 Stainless Steel Mesh (Chemical Analysis @ 26.5–27')	
					CH	FAT CLAY, 60% very plastic clay; 35% silt; 5% sand; moderate brown (5YR 4/4); moist; no odor.			Well TD = 27'
						Boring TD = 28'			
30									
35									
40									
45									

T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

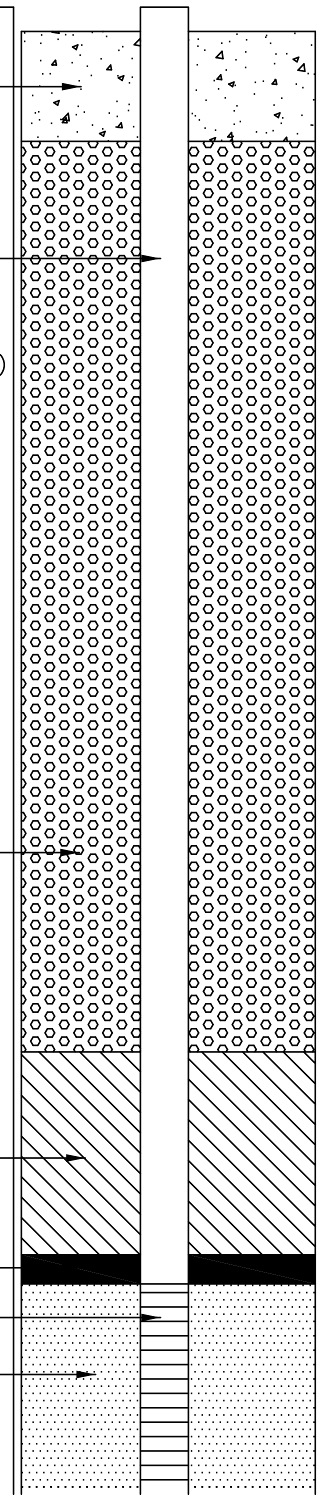
PROJECT No.: 2000126
TOP OF CASING ELEVATION: 137.43'
DRILLER: Darryl
DATE BEGAN: 4/18/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

LOCATION: In Walker Ave., Adjacent to Park and MW-5
PAGE: 1 of 2
DATE COMPLETED: 4/18/01
GWL DATE/TIME: 6/5/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-23
LOGGED BY: Jacques Marcillac
GWL DEPTH: 22.51'
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE
0					0"–3" Asphalt.		
					3"–1' Gravelly fill		
		8.5		SM	SILTY SAND, 75% fine sand; 25% silt; moderate olive brown (5Y 4/4); moist; no odor.		
		0.9		SM	SILTY SAND, 80% fine sand; 20% silt; dark yellowish brown (10YR 4/2); moist; no odor.		
5			X				(Chemical Analysis @ 5–5.5')
		0.9		SP–SM	POORLY GRADED SAND WITH SILT, 90% sub–angular fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.		
		0		SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; moderate olive brown (5Y 4/4); moist; no odor.		
		0		SM	SILTY SAND, 80% fine sand; 20% silt; moderate olive brown (5Y 4/4); moist; no odor.		
10		0.9		SM	SILTY SAND, 60% fine sand; 40% silt; trace clay; moderate olive brown (5Y 4/4); moist; no odor.		
15		0.9		SM	SILTY SAND, 70% fine sand; 30% silt; mod–erate olive brown (5Y 4/4); moist; no odor.		
		0		CL	LEAN CLAY, 65% non–plastic to semi–plastic clay; 30% silt; 5% fine sand; moderate olive brown (5Y 4/4); moist; no odor.		
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); moist to wet; no odor.		
20		0.9		CL	LEAN CLAY, 60% semi–plastic clay; 40% silt; trace fine sand; olive gray (5Y 4/1); moist; no odor.		
		2.8		SM	SILTY SAND, 85% angular fine sand; 15% silt; light olive gray (5Y 5/2); moist to saturated; no odor.		Wet @ 21' bg, Saturated @ 23' bg

WELL CONSTRUCTION



T N & Associates, Inc. Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/18/01

LOCATION: in Walker Ave., Adjacent to Park and MW-5

BORING No.: B-23

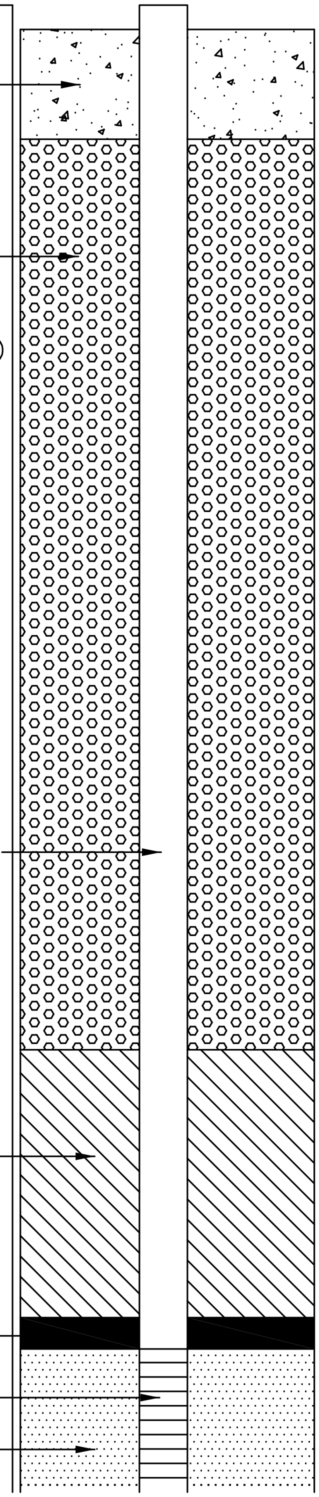
DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE	WELL CONSTRUCTION
		2.8			SM	SILTY SAND, 85% subangular fine sand; 15% silt; light olive gray (5Y 5/2); moist to saturated; no odor.	∇	(Chemical Analysis @ 23–23.5')	1.5"ID, Sch.40 PVC .010" Slotted Screen; 20/40 Lonestar Sand Enclosed in size GS Stainless Steel Mesh
		0			CH	FAT CLAY, 55% plastic clay; 40% silt; 5% fine sand; moderate brown (5YR 4/4) heavily mottled with olive gray (5Y 4/1); moist; no odor.			Well TD = 24'
25		2.8			CH	FAT CLAY, 60% plastic clay; 35% silt; 5% fine to medium sand; moderate brown; moist; no odor.		(Chemical Analysis @ 27–27.5')	
						Boring TD = 28'			
30									
35									
40									
45									

TN & A T N & Associates, Inc. Engineering and Science	**BORING LOG** PEMACO, INC. MAYWOOD, CALIFORNIA

PROJECT No.: 2000126	LOCATION: In street @ Walker and 59th, 11' from S.E. curb/driveway	**BORING No.: B-22**
TOP OF CASING ELEVATION: 138.12'	PAGE: 1 of 2	
DRILLER: Darryl		LOGGED BY: Jacques Marcillac
DATE BEGAN: 4/18/01	DATE COMPLETED: 4/18/01	GWL DEPTH: 20.73'
DRILLING METHOD: Direct Push	GWL DATE/TIME: 6/5/01	GWL EQUIPMENT: water level meter
CONTRACTOR: Vironex	DRILL EQUIPMENT: Geoprobe	CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE
0					0"–2" Asphalt.		
					2"–2' Gravelly Fill.		Portland Cement
		0		SP	POORLY GRADED SAND, 95% subangular fine sand; 5% silt; moderate yellowish brown (10YR 5/4); damp; no odor.		
		0		SM	SILTY SAND, 80% subangular fine sand; 20% silt; dark yellowish brown (10YR 4/2); damp; no odor.		1.5"ID, Sch.40 PVC Blank
5		0	X	SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; dark yellowish brown (10YR 4/2); damp; no odor.		(Chemical Analysis @ 5–5.5')
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; pale yellowish brown (10YR 6/2); well graded; damp; no odor.		
10		0		SM	SILTY SAND, 80% subangular fine sand; 20% silt; dark yellowish brown (10YR 4/2); damp; no odor.		
		0		SM	SILTY SAND, 60% subangular fine sand; 40% silt; pale yellowish brown (10YR 6/2); damp; no odor.		3/8" Bentonite Chips
15		0		SM	SILTY SAND, 60% fine sand; 40% silt; dark yellowish brown (10YR 5/4); well graded; dry to damp; no odor.		
		0	X	SM	SILTY SAND, 50% fine sand; 40% silt; 10% clay; olive gray (5Y 4/1); well graded; wet; no odor.		Pre–Pack Granular Bentonite; (Chemical Analysis @ 18.5–19')
20		0		CL	LEAN CLAY, 55% semi–plastic clay; 45% silt; olive gray (5Y 4/1); well graded; moist; no odor.	▽	Foam Packer
					SILTY SAND, 55% suangular fine sand; 40% silt; 5% clay; olive gray (5Y 4/1); well graded; damp; no odor.		1.5"ID Sch.40 PVC Slotted .010" Screen
		0		SM			20/40 Lonestar Sand Enclosed in size 65 Stainless Steel Mesh

WELL CONSTRUCTION



T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/18/01

LOCATION: In street @ Walker and 59th, 11th from S.E. curb/driveway

BORING No.: B-22

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE	WELL CONSTRUCTION
								20/40 Lonestar Sand Enclosed in size 65 Stainless Steel Mesh	
		16.5			ML	SILT WITH SAND, 60% silt; 40% fine sand; olive gray (5Y 4/1); well graded; saturated; faint odor.		1.5"ID, Sch.40 PVC .010" Slotted Screen	
25		26.7			ML	SILT, 55% semi-plastic silt; 45% clay; 5% fine sand; olive black with mottling olive gray (5Y 2/1 and 5Y 4/1); well graded; damp to moist; faint odor.		(Chemical Analysis @ 25–25.5')	Well TD = 25'
		7.2			CH	FAT CLAY, 50% hard clay; 45% silt; 5% fine sand; moderate brown (5YR 4/4); well graded; moist; no odor.			
					CH	FAT CLAY, 55% hard clay; 45% silt; trace fine sand; pale yellowish brown (10YR 6/2); damp; faint odor.			
30		44							
		76							
35								(Chemical Analysis @ 35–35.5')	
						Boring TD = 36'			
40									
45									

BORING LOG

T N & Associates, Inc.
Engineering and Science

PEMACO, INC.
MAYWOOD, CALIFORNIA

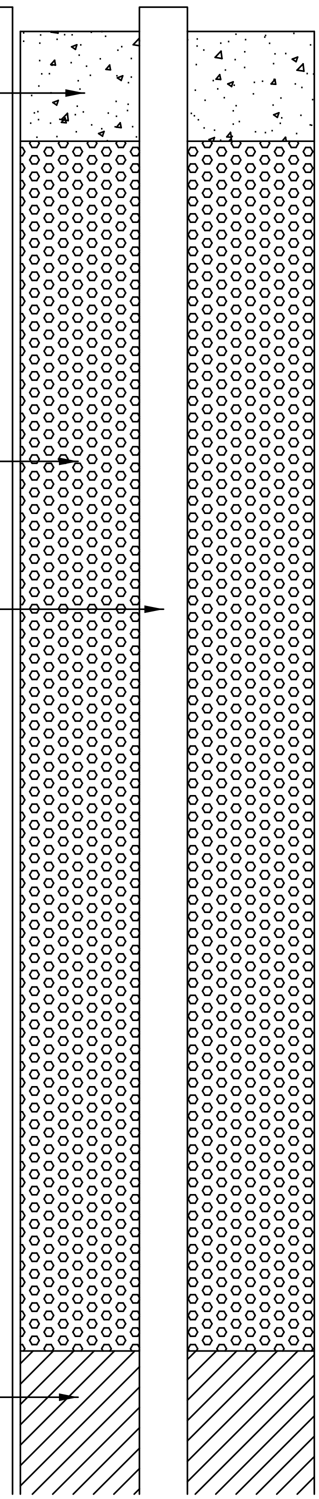
PROJECT No.: 2000126
TOP OF CASING ELEVATION: 140.20'
DRILLER: Darryl
DATE BEGAN: 4/16/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

LOCATION: RR row, 6' N. of 59th Place sidewalk, 5' East of West row fence
PAGE: 1 of 2
DATE COMPLETED: 4/16/01
GWL DATE/TIME: 6/5/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-21
LOGGED BY: Jacques Marcillac
GWL DEPTH: 22.30'
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION (ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.)	GW ELEVATION	REMARKS (CONTINUOUSLY CORED WITH MACROCORE)
0					0'–2' Heterogeneous Fill Material and Gravel.		Portland Cement
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% subrounded fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; possible faint solvent odor.		
		0		SM	SILTY SAND, 70% fine sand; 30% silt; dark yellowish brown (10YR 4/2); possible faint solvent odor.		
5		0	X	SM	SILTY SAND, 55% fine sand; 45% silt; olive gray (5Y 3/2); wet; possible faint solvent odor.		(Chemical Analysis @ 5–6')
		0		SM	SILTY SAND, 75% fine sand; 25% silt; dark yellowish brown (10YR 4/2); moist; possible faint solvent odor.		3/8" Bentonite Chips
		0		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.		1.5"ID, Sch.40 PVC Blank
10		0		SM	SILTY SAND, 80% fine sand; 20% silt; moderate olive brown (5Y 4/1); moist; no odor.		
		0		SM	SILTY SAND, 70% fine sand; 30% silt; moderate olive brown (5Y 4/1); moist; no odor.		
15		0	X	SM	SILTY SAND, 65% fine sand; 35% silt; olive gray (5Y 3/2); moist to wet; no odor.		Wet from 17–18.5'. (Chemical Analysis @ 18'–18.5')
		0		SM	SILTY SAND, 80% fine sand; 20% silt; olive gray (5Y 3/2); moist; no odor.		
		0		SP	POORLY GRADED SAND, 95% subangular fine sand; 5% silt; moderate olive brown (5Y 4/4); moist; no odor.		Abrupt lithology change at 19' (bgs).
20		0		ML	SILT, 70% silt; 25% clay; 5% sand; olive black (5Y 2/1); moist; no odor.		Pre–Pack Granular Bentonite

WELL CONSTRUCTION



T N & Associates, Inc. Engineering and Science	**BORING LOG** PEMACO, INC. MAYWOOD, CALIFORNIA

PROJECT No.: 200126

DATE COMPLETED: 4/16/01

LOCATION: RR row, 6' N. of 59th Place sidewalk, 5' E. of West row fence

BORING No.: B-21

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION (ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.)	GW ELEVATION	REMARKS (CONTINUOUSLY CORED WITH MACROCORE)	WELL CONSTRUCTION
		0.7				▽		Pre–Pack Granular Bentonite; Foam Packer
				SM	SILTY SAND, 80% sand; 20% silt; olive gray (5Y 4/1); moist; faint solvent odor.			1.5"ID, Sch.40 PVC Screen 0.010" Slots
25		5.2		SP–SM	POORLY GRADED SAND WITH SILT, 90% subangular fine sand; 10% silt; light olive gray (5Y 5/2); wet to saturated; weak to strong solvent odor.			20/40 Lonestar Sand Enclosed in size 65 Stainless Steel Mesh
		14.1			Same as above. Saturated; moderate solvent odor.			
			X				(Chemical Analysis @ 27–27.5')	
		6.7		ML	SILT, 85% silt; 10% fine sand; 5% clay olive gray (5Y 3/2); weak solvent odor.			
		4		ML	SILT, 60% silt; 35% clay; 5% fine to medium sand; olive gray (5Y 3/2); damp to moist; possible faint solvent odor.			Well TD = 28'
		4		CH	FAT CLAY, 60% very plastic clay; 35% silt; 5% fine to medium sand; moderate brown (5YR 3/4) heavily mottled with olive gray (5Y 3/2); moist; no odor. Trace organic clasts (1–2mm)			
30				CH	FAT CLAY, 50% very plastic clay; 40% silt; 10% fine to medium sand; moderate brown (5YR 4/4); damp; no odor.			
		8						
		6						
35		8	X	SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; light olive gray (5Y 5/2); moist; faint solvent odor.		(Chemical Analysis @ 35–35.5')	
					Boring TD = 36'			
40								
45								

TN&A T N & Associates, Inc. Engineering and Science	BORING LOG PEMACO, INC. MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
TOP OF CASING ELEVATION: 141.40'
DRILLER: Darryl
DATE BEGAN: 04/19/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

LOCATION: Center of RR btwn Pemaco & W.W. Henry Ppty 16' S.W. of East RR row fence
PAGE: 1 of 2
DATE COMPLETED: 04/19/01
GWL DATE/TIME: 6/5/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-20
LOGGED BY: Jacques Marcillac
GWL DEPTH: 23.55'
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE	WELL CONSTRUCTION
0						Gravel from ROW Fill Material			
		0			SP–SM	POORLY GRADED SAND WITH SILT, 90% fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.		Portland Cement	
5		0	X		SP	POORLY GRADED SAND, 100% fine to medium sand; light olive gray (5Y 6/1); moist; no odor.		(Chemical Analysis @ 5–5.5')	
		0			SM	SILTY SAND, 80% fine sand; 20% silt; dark yellowish brown (5YR 4/2); moist; no odor.			
10		0			SP–SM	POORLY GRADED SAND WITH SILT, 90% fine sand; 10% silt; moderate olive brown (5Y 4/4); moist; no odor.		1.5"ID, Sch.40 PVC Blank	
		0			SM	SILTY SAND, 60% fine sand; 35% silt; 5% clay; moderate olive brown (5Y 4/4); moist; no odor.			
		0			SM	SILTY SAND, 70% fine sand; 30% silt; dark yellowish brown (5YR 4/2); moist; no odor.		3/8" Bentonite Chips	
		0			ML	SANDY SILT; 60% silt; 40% fine sand; moderate olive brown (5YR 4/4); moist; no odor.			
15		0			SM	SILTY SAND, 65% fine sand; 35% silt; moderate olive brown (5YR 4/4); moist; no odor.			
		0	X		ML	SANDY SILT, 60% silt; 35% sand; 5% clay; moderate olive brown (5YR 4/4); moist to wet; no odor.		(Chemical Analysis @ 18–18.5') Pre–Pack Granular Bentonite	
		0			SM	SILTY SAND, 60% fine sand; 40% silt; moderate olive brown (5YR 4/4); moist; no odor.		1.5"ID, Sch.40 PVC 0.010"Slotted Screen	
20		0			SM	SILTY SAND, 85% fine sand; 15% silt; light olive gray (5Y 6/1); moist to saturated; no odor.		Wet @ 21, Sat @ 22 4" Foam Packer	

TN &A T N & Associates, Inc. Engineering and Science	BORING LOG PEMACO, INC. MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/19/01

LOCATION: Center of RR btwn Pemaco &W.W. Henry Ppty 16' S.W. of East of RR row fence

BORING No.: B-20

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUS CORING WITH MACROCORE	WELL CONSTRUCTION
		20			CH	FAT CLAY, 55% plastic clay; 40% silt; 5% fine sand; medium olive gray (5Y 4/1); wet; moderate product odor.	∇	(Chemical Analysis @ 22–22.5')	
25		2.8			ML	SANDY SILT, 55% silt; 40% fine sand; 5% clay; olive gray (5Y 4/1); moist; weak product odor.		Odor similar to product odor from B–15	
		0			SM	SILTY SAND, 55% fine sand; 45% silt; trace clay; olive gray (5Y 4/1); moist; faint sweet odor.		20/40 Lonestar Sand Enclosed in size 65 Stainless Steel Mesh	
		0			SM	SILTY SAND, 70% fine sand; 30% silt; light olive gray (5Y 4/1); wet; faint sweet odor.			
30		0			SM	SILTY SAND, 70% fine sand; 30% silt; trace clay; olive gray (5Y 3/2); wet to saturated; weak sweet odor.		Saturated at 30'.	
		0			ML	SANDY SILT, 55% silt; 40% sand; 5% clay; olive gray (5Y 3/2); moist; faint sweet odor.		1.5"ID, Sch.40 PVC .010" Slottled Screen	
		0			CL	LEAN CLAY, 80% semi–plastic clay; 20% silt; dark greenish gray (5GY 4/1); moist; faint sweet odor.			Well TD = 32'
35		0			CL	LEAN CLAY, 80% non–plastic to semi–plastic clay; 20% silt; olive black (5Y 2/1); faint sweet odor. Very abundant shell fragments Turitella (?) and organic debris, organic clay (?).			
						Boring TD = 36'			
40									
45									

T N & Associates, Inc. Engineering and Science	**BORING LOG** PEMACO, INC. MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
TOP OF CASING ELEVATION: 143.58'
DRILLER: Darryl
DATE BEGAN: 4/18/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

LOCATION: RR row adjacent to Arrow Property, 10' E. of West fence
PAGE: 1 of 2
DATE COMPLETED: 4/18/01
GWL DATE/TIME: 6/5/01
DRILL EQUIPMENT: Geoprobe

BORING No.: **B-19**
LOGGED BY: Jacques Marcillac
GWL DEPTH: 24.67'
GWL EQUIPMENT: water level meter
CHECKED BY: Tim Garvey

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH MACROCORE	WELL CONSTRUCTION
0		0		SM	SILTY SAND, 80% fine to coarse sand; 15% silt; 5% subangular gravel; dusky yellowish brown (10YR 2/2); well graded; moist; no odor.		Fill Material	Portland Cement
		0		SM	SILTY SAND, 70% fine sand; 30% silt; moderate yellowish brown (10YR 5/4); moist; no odor.			
		0		SP-SM	WELL GRADED SAND WITH SILT, 90% subrounded to subangular fine to medium sand; 10% silt; light olive gray (5Y 5/2); well graded; moist; no odor.			
5		0	X	SM	SILTY SAND, 55% fine sand; 40% silt; 5% clay; olive gray (5Y 3/2); moist; no odor.		(Chemical Analysis @ 5–5.5')	
		0		SP	POORLY GRADED SAND, 100% subangular fine sand; light olive gray (5Y 5/2); poorly graded; moist; no odor.			3/8" Bentonite Chips
		0		SM	SILTY SAND, 60% fine sand; 40% silt; dark yellowish brown (10YR 4/2); moist; no odor.			
10		0		SM	SILTY SAND, 80% subangular fine sand; 20% silt; light olive gray (5Y 5/2); moist; no odor.			
		0		SM	SILTY SAND, 65% fine sand; 35% silt; olive gray (5Y 4/1); moist; no odor.			
15		0		SP	POORLY GRADED SAND WITH SILT, 95% subangular fine sand; 5% silt; light olive gray (5Y 5/2).			Blank 1.5" PVC Pipe
		0		ML	SANDY SILT, 60% silt; 30% sand; 10% clay; olive gray (5Y 4/1); moist; no odor.			Pre–Pack Granular Bentonite
20		0	X	ML	SANDY SILT, 60% silt; 40% fine sand; light olive gray (5Y 5/2); moist; no odor. Increasing sand content with depth. ML to SM.		(Chemical Analysis @ 21–22')	4" Foam Packer

T N & Associates, Inc.
Engineering and Science

BORING LOG
PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/18/01

LOCATION: RR row adjacent to Arrow Property, 10' E. of West fence

BORING No.: B-19

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION (ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.)	GW ELEVATION	REMARKS (CONTINUOUSLY CORED WITH MACROCORE)	WELL CONSTRUCTION
		0		SP-SM	POORLY GRADED SAND WITH SILT, 90% sub-angular fine sand; 10% silt; light olive gray (5Y 5/2); wet; no odor.			Slotted 0.010" 1.5" PVC Pipe
25		0		ML	SILT, 55% plastic silt; 40% clay; 5% sand; olive gray (5Y 4/1); moist; faint solvent odor.	▽		20/40 Lone Star Sand enclosed in size 65 Stainless Steel Mesh
		0		ML	SILT, 70% silt; 20% clay; 10% fine sand; olive gray (5Y 4/1); moist; no odor. Black mottling from 26 to 27.5'.			
30		0	X	ML	SANDY SILT, 65% silt; 20% sand; 15% clay; dark greenish gray (5GY 4/1); wet; no odor.		(Chemical Analysis @ 31-31.5')	
		0		CH	FAT CLAY, 80% plastic clay; 20% silt; olive gray, mottled with black (5y 4/1); moist; faint unknown odor.		Mottled with veins and splotches of black.	Well T.D. = 32'
35		0	X	CH	FAT CLAY, 65% plastic clay; 30% silt; 5% sand; olive gray, slightly mottled with moderate yellowish brown (5Y 4/1); moist; no odor.		Black stained layers from 35' to 35.3', bgs. (Chemical Analysis @ 35-35.5)	
					T.D. of Boring = 36'			
40								
45								

T N & Associates, Inc.
Engineering and Science

BORING LOG

PEMACO, INC.
MAYWOOD, CALIFORNIA

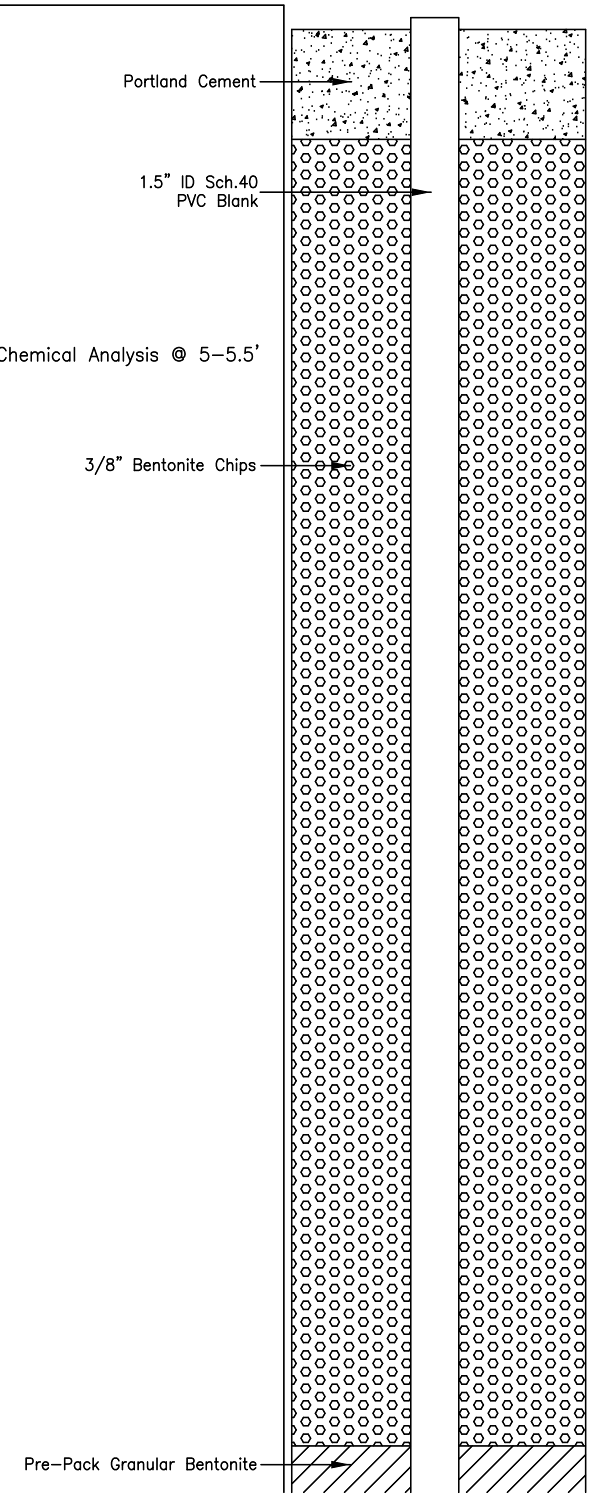
PROJECT No.: 2000126
TOP OF CASING ELEVATION: 147.05
DRILLER: Darryl
DATE BEGAN: 4/16/01
DRILLING METHOD: Direct Push
CONTRACTOR: Vironex

LOCATION: N.W. portion of site, 18' E. of West fence, 75' S. of N. fence
PAGE: 1 of 2
DATE COMPLETED: 4/16/01
GWL DATE/TIME: 6/5/01
DRILL EQUIPMENT: Geoprobe

BORING No.: B-18/GP-VS-1
LOGGED BY: Jacques Marcillac
GWL DEPTH: 26.21'
GWL EQUIPMENT: water level meter
CHECKED BY: Perry Russell R.G.#5777

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	GRAPHIC	USCS	DESCRIPTION ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.	GW ELEVATION	REMARKS CONTINUOUSLY CORED WITH MACROCORE
0		0			SM	SILTY SAND, 60% fine sand; 40% silt; moderate olive brown (5Y 4/4); moist; no odor.		
		0			SM	SILTY SAND, 85% fine sand; 15% silt; light olive gray (5Y 5/2); damp; no odor.		
5 10		0 0	X		SP-SM	POORLY GRADED SAND WITH SILT, 90% subrounded fine sand; 10% silt; pale yellowish brown (10YR 6/2); damp; no odor.		Chemical Analysis @ 5-5.5'
		0			SM	SILTY SAND, 70% fine sand; 30% silt; dark yellowish brown (10YR 4/2); moist; no odor.		
15		0			SP-SM	POORLY GRADED SAND WITH SILT, 90% fine to medium sand; 10% silt; moderate olive brown (5y4/4); damp; no odor.		
		0			SM	SILTY SAND, 80% fine to medium sand; 20% silt; light olive gray (5Y 5/2); moist; no odor.		
20		0			ML	SANDY SILT, 55% silt; 45% sand; light olive gray (5Y 5/2); moist; no odor.		

WELL CONSTRUCTION



TN & Associates, Inc.
Engineering and Science

BORING LOG
PEMACO, INC.
MAYWOOD, CALIFORNIA

PROJECT No.: 2000126
DATE COMPLETED: 4/16/01

LOCATION: N.W. portion of site, 18' E. of West fence, 75' S. of N. fence

BORING No.: B-18/GP-VS-1

DESCRIPTION: ALL LITHOLOGIC PERCENTAGES ARE APPROXIMATE UNLESS OTHERWISE NOTED.

REMARKS: CONTINUOUSLY CORED WITH MACROCORE

DEPTH (feet)	BLOW COUNT (blows/6")	PID (ppm)	SAMPLE	USCS	DESCRIPTION	GW ELEVATION	REMARKS	WELL CONSTRUCTION
23–24							Pre–Pack Granular Bentonite; 1.5" ID Sch.40 PVC Blank; 4" Foam Packer	
24–28		0	25–26		80% subangular fine sand; 20% silt; light olive gray (5Y 5/2); moist to wet; no odor. Laminated from 26–28'.	▽	(Chemical Analysis @ 25–26'); 20/40 Lone Star Sand enclosed in size 65 stainless steel mesh; 1.5" ID Sch. 40 0.010" Slotted PVC Pipe	
28–31		0		CL	LEAN CLAY, 70% semi–plastic clay; 30% silt; medium dark gray (N4); moist; no odor.			Well T.D. = 29'
31–32		0		ML	SANDY SILT, 65% silt; 35% fine sand; olive gray; (5Y 4/1); moist; no odor.			
32–33.7		0	33–33.5	ML	SILTY SAND, 55% silt; 45% fine sand; olive gray (5Y 4/); moist; no odor.		(Chemical Analysis @ 33–33.5')	
33.7–35		0		CH	FAT CLAY, 65% plastic clay; 35% silt; med–gray slightly mottled with moderate brown; moist; no odor.			
35–36		0		CH	FAT CLAY, 75% plastic clay; 25% silt; dark greenish gray (5GY 4/1). Dark organic (?) horizon at 35.5'–36'.			

Boring T.D. = 36'

SECTION 01250

MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 PROPOSED PROJECT MODIFICATIONS

Price proposals for proposed modifications shall be submitted to the Project Engineer. If change order work impacts or delays other unchanged contract work, the costs of such impacts or delays shall be included in the proposals and separately identified. Additional instructions for submitting price proposals can be found in NPSP-415-1-1, INSTRUCTION AND INFORMATION FOR CONTRACTORS, a copy of which will be furnished to Contractor at the Preconstruction Conference.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01270

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.1 REFERENCES (NOT USED)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor approval.

SD-09 Reports
Bid Schedule and Engineers Cost Estimate; G.

Measurement and Payment information is to be provided with a bid schedule and Engineer's Cost Estimate under separate cover.

1.3 LUMP SUM PAYMENT ITEMS

The lump sum price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for which separate payment is not otherwise provided. Payment items for work on this contract for which contract lump sum payments will be made will be determined via a "best value" competitive bid process. Lump sum payment items will be determined on a contract by contract basis as determined by the Remedial Action Contractor. All costs for items of work, which are not specifically mentioned to be included in a particular lump sum or unit price payment item, shall be included in the listed lump sum item most closely associated with the work involved.

1.4 UNIT PRICE PAYMENT ITEMS

The unit price and payment made for each item listed shall constitute full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for each of the unit price items. Payment items for work on this contract for which contract unit price payments will be made will be determined via a "best value" competitive bidding process. Units of measure, payment terms and schedules shall be defined on a contract by contract basis as determined by the Remedial Action Contractor.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

END OF SECTION

SECTION 01320

PROJECT SCHEDULE

PART 1 GENERAL

1.1 SCOPE OF WORK

The Contractor shall be responsible for preparing the Project Schedule for review at the Pre-Work Meeting and updating the schedule for all subsequent meetings

1.2 SUBMITTALS

Government approval is required for submittals having a "G" designation; all other submittals are for Contractor Quality Control Engineer approval. In accordance with SECTION 1330 - SUBMITTAL PROCEDURES, the Contractor shall submit the following:

A. Submit initial schedules within 10 days after Notice to Proceed is made. The Progress Schedule shall start with the Notice to Proceed date; G

B. Submit revised schedules at periodic Progress Meetings; G

1) The Project Engineer will review schedules and return comments within five days after receipt.

2) If required, the Contractor shall resubmit within two days after responding to comments.

C. Submit revised progress schedules for each progress meeting; G

D. Submit a narrative report that explains each update to the project schedule as well as items completed. The narrative report and schedule shall provide the basis for the Contractor's program payment requests.

1.3 FORM OF SCHEDULES

The Contractor shall prepare schedules in the form of a bar chart, Gantt chart, or approved equal.

a) Provide separate horizontal bar for each work activity or operation.
b) Horizontal time scale: Identify the first work day of each week.
c) Scale and spacing: Allow space for notations and future revisions.

1.4 CONSTRUCTION PROGRESS SCHEDULE

A. Show the complete sequence of work by activity.
B. Show the dates for the beginning and completion for each major element of work. This list includes, but is not limited to:
   a) Submittals
   b) Notice to Proceed
   c) Mobilization
   d) Site utilities, temporary facilities, and health and safety preparations
   e) Well installation
   f) Trench construction and pipe installation
   g) ERH installation

h) Treatment compound foundation construction
i) Treatment building construction
j) Electrical and plumbing installation
k) Treatment equipment installation
l) Treatment equipment testing certification
m) Submission and approval of “As Built” drawings, O & M manual, and systems test data
n) Perform correction of punchlist items
o) Final inspections and approval
p) System start-up
q) Begin remediation and O & M schedule

1.5 PROGRESS REVISIONS

A. Indicate progress of each activity to date of submissions.

B. Show changes occurring since previous submission of schedule:

   a) Major changes in scope (if any).

   b) Activities modified since previous submission.

   c) Revised projects of progress and completion.

   d) Other identifiable changes.

C. Provide a very brief narrative report as needed to define:

   a) Problem areas, anticipated delays, and the impact on schedule.

   b) Corrective action recommended, and its effect

   c) The effect of changes, if any, on schedules, the budget, or other subcontractors.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

A Project Schedule as described below shall be prepared and the scheduling of construction shall be the responsibility of Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project should also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work to aid in evaluating time extensions and to provide the basis of all progress payments.

3.1.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. Contractor shall provide the Project Schedule in Gantt chart, or approved equal.

3.1.2 Level of Detail Required

With the exception of the preliminary and initial schedule submission, the Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the EPA at the appropriate level of detail, as specified by the EPA, shall result in disapproval of the schedule. The EPA will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule.

3.1.3 Activity Durations

Contractor submissions shall be required to follow the directions of the Project Engineer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods. A rule of thumb, that Contractor should use, is that less than 2 percent of all non-procurement activities' Original Durations shall be greater than 20 calendar days.

3.1.4 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 calendar days. Examples of procurement process activities include, but are not limited to, submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing.

3.1.5 Government Activities

Government and other agency activities that could impact progress shall be shown. These activities include, but are not limited to, approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and notice to proceed for phasing requirements.

3.1.6 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm (at the lowest tier), contractor work force, or Government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

3.1.7 Category of Work

All Activities shall be identified in the project schedule according to the category of work that best describes the activity. Category of work refers, but is not limited to, the procurement chain of activities including such items as submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing. The category of work for each activity shall be identified by the Category of Work Code.

3.2 PROJECT SCHEDULE

The Progress Schedule and narrative report shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel shall result in an inability of the EPA to evaluate contractor progress for the purpose of payment. Failure of Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule, submission and the inability of the EPA to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the EPA and those revisions have not been included in the Project Schedule, then the EPA may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

3.2.1 Network Diagram

The time-scaled network diagram shall be required on the initial schedule submission and on quarterly update submission. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished, The EPA will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.2.2 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity or even number, description, duration, and estimated earned value shall be shown on the diagram.

3.2.3 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract-required interim completion dates, and contract completion dates.

3.2.4 Critical Path

The critical path shall be clearly shown.

3.2.5 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.3 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly on-site meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting Contractor will describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule to reflect the current status of the project. The EPA will approve activity progress, proposed revisions, and adjustments as appropriate.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 CONTROL AND SCHEDULING OF SUBMITTALS

1.1.1 Submittal Coordination Meeting

After the preconstruction conference and before any submittals are sent to the EPA, Contractor shall meet with the EPA and provide and further develop an approved preliminary submittal register, ENG Form 4288. During the meeting all required items will be identified and grouped into three categories:

a) Government Approval ("G"): Government approval is required for extensions of design, critical materials, variations/deviations, an "or equal" decision, equipment whose compatibility with the entire system must be checked, architectural items such as Color Charts/Patterns/Textures, and other items as designated by the EPA. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," these submittals will be acted on as "shop drawings."

b) Submittals not requiring Government approval, such as Installation Procedures, Certificates of Compliance, Samples, Qualifications will not be acted on as "shop drawings" if within the terms of the Contract Clause entitled "Specifications and Drawings for Construction."

c) Those items that can be visually inspected by Contractor Quality Control (CQC) System Manager on site or are provided to the Government other than with an ENG Form 4025: The items that fall into this category shall remain on the register but shall not be submitted to the EPA. For these items, the "Classification" column on the submittal register shall remain blank.

1.1.2 Submittal Register Updates

The CQC System Manager shall review the listing at least every 30 calendar days and take appropriate action to maintain an effective system. Copies of updated or corrected listings shall be submitted to the EPA at least every 30 calendar days in the quantity specified.

1.2 SUBMITTAL TYPES

Throughout these specifications submittals may be identified with the prefix "SD" (submittal data) followed by a number (category, i.e., data, drawings, reports, etc.). This is for bookkeeping and record sorting in the system:

SD-01 Data
Submittals which provide calculations, descriptions, or documentation regarding the work.

SD-04 Drawings
Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections, and other relational aspects of the work.

SD-06 Instructions
Preprinted material describing installation of a product, system or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions.

SD-07 Schedules
Tabular lists showing location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

SD-08 Statements
A document, required of Contractor, or through Contractor from a subcontractor, supplier, installer, or manufacturer to confirm the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other quality verifications.

SD-09 Reports
Reports of inspections or tests, including analyses and interpretation of test results. Each report shall be properly identified. Test methods used shall be identified and test results shall be recorded.

SD-13 Certificates
Statement signed by an official authorized to certify on behalf of the manufacturer that a product, system or material meets specified requirements. The statement must be dated after the award of this contract and state Contractor's name and address, project and location, and list specific requirements which are being certified.

SD-14 Samples
Fabricated and/or unfabricated physical examples of materials, products, and/or units of work as complete units or as portions of units.

SD-18 Records
Documentation to record compliance with technical or administrative requirements.

SD-19 Operation and Maintenance (O&M) Manuals
Data which forms a part of an O&M manual. Submittals required by the Contract Clauses and other nontechnical parts of the contract are not necessarily included in this section. These type of submittals can be added to the register before or during the submittal coordination meeting.

1.3 APPROVED SUBMITTALS

The approval of submittals by the EPA shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve Contractor of the responsibility for any error which may exist. Contractor, under the CQC requirements of this contract, is responsible for the dimensions and design of adequate connections, details, and satisfactory construction of all work. After submittals have been approved by the EPA, no resubmittal for the purpose of substituting materials or equipment will be given consideration.

1.4 DISAPPROVED SUBMITTALS

Contractor shall make all corrections required by the EPA and promptly furnish a corrected submittal in the format and number of copies specified for the initial submittal. If Contractor considers any correction indicated on the submittals to constitute a change to the contract, written notice, as required under the Contract Clause entitled “Changes,” shall be given to the EPA.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

Prior to submittal, all items shall be checked and approved by the CQC System Manager and each item of the submittal shall be stamped, signed, and dated. Each respective transmittal form (ENG Form 4025) shall be signed and dated by the CQC System Manager certifying that the accompanying submittal complies with the contract requirements. This procedure applies to all submittals. Submittals shall include items such as: Contractor’s, manufacturer’s, or fabricator’s drawings; descriptive literature including, but not limited to, catalog cuts, diagrams; operating charts or curves; test reports; test cylinders; samples; O&M manuals including parts lists; certifications; warranties and other such required items. Units of weights and measures used on all submittals shall be the same as the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. G submittals shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. The EPA may request submittals in addition to those listed when deemed necessary to adequately describe the work covered in the respective sections. Contractor shall maintain a complete and up-to-date file of all submittals/items on site for use by both Contractor and the Government.

3.2 SUBMITTAL REGISTER (ENG FORM 4288)

The submittal register (ENG Form 4288) for Divisions 1 through 16 shall be developed by Contractor prior to the submittal coordination meeting and list each item of equipment and material for which submittals are required in the Technical Specifications. (See paragraph SUBMITTALS at the beginning of each specification section. A blank ENG Form 4288 is attached at the end of this specification section.)

Contractor shall approve all items listed on the submittal register. During the submittal coordination meeting, a preliminary submittal register will be created by annotating this ENG Form 4288. When the final submittal register is submitted for approval, Contractor shall complete the column entitled “Item No.” and all data under “Contractor Schedule Dates” and return five completed copies to the EPA for approval. Contractor shall review the list to ensure its completeness and may expand general category listings to show individual entries for each item. The numbers in column “Item No.” are to be assigned sequentially starting with “1” for each specification section. DO NOT preassign transmittal numbers when preparing the submittal register. When a conflict exists between the submittal register and a submittal requirement in the technical sections, other than those submittals referenced in paragraph 3.9 FIELD TEST REPORTS, the approved submittal register shall govern. The preliminary, and then the final approved submittal register, will become the scheduling documents and will be updated monthly and used to control submittals throughout the life of the contract. Names and titles of individuals authorized by Contractor to approve shop drawings shall be submitted to EPA with the final ENG Form 4288. Supplier or subcontractors certifications are not acceptable as meeting this requirement.

3.3 SCHEDULING

Submittals covering component items forming a system, or items that are interrelated, shall be coordinated and submitted concurrently. Certifications shall be submitted together with other pertinent information and/or drawings. Additional processing time beyond 30 calendar days, or number of copies, may be shown by the EPA on the submittal register attached in the “Remarks” column, or may be added by the EPA during the coordination meeting. No delays damages or time extensions will be allowed for time lost due to Contractor not properly scheduling and providing submittals.

3.4 TRANSMITTAL FORM (ENG FORM 4025)

Transmittal ENG Form 4025 (sample at end of this section) shall be used for submitting “G”-type submittals in accordance with the instructions on the reverse side of the form. Transmittal numbers shall be assigned sequentially. Electronically generated copies of ENG Form 4025 transmittals shall be printed on carbonless paper and be a reasonable facsimile of the original. If electronic forms are not used, originals of the ENG Form 4025 shall be used (do not photo copy) and will be furnished by the EPA. These forms shall be filled in completely prior to submittal. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item. Each submittal item shall be listed separately on the form, naming subcontractor, supplier, or manufacturer, applicable specification paragraph number(s), drawing/sheet number, pay item number, and any other information needed to identify the item, define its use, and locate it in the work. One or more ENG Form 4025 transmittals may be used per specification section; however, DO NOT include more than one specification section per transmittal.

3.5 CROSS-REFERENCE (ENG FORM 4288/ENG FORM 4025)

To provide a cross-reference between the approved submittal register and transmittal forms, Contractor shall record the “transmittal numbers” assigned when submitting items in column “Transmittal No.” of the ENG Form 4288. The item numbers in column “Item No.” of submittal register shall correspond to the item numbers on ENG Form 4025.

3.6 SUBMITTAL PROCEDURE

3.6.1 General

Shop drawings with ENG Form 4025 transmittals shall be submitted in the number of copies specified in subparagraphs “Government Approved Submittals” or as indicated on the submittal register in the “Remarks” column. Submit a complete collated “reviewers copy” with one ENG Form 4025 and attachments (not originals). The remaining copies of ENG Form 4025 and attachments shall not be collated. This would not apply to a series of drawings. 3.6.2 Approval of Submittals by Contractor. Before submittal to the EPA, Contractor shall review and correct shop drawings prepared by subcontractors, suppliers, and itself, for completeness and compliance with plans and specifications. Contractor shall not use red markings for correcting material to be submitted. Red markings are reserved for EPA’s use. Approval by Contractor shall be indicated on each shop drawing by an approval stamp containing information as shown in this section. Submittals not conforming to the requirements of this section will be returned to Contractor for correction and resubmittal.

3.6.2 Variations

For submittals which include proposed variations requested by Contractor, column “h” of ENG Form 4025 shall be checked and the submittal shall be classified as G, and submitted accordingly. Contractor shall set forth in writing the justification for any variations and annotate such variations on the transmittal form in the REMARKS block. Variations are not approved unless there is an advantage to the Government. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted variations.

3.7 SAMPLES REQUIRING LABORATORY ANALYSIS

See SECTION 01451 - CONTRACTOR QUALITY CONTROL for procedures and address for samples requiring Government testing.

3.8 SAMPLES REQUIRING VISUAL INSPECTION

Samples requiring only physical inspection for appearance and suitability shall be coordinated with the on-site Government quality assurance representative (QAR).

3.9 FIELD TEST REPORTS

Routine tests such as soil density, concrete deliveries, repetitive pressure testing shall be delivered to the QAR with the daily Quality Control reports. See SECTION 01451 - CONTRACTOR QUALITY CONTROL.

3.10 CONTROL OF SUBMITTALS

Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before Contractor scheduled submittal date shown on the approved “Submittal Register.”

3.11 “G” SUBMITTALS

Contractor shall submit 5 copies of “G” submittals with 5 corresponding copies of ENG Form 4025 unless extra copies are specified in a specific section. Upon completion of G submittal review, copies as specified below will be marked with an action code, dated, and returned to Contractor.

3.11.1 Processing of “G” Submittals

Submittals will be reviewed and processed as follows:

a) Approved as Submitted (Action Code “A”): Shop drawings which can be approved without correction will be stamped “Approved” and two copies will be returned to Contractor. No resubmittal required.

b) Approved Except as Noted (Action Code “B”): Shop drawings which have only minor discrepancies will be annotated in red to indicate necessary corrections. Marked material will be stamped “Approved Except as Noted” and two copies returned to Contractor for correction. No resubmittal required.

c) Approved Except as Noted (Action Code “C”): Shop drawings which are incomplete or require more than minor corrections will be annotated in red to indicate necessary corrections. Marked material will be stamped “Approved Except as Noted - Resubmission Required” and two copies returned to Contractor for correction. Resubmittal of only those items needing correction required.

d) Disapproved (Action Code “E”): Shop drawings which are fundamentally in error, cover wrong equipment or construction, or require extensive corrections, will be returned to Contractor stamped “Disapproved.” An explanation will be furnished on the submitted material or on ENG Form 4025 indicating reason for disapproval. Complete resubmittal required.

e) Resubmittal will not be required for shop drawings stamped “A” or “B” unless subsequent changes are made by Contractor or a contract modification. For shop drawings stamped “C” or “E,” Contractor shall make corrections required, note any changes by dating the revisions to correspond with the change request date, and promptly resubmit the corrected material. Resubmittals shall be associated with the “parent” by use of sequential alpha characters (for example, resubmittal of transmittal 8 will be 8A, 8B, etc). Government costs incurred after the first resubmittal may be charged to Contractor.

3.12 CONTRACTOR APPROVAL STAMP

The stamp used by Contractor on the submittal data to certify that the submittal meets Contract requirements shall be similar to the following:

CONTRACTOR:_________________
CONTRACT NUMBER:___________
TRANSMITTAL NUMBER:_________
ITEM NUMBER:_________________
SPECIFICATION SECTION:________
PARAGRAPH NUMBER:___________
______ APPROVED AS SUBMITTED
______ APPROVED WITH CORRECTIONS AS NOTED
SIGNATURE:____________________
TITLE:__________________________
DATE:__________________________

CONTRACTORS REVIEW STAMP
MAXIMUM SIZE: 3 INCHES BY 3 INCHES

SECTION 01351

SAFETY, HEALTH, AND EMERGENCY RESPONSE

PART 1 GENERAL

1.1 REFERENCES

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
ACGIH-02 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
ANSI Z358.1(1998) Emergency Eyewash and Shower Equipment

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
10 CFR 20 Standards for Protection Against Radiation

29 CFR 1904 Recording and Reporting Occupational Injuries and Illnesses

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1910.120 Hazardous Waste Operations and Emergency Response

29 CFR 1926 Safety and Health Regulations for Construction

29 CFR 1926.65 Hazardous Waste Operations and Emergency Response

49 CFR 171 General Information, Regulations, and Definitions

49 CFR 172 Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

U.S. ARMY CORPS OF ENGINEERS (USACE)
EM 385-1-1(2003) Safety -- Safety and Health Requirements

ER 385-1-95(2003) Safety and Health Requirements for Ordnance and Explosives (OE) Operations

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)
NIOSH 85-115(1985) Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities

1.2 DESCRIPTION OF WORK

This section provides additional requirements for implementing the accident prevention provisions of EM 385-1-1, and provides specifications for Contractor's Site Safety and Health plan (SSHP) which shall satisfy the requirements for submission of a separate Accident Prevention Plan (APP) as required by EM 385-1-1. Contractor must prepare and submit a SSHP to provide protective procedure for its employees and subcontractors performing work at the Pemaco Superfund Site (Site).

Specific inorganics have separate standards that must be reviewed; including arsenic, cadmium, and lead (29 CFR 1910.1018, 1910.1027, and 1910.1025, respectively). In addition, mercury and various polycyclic aromatic hydrocarbons (PAHs including benzene, pyrene and chrysene, for example) shall be addressed in an initial monitoring strategy. As all compounds mentioned can pose a significant health risk at elevated levels, a stringent SSHP is required. In general, the California Occupational Safety and Health Administration (Cal-OSHA) has adopted by reference federal OSHA standards. However, in some cases, Cal-OSHA may have state-approved standards that differ from the federal standard. The Contractor should review all standards that apply, and use the most stringent enforceable standard.

1.3 SUBMITTALS

Government approval is required for submittals having a "G" designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-09 Reports

Contractor's SSHP; G
The content of the required Contractor's SSHP is generally described in Paragraph 1.7, SITE SAFETY AND HEALTH PLAN (SSHP) of this section. Specific requirements are described in paragraphs 1.8 through 1.25 of this section. The SSHP shall be submitted 45 calendar days after Notice to Proceed (NTP).

Monitoring/Sampling Results
Personnel exposure monitoring/sampling results. Monitoring/sampling results shall be submitted daily with the Daily Construction Quality Control Reports (DCQCRs). Formal monitoring/sample results shall be submitted monthly.

Site Control Log
Record of each individual's entry and exit into the site, as specified. The site control log will be submitted with the DCQCRs.

Construction Safety Conference Minutes
Minutes of pre-construction and construction safety conferences attended by Contractor and government representatives.

Safety and Health Phase-Out Report; G.

A summary of health and safety issues encountered and resolved during the course of the project. Any areas of potential improvement and "lessons learned" should be noted in this report, as well as any pertinent accident/incident reports.

1.4 REGULATORY REQUIREMENTS

Work performed under this contract shall comply with EM 385-1-1, as well as applicable federal, state, and local safety and occupational health laws and regulations. This includes, but is not limited to, OSHA standards, 29 CFR 1910.120, "Hazardous Waste Site Operations and Emergency Response." Matters of interpretation of standards shall be submitted to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply.

1.5 PRECONSTRUCTION SAFETY CONFERENCE

Contractor shall conduct a preconstruction safety conference before on-site work begins. In order to appropriately schedule personnel, the EPA will be given notice 5 calendar days in advance of this meeting. All Contractor's safety-related issues shall be presented at the conference. Contractor will take minutes of this meeting. As work proceeds, the Contractor shall hold "tailgate" safety meetings every morning before start of work to address the hazard/risk for each task and discuss work procedures. These meetings shall be documented (Attachment 01351-A SAMPLE FORM FOR ON-SITE SAFETY MEETING/TAILGATE MEETING DOCUMENTATION is provided at the end of this section).

1.6 ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN (APP/SSHP)

OSHA Standards 29 CFR 1910.120 (b) and 29 CFR 1926.65 (b) require employers to develop and implement a written Safety and Health Program for employees involved in hazardous waste operations. The site-specific program requirements of the OSHA standards shall be integrated into one site-specific document, the SSHP. The SSHP shall interface with the employer's overall Safety and Health Program. Any portions of the overall Safety and Health Program that are referenced in the SSHP shall be included as appendices to the SSHP.

1.7 SITE SAFETY AND HEALTH PLAN

1.7.1 Preparation and Implementation

The SSHP shall be prepared covering on-site work to be performed by Contractor and all subcontractors. Contractor's Safety and Health Manager shall be responsible for the development, implementation, and oversight of the SSHP. The SSHP shall establish, in detail, the protocols necessary for the anticipation, recognition, evaluation, and control of hazards associated with each task performed. The SSHP shall address site-specific safety and health requirements and procedures based upon site-specific conditions. The level of detail provided in the SSHP shall be tailored to the type of work, complexity of operations to be performed, and hazards anticipated. Details about some activities may not be available when the initial SSHP is prepared and submitted. Therefore, the SSHP shall address, in as much detail as possible, anticipated tasks, their related hazards, and anticipated control measures.

1.7.2 Acceptance and Modifications

Prior to submittal, the SSHP shall be signed and dated by the Safety and Health Manager, the Construction Manager, and the Site Safety and Health Officer (SSHO). The SSHP shall be submitted for review 30 calendar days prior to the Preconstruction Safety Conference. Deficiencies in the SSHP will be discussed at the Preconstruction Safety Conference. The SSHP shall be revised to correct the deficiencies and resubmitted for acceptance. On-site work shall not begin until the plan has been accepted. A copy of the written SSHP shall be maintained on the site. As work proceeds, the SSHP shall be adapted to new situations and new conditions. Changes and modifications to the accepted SSHP shall be made with the knowledge and concurrence of the Safety and Health Manager, the SSHO, the Construction Manager, and the EPA. Should any unforeseen hazards become evident during the performance of the work, the SSHO shall bring any such hazards to the attention of the Safety and Health Manager, the Construction Manager, and the EPA, both verbally and in writing, for resolution as soon as possible. In the interim, necessary actions shall be taken to re-establish and maintain safe working conditions to safeguard on-site personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted SSHP shall cause the government to order a stopping of work until the matter has been rectified.

1.7.3 Availability

The SSHP shall be made available to all site employees, subcontractors, and site visitors in accordance with 29 CFR 1910.120 and 29 CFR 1926.65. All individuals receiving a copy of the SSHP or directed to read the SSHP, will sign the Certificate of Worker/Visitor Acknowledgement, described in Certificate of Worker/Visitor Acknowledgement. Attachment 01351-B SAMPLE FORM FOR CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGEMENT of this certificate is provided at the end of this section.

1.7.4 Elements

Topics required by 29 CFR 1910, Section 120 , 29 CFR 1926, Section .65, the Accident Prevention Plan as described in Appendix A of EM 385-1-1, appropriate elements from Appendix C of ER 385-1-92, and the elements included below in paragraphs 1.8 through 1.25 shall be addressed in the SSHP. Where use of a specific topic is not applicable to the project, the SSHP shall include a statement to justify its omission or reduced level of detail and establish that adequate consideration was given to the topic.

1.8 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

1.8.1 Project/Site Conditions

The following information is a record of site contaminants and a description of the site. This information is provided to assist in preparing the SSHP. Additional sources of information are available as listed below.

1.8.1.1 Site Information

See SECTION 01115 - SITE DESCRIPTION.

1.8.2 SSHP REQUIREMENTS

The SSHP shall include a contamination characterization section that provides a list of contaminants which may present occupational health and safety hazards during site remedial activities. This list shall be created by evaluating the analytical results in this section and by researching sources of information from past site investigation activities. Chemical names, concentration ranges, media in which found, locations on site, and estimated quantities/volumes to be impacted by site work shall be included, if known. The contamination characterization shall be reviewed and revised if new chemicals are identified as work progresses. The SSHP will provide a description of site location, topography, size, and past uses of the site or reference another document which provides this information.

1.9 SAFETY AND HEALTH HAZARD/RISK ANALYSIS

The SSHP shall include a safety and health hazard/risk analysis for each site task and operation to be performed. The hazard/risk analysis shall provide information necessary for determining safety and health procedure, equipment, and training to protect on-site personnel, the environment, and the public. Available site information shall be reviewed when preparing this section of the SSHP. The format shall be in accordance with EM 385-1-1, Figure 1-1. The analysis shall define the activities to be performed and identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to eliminate or reduce each hazard to an acceptable level. The analysis shall be continuously reviewed by the Site Safety and Health Officer, and when appropriate, modified to address changing site conditions or operations, with the concurrence of the Safety and Health Manager, the Construction Manager, the Project Engineer, and the EPA. The analysis and any modifications will be integrated into the SSHP. The following elements will be included in the analysis.

1.9.1 Site Tasks and Operations (Work Plan)

The SSHP shall include a comprehensive section that addresses the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives, or reference another document which provides this information. The SSHP shall be expanded and/or revised as necessary.

1.9.2 Hazards

The following potential hazards may be encountered during site work. These are not complete lists; therefore, they shall be expanded and/or revised as necessary during preparation of the SSHP.

1.9.2.1 Heat Stress Monitoring and Management

The Contractor shall document in the APP/SSHP and implement the procedures and practices in section 06.J. in EM 385-1-1 to monitor and manage heat stress.

1.9.2.2 Chemical Hazards

Potential chemical hazards that may be encountered during site work are discussed in SECTION 01115 - SITE DESCRIPTION. The Hazard/Risk Analysis section of the SSHP shall describe the chemical, physical, and toxicological properties of contaminants, sources and pathways of employee exposures, anticipated on-site and off-site exposure level potentials, and regulatory (including Federal, state, and local) or recommended protective exposure standards. The SSHP shall also address employee exposure to hazardous substances brought onsite, and shall comply with the requirements of 29 CFR 1910.1200 and 29 CFR 1926.59, Hazard Communication.

1.9.2.3 Physical Agents

A number of physical hazards are anticipated at this site. Noise levels from heavy equipment in use at the site will be measured, and appropriate engineering or personal protective equipment (PPE) requirements made if the OSHA time-weighted average (TWA) permissible exposure limit (PEL) of 85 decibels (dB) is exceeded.

1.9.2.4 Heavy Equipment Use

The Contractor shall ensure that the employees working on heavy equipment are trained in each specific piece of equipment they will be operating. Contractor shall appraise that employees working around the equipment of the hazards associated with the equipment in use. Contractor shall ensure that equipment operator’s equipment is in proper working order, with all safety features (back-up alarms, brakes, etc.) fully operational. Employees working on the ground shall wear highly visible safety vests, and maintain voice or hand contact with the equipment operators.

1.9.2.5 Radiological Hazards

There are no known radiological hazards at this site.

1.9.2.6 Biological Hazards

Biological hazards include biting or stinging insects and spiders, noxious weeds and stray animals.

1.9.3 Action Levels

1.9.3.1 General

Actions levels (air monitoring measurements above which specific actions must be taken) shall be established for the situations listed below, at a minimum. The action levels and required actions (engineering controls, changes in PPE, etc.) shall be presented in the SSHP in both text and tabular form and include the following:

a. When and where specific engineering controls and work practices are to be implemented;

b. The appropriate level of PPE to wear, and the basis for upgrading or downgrading the attire;

c. What conditions constitute a work stoppage and/or emergency evacuation of on-site personnel

d. Means of prevention and/or minimization of public exposures to hazards created by site activities.

1.10 CONFINED SPACE ENTRY

Although confined space entry is not anticipated, Contractor may encounter confined spaces during the excavation and trenching work. Possible confined space issues that may arise include manhole tie-ins with treatment system connection piping and sanitary lines in open trenches. A Confined Space Entry Program shall be included in the SSHP. In no case may Contractor allow entry when oxygen readings are less than 19.5 percent or greater than 23.5 percent or if the Lower Explosive Limit (LEL) reading is greater than 10 percent, unless protective measures for these conditions are adequately addressed in the Confined Space Entry Program shall be in compliance with 29 CFR 1910.146 EM 385-1-1.

1.11 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

An organizational structure shall be developed that sets forth lines of authority (chain of command), responsibilities, and communication procedures concerning site safety, health, and emergency response. This organizational structure shall cover management, supervisors, and employees of Contractor and subcontractors. The structure shall include the means for coordinating and controlling work activities of subcontractors and suppliers. The SSHP shall include a description of this organizational structure as well as qualifications and the responsibilities of each of the following individuals. Contractor shall obtain the EPA's acceptance before replacing any member of the Safety and Health Staff. Requests shall include the names, qualifications, duties, and responsibilities of each proposed replacement.

1.11.1 Construction Manager

A Construction Manager, who has the responsibility to implement the SSHP, the authority to direct work performed under this contract and verify compliance, shall be designated.

1.11.2 Safety and Health Manager

1.11.2.1 Qualifications

The services of an Industrial Hygienist certified by the American Board of Industrial Hygiene (ABIH) shall be utilized. The name, qualifications (education summary and documentation, ABIH certificate), and work experience summary shall be included in the SSHP. The Safety and Health Manager shall have the following additional qualifications:

a. A minimum of 3 years experience in developing and implementing safety and health programs at hazardous waste sites;

b. Documented experience in supervising professional and technician level personnel;

c. Documented experience in developing worker exposure assessment programs and air monitoring programs and techniques;

d. Documented experience in the development of PPE programs, including programs for working in and around potentially toxic, flammable and combustible atmospheres and confined spaces; and

e. Working knowledge of state and Federal occupational safety and health regulations.

1.11.2.2 Responsibilities

The Safety and Health Manager shall:

a. Be responsible for the development, implementation, oversight, and enforcement of the SSHP;

b. Sign and date the SSHP prior to submittal of original and all subsequent revisions;

c. Prepare and supervise implementation of site-specific training;

d. Be present on site during the first 3 calendar days of remedial activities and at the startup of each new major phase;

e. Visit the site as needed and at least once per month for the duration of activities, to audit the effectiveness of the SSHP;

f. Be available for emergencies;

g. Provide on site consultation as needed to ensure the SSHP is fully implemented;

h. Coordinate any modifications to the SSHP with the Construction Manager, the Project Engineer, SSHO, and the EPA;

i. Provide continued support for upgrading/downgrading of the level of PPE;

j. Be responsible for collection and evaluation of air monitoring data and recommending changes to engineering controls, work practices, and PPE;

k. Review accident reports and results of daily inspections; and

l. Serve as a member of Contractor’s quality control staff.

1.11.3 Site Safety and Health Officer (SSHO)

1.11.3.1 Qualifications of SSHO

An individual and one alternate shall be designated the SSHO. The name, qualifications (education and training summary and documentation), and work experience of the SSHO and alternate shall be included in the SSHP. The SSHO shall have the following qualifications:

a. A minimum of 2 years experience in implementing safety and health programs;

b. Documented experience in construction techniques and construction safety procedures;

c. Working knowledge of Federal and state occupational safety and health regulations; and

d. Specific training in personal and respiratory protective equipment program implementation, confined space program oversight, and in the proper use of air monitoring instruments, and air sampling methods.

1.11.3.2 Responsibilities of SSHO

The SSHO shall:

a) Assist and represent the Safety and Health Manager in on-site training and the day to day on-site implementation and enforcement of the accepted SSHP;

b) Be assigned to the site on a full-time basis for the duration of field activities. The SSHO shall have no duties other than Safety and Health-related duties. If operations are performed during more than 1 work shift per day, a site Safety and Health Officer shall be present for each shift;

c) Have authority to ensure site compliance with specified safety and health requirements, Federal, state, and OSHA regulations and all aspects of the SSHP including, but not limited to, activity hazard analyses, air monitoring, use of PPE, decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, confined space entry procedures, spill containment program, and preparation of records by performing a daily safety and health inspection and documenting the results on the Daily Safety Inspection Log;

d) Have authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions;

e) Consult with and coordinate any modifications to the SSHP with the Safety and Health Manager, the Construction Manager, and the EPA;

f) Serve as a member of Contractor's quality control staff on matters relating to safety and health;

g) Conduct accident investigations and prepare accident reports;

h) Review results of daily quality control inspections and document safety and health findings into the Daily Safety Inspection Log; and

i) In coordination with site management and the Safety and Health Manager, recommend corrective actions for identified deficiencies and oversee the corrective actions.

1.12 TRAINING

Personnel shall receive training in accordance with Contractor's written safety and health training program, 29 CFR 1910 Section .120, 29 CFR 1926 Section .65, 29 CFR 1926 Section .21, 29 CFR 1926 Section .62, 29 CFR 1926 Section .1118, and 29 CFR 1926 Section .1127. The SSHP shall include a section describing training requirements.

1.12.1 General Hazardous Waste Operations Training

Personnel entering the exclusion or contamination reduction zones shall have successfully completed 40 hours of hazardous waste instruction off the site; 3 calendar days actual field experience under the direct supervision of a trained, experienced supervisor; and 8 hours refresher training within 12 months after completion of 40-hour initial training, or within 12 months of time of entry onto site. On-site supervisors shall have completed the above training and 8 hours of additional, specialized training covering at least the following topics: the employer's safety and health program, personal protective equipment program, spill containment program, and health hazard monitoring procedures and techniques.

1.12.2 Site-Specific Training

Site-specific training sessions shall be documented in accordance with Section 01.B.03.b of EM 385-1-1.

1.12.2.1 Initial Sessions (Pre-Entry Briefing)

Prior to commencement of on-site field activities, all site employees shall attend a site-specific safety and health training session of at least 4 hours duration. This session shall be conducted by the Safety and Health Manager and the SSHO to ensure that all personnel are familiar with requirements and responsibilities for maintaining a safe and healthful work environment. Procedures and contents of the accepted SSHP and Sections 01.B.02 and 28.D.03 of EM 385-1-1 shall be thoroughly discussed. The RPM shall be notified at least 5 calendar days prior to the initial site-specific training session so government personnel involved in the project may attend.

1.12.2.2 Periodic Sessions

Periodic on-site training shall be conducted by the SSHO at least weekly during site work for personnel assigned to work at the site during the following 5 to 7 calendar days. The training shall address safety and health procedures, work practices, any changes in the SSHP, activity hazard analyses, work tasks, or schedule; results of previous week's air monitoring, review of safety discrepancies and accidents. Should an operational change affecting on-site field work be made, a meeting prior to implementation of the change shall be convened to explain safety and health procedures. Site-specific training sessions for new personnel, visitors, and suppliers shall be conducted by the SSHO using the training curriculum outlines developed by the Safety and Health Manager.

1.12.2.3 Other Training and Safety Meetings

All work positions in the exclusion and contamination reduction zones will be staffed with personnel who have successfully completed a classroom occupational hazards training program and other training (including annual refresher training) that meets or exceeds the requirements of 29 CFR 1910.120. Required training includes a minimum of 3 calendar days actual field experience under supervision of a trained and experienced supervisor and 8-hour training for supervisors. For those persons wearing respirators, annual respirator training will be provided as required by substance-specific standards, or under the general program requirements of 1910.134(b).

Joint Health and Safety meetings will be held once work begins on site with all Contractors participating. Contractor and the EPA may request Joint Health and Safety meetings when deemed necessary. Contractor will take minutes of all Joint Health and Safety Conferences.

1.13 PERSONAL PROTECTIVE EQUIPMENT

1.13.1 General

In accordance with 29 CFR 1910 Section .120(g) (5), a written PPE program which addresses the elements listed in that regulation, and which comply with respiratory protection program requirements of 29 CFR 1910 Section .134, is to be included in the employer's Safety and Health

Program. The SSHP shall detail the minimum PPE ensembles (including respirators) and specific materials from which the PPE components are constructed for each site-specific task and operation to be performed, based upon the hazard/risk analysis. Components of levels of protection (B, C, D and modifications) must be relevant to site-specific conditions, including heat and cold stress potential and safety hazards. Only respirators approved by NIOSH shall be used. On-site personnel shall be provided with appropriate PPE. Protective equipment and clothing shall be kept clean and well-maintained. The PPE section of the SSHP shall include site-specific procedures to determine PPE program effectiveness and for on-site fit-testing of respirators, cleaning, maintenance, inspection, and storage of PPE.

1.13.2 Levels of Protection

The Safety and Health Manager shall establish appropriate levels of protection for each work activity based on review of historical site information, existing data, an evaluation of the potential for exposure (inhalation, dermal, ingestion, and injection) during each task, past air monitoring results, and a continuing safety and health monitoring program. The Safety and Health Manager shall also establish action levels for upgrade or downgrade in levels of PPE from the following specified minimum levels of protection. Protocols and the communication network for changing the level of protection shall be described in the SSHP. The PPE reassessment protocol shall address air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, individual medical considerations, etc.

1.13.2.1 Components of Levels of Protection

Details regarding the levels of protection shall be addressed in the in the SSHP. Level D shall be used at a minimum for non-sampling and non-excavation portions of the site work. Level D includes, at a minimum, coveralls or similar work clothing, chemical-resistant safety boots, safety glasses, and a hard hat. Work gloves will be worn as necessary to avoid skin contact with sharp objects or rough edges on equipment.

1.13.3 PPE for Government Personnel

Three clean sets of PPE and clothing (excluding air-purifying negative-pressure respirators and safety shoes, which will be provided by individual visitors), as required for entry into the EZ and/or CRZ, shall be available for use by the EPA or official visitors. The items shall be cleaned and maintained by Contractor and stored as to provide adequate protection from contaminants and clearly marked: “FOR USE BY GOVERNMENT ONLY.” Contractor shall provide basic training in the use and limitations of the PPE provided, and institute administrative controls to check prerequisites prior to issuance. Such prerequisites include meeting minimum training requirements for the work tasks to be performed and medical clearance for site hazards and respirator use.

1.14 MEDICAL SURVEILANCE (REFER TO SSHP)

1.15 RADIATION DOSIMETRY (NOT USED)

1.16 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

The Safety and Health Manager shall prepare and implement an exposure monitoring/air sampling program to identify and quantify safety and health hazards and airborne levels of hazardous substances to assure proper selection of engineering controls, work practices and PPE for affected site personnel. Available site information shall be reviewed and the exposure monitoring/air sampling program shall be expanded and/or revised for submittal as part of the SSHP. Air sampling strategies should be based on the PELs of the compounds/elements present, the likelihood of their becoming airborne, and the physical parameters of each candidate contaminant (e.g. vapor pressure, percent pure product in sample media, etc.).

1.17 HEAT AND COLD STRESS MONITORING

The Safety and Health Manager shall develop a heat stress and cold stress monitoring program for on-site activities. Details of the monitoring program, including schedules for work and rest, and physiological monitoring requirements, shall be described in the SSHP. Personnel shall be trained to recognize the symptoms of heat and cold stress. The SSHO and an alternate person shall be designated, in writing, to be responsible for the heat and cold stress monitoring program.

1.17.1 Heat Stress

Physiological monitoring shall commence when the ambient temperature is above 70 degrees F. Monitoring frequency shall increase as the ambient temperature increases or as slow recovery rates are observed. Shaded rest areas and an adequate supply of cool drinking water shall be provided for the workers. NIOSH Pub No. 85-115 shall be consulted for guidance in determining protocols for prevention of heat stress.

1.17.2 Cold Stress

To guard against cold injury, appropriate clothing and warm shelter for rest periods shall be provided. Procedures to monitor and avoid cold stress shall be followed in accordance with the current threshold limit values for Cold Stress as recommended in ACGIH-02.

1.18 SAFETY PROCEDURES, ENGINEERING CONTROLS AND WORK PRACTICES

The SSHP shall describe the standard operating safety procedures, engineering controls, and safe work practices to be implemented for the work covered. These shall include, but not be limited to, the following.

1.18.1 General Site Rules/Prohibitions

General site rules/prohibitions will be followed; including: use of the buddy system; prohibiting eating, drinking, chewing tobacco or applying cosmetics while in any designated work zones at the site; having communications available with emergency responders off site (cell phone, radio); and the prohibitions of alcohol or drug use while on site. (Note that the use of individual, non-behavior altering prescription drugs will be allowed. These are drugs that do not produce drowsiness, inattentiveness or slow reaction times.)

1.18.2 Work Permit Requirements

Contractor is responsible for obtaining any permits necessary for work at this Site.

1.18.3 Material Handling Procedures

Excavated materials shall be handled in a manner to reduce the production of airborne contaminants. Liquids and residues shall be removed from tanks and/or pipelines using explosion-proof or air-driven pumps. Pump motors and suction hoses shall be bonded to the tank and grounded to prevent electrostatic ignition hazards. Use of a hand pump will be permitted to remove the last of the liquid from the bottom of the tanks. If a vacuum truck is used for removal of liquids or residues, the area of operation for the vacuum truck shall be vapor free. The truck shall be located upwind from the tank and outside the path of probable vapor travel. The vacuum pump exhaust gases shall be discharged through a hose of adequate size and length downwind of the truck and tank area. Vacuum truck operating and safety practices shall conform to API Publ. 2219. Tank residues shall be collected in drums, tanks, or tank trucks labeled according to 49 CFR 171 and 49 CFR 172 and disposed of as specified.

1.18.4 Drum and Container Handling

Drums containing purge water, decontamination water, soil cuttings, and other waste materials will be moved using proper drum moving techniques, to a site location to be determined based on information developed during the initial site visit.

1.18.5 Confined Space Entry Procedures

See paragraph 1.10 CONFINED SPACE ENTRY.

1.18.6 Hot Work

Hot work is anticipated for the erection of the pre-engineered steel building. Hot work safety procedures will be included in the SSHP. Prior to conducting hot work, a hot work permit shall be prepared by the person to be conducting the hot work and reviewed and signed of on by the Contractor's qualified person. An additional hot work permit may need to be obtained from local authorities or in the case of military or other federal installations, the fire marshal. An example format for a hot work permit shall be included in the AAPP/SSHP.

An individual at each hot work site shall be designated as a fire watch. This person's sole responsibility shall be to monitor the hot work and have immediate access to the fire extinguisher located at each hot work site. A new permit shall be obtained at the start of each work shift during which hot work will be conducted.

Additional information and safety procedures for performing hot work are provided in SECTION 01525 - SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS.

1.18.7 Ignition Sources

Ignition sources including smoking, open flames, or fires are not permitted at the Site, except by permit, as for hot-work.

1.18.8 Fire Protection and Prevention

Appropriate measures regarding housekeeping and other activities to reduce or eliminate the risk of fires shall be covered in the SSHP. Large construction vehicles and heavy equipment shall be equipped with a fire extinguisher. Fire extinguishers will also be placed in easily accessible locations for all areas where generators, fuel cans, or other flammable equipment are present.

1.18.9 Electrical Safety

Electrical Extension Cords shall not be used except for temporary job site requirements. Approval for any other use must be obtained from the SSHO.

All temporary electrical equipment used on the job site will be listed by an approved testing laboratory for the specific application. All temporary electrical installations must conform to the National Electric Code.

- Splices in electrical cords must retain the mechanical dielectric strength of the original cable;
- All generators and electrical equipment must be properly grounded; and
- Ground fault circuit interrupters (GFCIs) will be used on electrical equipment.

1.18.10 Excavation and Trench Safety

Trench excavations shall be performed in accordance with OSHA guidance for sloping, shoring, and shielding (CFR, Title 29, Part 1926.650-652) and in accordance with USACE EM-385-1-1. Site personnel will be cautioned to stand clear of all powered equipment and open excavations. Equipment must be positioned at least 4 feet away from the edges of the excavation. Use of a utility locator prior to digging is required. Routine entry into excavations for any reason is not anticipated. Site personnel will not enter any excavations of 4 feet or greater depth without proper shoring or loping, or without taking precautions for confined space entry in accordance with paragraph 1.10 CONFINED SPACE ENTRY.

1.18.11 Guarding of Machinery and Equipment
Proper guarding of moving part of machinery is not necessary for special attention in this plan. If any machine guard on earth moving or drill rig equipment is removed, it must be replaced prior to restarting the equipment.

1.18.12 Lockout/Tagout
Contractor must maintain its own Lockout/Tagout program for equipment it brings to the site, as well as for the use of any site utilities (i.e., steam, electricity, pressurized water, etc.).

1.18.13 Fall Protection
It is not anticipated that working from heights will be required for this project.

1.18.14 Hazard Communication
Contractor will provide the appropriate level of Hazard communication training to their employees, specific to those chemicals anticipated to be encountered while conducting intrusive work on site, as well as chemicals used as sample preservatives and/or cleaning agents.

1.18.15 Illumination
Outside work shall be conducted during daylight hours. For inside work which will be required as the treatment building is constructed, portable lighting shall be provided by the building contractor. The lighting shall provide adequate illumination for performance of work.

1.18.16 Sanitation
No sanitation facilities will be provided by the Government on the work Site. Contractor shall provide and maintain appropriate sanitation facilities on the work site including both toilet and hand/face wash facilities.

1.18.17 Process Safety Management
There are no industrial processes to be sampled during this project, so this item is not relevant to work at this site.

1.18.18 Signs and Labels
Labeling of all samples and/or disposal materials shall be in accordance with appropriate state and Federal regulations. Warning signs will also be posted in accordance with appropriate state and Federal regulation.

1.18.19 Waste Disposal
Waste products shall be stored in appropriate containers, which are emptied on a regular basis. Waste containers shall be removed from the work area and disposed of in accordance with Federal, state, and local regulations.

1.19 SITE CONTROL MEASURES

To prevent the spread of contamination and control the flow of personnel, vehicles, and materials into and out of work areas, site control measures shall be established and described in the SSHP. The SSHP shall describe the methodology to be used by the Safety and Health Manager and SSHO in determining work zone designations and their modifications, and procedures to limit the spread of contamination. The SSHP shall include procedures for the implementation and enforcement of safety and health rules for all persons on the site, including employers, employees, outside Contractors, government representatives, and visitors.

1.19.1 Work Zones

Initial anticipated work zone boundaries are shown on the Drawings. Non-essential personnel shall have limited access to these zones. Utilizing this guidance, work zone boundaries (EZ, including restricted and regulated areas; CRZ; and SZ) and access points shall be established and the boundary delineations shall be included on the Drawings and in the SSHP. Delineation of work zone boundaries shall be based on the contamination characterization data and the hazard/risk analysis to be performed as described in paragraph 1.19 SAFETY AND HEALTH HAZARD/RISK ANALYSIS. As work progresses and field conditions are monitored, work zone boundaries may be modified with approval of the EPA or Construction Manager in consultation with the Project Engineer. Work zones shall be clearly identified and marked in the field (using fences, tape, signs, etc.). A site map, showing work zone boundaries and locations of decontamination facilities, shall be posted in the on-site office. Work zones shall consist of the following:

a) Exclusion Zone (EZ): The exclusion zone is the area where hazardous contamination is either known or expected to occur and the greatest potential for exposure exists. Entry into this area shall be controlled and exit may only be made through the CRZ.

b) Contamination Reduction Zone (CRZ): The CRZ is the transition area between the Exclusion Zone and the Support Zone. The personnel and equipment decontamination areas shall be separate and unique areas located in the CRZ.

c) Support Zone (SZ): The Support Zone is defined as areas of the site, other than exclusion zones and contamination reduction zones, where workers do not have the potential to be exposed to hazardous substances or dangerous conditions resulting from hazardous waste operations. The Support Zone shall be secured against active or passive contamination. Site offices, parking areas, and other support facilities shall be located in the Support Zone.

1.19.2 Site Control Log

A log of personnel visiting, entering, or working on the site shall be maintained. The log shall include the following: date, name, agency or company, time entering and exiting site, time entering and exiting the exclusion zone (if applicable), and PPE utilized. Before visitors are allowed to enter the Contamination Reduction Zone or Exclusion Zone, they shall show proof of current training, medical surveillance and respirator fit testing (if respirators are required for the tasks to be performed) and shall fill out a Certificate of Worker or Visitor Acknowledgment. This visitor information, including date, shall be recorded in the log.

1.19.3 Communication

An employee alarm system that has adequate means of on and off site communication shall be provided and installed in accordance with 29 CFR 1910.165. The means of communication shall be able to be perceived above ambient noise or light levels by employees in the affected portions of the workplace. The signals shall be distinctive and recognizable as messages to evacuate or to perform critical operations. This includes the use of walkie talkies, radios, and telephones.

1.19.4 Site Security

Only authorized individuals will be allowed to enter the EZ. Control measures to exclude the public and unauthorized visitors will be established. Signs shall be printed in bold large letters on contrasting backgrounds in English and/or, where appropriate, in the predominant language of worker unable to read English. Signs shall be visible from all points where entry might occur and at such distances from the restricted area that employees may read the signs and take necessary protective steps before entering. Persons not authorized to work on Site shall not be granted access to restricted zones except when escorted by management-level project personnel.

1.20 PERSONNEL HYGIENE AND DECONTAMINATION

Personnel entering the EZ or CRZ or otherwise exposed or subject to exposure to hazardous chemical vapors, liquids, or contaminated solids shall adhere to the following personal hygiene and decontamination provisions. Decontamination shall be performed in the CRZ prior to entering the SZ from the EZ. Chapter 10.0 of NIOSH Pub No. 85-115 shall be consulted when preparing decontamination procedures. A detailed discussion of personal hygiene and decontamination facilities and procedures to be followed by site workers shall be submitted as part of the SSHP. Employees shall be trained in the procedures and the procedures shall be enforced throughout site operations. Persons disregarding these provisions of the SSHP shall be barred from the Site.

1.20.1 Personnel Decontamination Facilities

A personnel decontamination facility in the CRZ shall be provided by Contractor. This facility shall be used by both Contractor personnel and government representatives. The decontamination facility shall provide for separation of street clothing and contaminated PPE and shall be equipped with heating, lighting, ventilation, a change room and lockers, hot and cold water, shower facilities with hot and cold water, towels, soap in sufficient quantities for all anticipated personnel, and wastewater storage facilities for controlling the disposal of used water. Laundry facilities or provisions of laundry service are also required. If an off-site laundry service is used, they shall be notified, in writing, of the possibility and nature of contaminants expected on clothing. Provisions for appropriate separation of the sexes in the decontamination facility shall be made by Contractor.

1.20.2 Decontamination Procedures

Minimum decontamination procedures shall be specified in the SSHP. Available site information shall be reviewed and thee procedures shall be expanded and/or revised for submittal as part of the SSHP, as necessary.

1.21 EQUIPMENT DECONTAMINATION

Vehicles and equipment used in the EZ shall be decontaminated in the CRZ prior to leaving the site. The procedures for decontamination of vehicles and equipment shall be addressed in the SSHP.

1.21.1 Decontamination Facilities

A vehicle/equipment decontamination station shall be provided so that Contractor decontaminates vehicles and equipment prior to leaving the site. Contractor shall provide vehicle decontamination stations within the CRZ for decontaminating vehicles and equipment leaving the EZ as these zones are defined by Contractor.

1.21.2 Decontamination Procedures

Procedures for equipment decontamination shall be developed and utilized to prevent the spread of contamination into the SZ and offsite areas. These procedures shall address disposal of contaminated products and spent materials used on the site, including containers, fluids, oils, etc. Any item taken into the EZ shall be assumed to be contaminated and shall be inspected and/or decontaminated before the item leaves the area. Vehicles, equipment, and materials shall be cleaned and decontaminated prior to leaving the site. Construction material shall be handled in such a way as to minimize the potential for contaminants being spread and/or carried off site. Prior to exiting the site, vehicles and equipment shall be monitored to ensure the adequacy of decontamination.

1.22 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

The SSHP shall describe the emergency and first aid equipment to be available on site. The following items, as a minimum, shall be maintained onsite and available for immediate use:

a. First aid equipment and supplies approved by the consulting physician;

b. Emergency eyewashes and showers that comply with ANSI Z358.1;

c. Emergency-use respirators. The SSHP shall provide a rationale for whether emergency respirators are needed for the phase involving excavation/new exposure of surface soils. If needed, Contractor hall provide the respirators on site and available for immediate use.

d. Fire extinguishers shall be provided at site facilities and in all vehicles and at any other site locations where flammable materials present a fire risk.

1.23 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

An Emergency Response Plan, that meets the requirements of 29 CFR 1910.120(l) and 29 CFR 1926.65(l), shall be developed and implemented as a section of the SSHP. In the event of any emergency associated with remedial action, the Contractor shall, without delay, alert all on-site employees that there is an emergency situation; take action to remove or otherwise minimize the cause of the emergency; alert the EPA; and institute measures necessary to prevent repetition of the conditions or actions leading to, or resulting in, the emergency. Employees that are required to respond to hazardous emergency situations shall be trained in how to respond to such expected emergencies.

The plan shall be rehearsed regularly as part of the overall training program for site operations. The plan shall be reviewed periodically and revised as necessary to reflect new or changing site conditions or information. Copies of the accepted SSHP shall be provided to the affected local emergency response agencies. The following elements, as a minimum, shall be addressed in the plan:

a. Pre-emergency planning. The local emergency response agencies shall be contacted and met with during preparation of the Emergency Response Plan. Agencies to be contacted include local fire, police, and rescue authorities with jurisdiction and nearby medical facilities that may be utilized for emergency treatment of personnel. The Contractor shall ensure the Emergency Response Plan for the site is compatible and integrated with disaster, fire, and/or emergency response plans of local, state, and Federal agencies;

b. Personnel roles, lines of authority, communications for emergencies;

c. Emergency recognition and prevention;

d. Site topography, layout, and prevailing weather conditions;

e. Criteria and procedures for site evacuation (emergency alerting procedures, employee alarm system, emergency PPE and equipment, safe distances, places of refuge, evacuation routes, site security and control);

f. Specific procedures for decontamination and medical treatment of injured personnel;

g. Route maps to nearest prenotified medical facility. Site-support vehicles shall be equipped with maps. At the beginning of project operations, drivers of the support vehicles shall become familiar with the emergency route and the travel time required;

h. Emergency alerting and response procedures including posted instructions and a list of names and telephone numbers of emergency contacts (physician, nearby medical facility, fire and police departments, ambulance service, Federal, state, and local environmental agencies; as well as Safety and Health Manager, the Construction Manager, the EPA and/or their alternates);

i. Criteria for initiating community alert program, contacts, and responsibilities;

j. Procedures for reporting incidents to appropriate government agencies. In the event that an incident such as an explosion or fire, or a spill or release of toxic materials occurs during the course of the project, the appropriate government agencies shall be immediately notified. In addition, the EPA shall be verbally notified immediately and receive a written notification within 24 hours. The report shall include the following items:

    a. Name, organization, telephone number, and location of the Contractor;

    b. Name and title of the person(s) reporting;

    c. Date and time of the incident;

    d. Location of the incident, i.e., site location, facility name;

    e. Brief summary of the incident giving pertinent details including type of operation ongoing at the time of the incident;

    f. Cause of the incident, if known;

    g. Casualties (fatalities, disabling injuries);

    h. Details of any existing chemical hazard or contamination;

    i. Estimated property damage, if applicable;

    j. Nature of damage, effect on contract schedule;

    k. Action taken to ensure safety and security;

l. Other damage or injuries sustained, public or private;

k. Procedures for critique of emergency responses and follow-up.

1.24 CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGEMENT

A copy of a Contractor-generated certificate of worker/visitor acknowledgement shall be completed and submitted for each visitor allowed to enter contamination reduction or exclusion zones, and for each employee, following the example certificate at the end of this section.

1.25 INSPECTIONS

The SSHO's Daily Inspection Logs shall be attached to and submitted with the Daily Quality Control reports. Each entry shall include the following: date, work area checked, employees present in work area, PPE and work equipment being used in each area, special safety and health issues and notes, and signature of preparer.

1.26 SAFETY AND HEALTH PHASE-OUT REPORT

A Safety and Health Phase-Out Report shall be submitted within 10 working days following completion of the work, prior to final acceptance of the work. The following minimum information shall be included:

a. Summary of the overall performance of safety and health (accidents or incidents including near misses, unusual events, lessons learned, etc.);

b. Final decontamination documentation including procedures and techniques used to decontaminate equipment, vehicles, and on site facilities;

c. Summary of exposure monitoring and air sampling accomplished during the project;

d. Signatures of Safety and Health Manager and SSHO.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

Attachment 01351-A
SAMPLE FOR ON-SITE SAFETY MEETING/TAILGATE MEETING DOCUMENTATION

Project name:_______________________________________ Date:_________________

Location:____ Start Time:_____________

Conducted By:______________________________________ Stop Time:_____________

Topics Covered:____
____
____
____
____
____
____
____

Comments:____
____
____
____
____
____

ATTENDANCE:
Name (print):_____________________________Signature:___________________________
Name (print):_____________________________Signature:___________________________
Name (print):_____________________________Signature:___________________________
Name (print):_____________________________Signature:___________________________
Name (print):_____________________________Signature:___________________________
Name (print):_____________________________Signature:___________________________
Name (print):_____________________________Signature:___________________________
Name (print):_____________________________Signature:___________________________

Attachment 01351-B

SAMPLE FORM FOR CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGEMENT

PROJECT NAME:_______________________________________CONTRACT NO.___________
PROJECT
ADDRESS:____
CONTRACTOR'S NAME:____
[EMPLOYEE'S][VISITOR'S] NAME:____

The contract for the above project requires the following: that you be provided with and complete formal and site-specific training; that you be supplied with proper personal protective equipment including respirators; that you be trained in its use; and that you receive a medical examination to evaluate your physical capacity to perform your assigned work tasks, under the environmental conditions expected, while wearing the required personal protective equipment. These things are to be done at no cost to you. By signing this certification, you are acknowledging that your employer has met these obligations to you.

I HAVE READ, UNDERSTAND AND AGREE TO FOLLOW THE SITE SAFETY AND HEALTH PLAN FOR THIS SITE.

Name:____Date:____________________

FORMAL TRAINING: I have completed the following formal training courses that meet OSHA'S requirements:
Date completed 40 Hour:______________________
8 hour supervisory:_____________
8 hour refresher:_______________

SITE-SPECIFIC TRAINING: I have been provided and have completed the site-specific training required by this Contract. The Site Safety and Health Officer conducted the training.

____

RESPIRATORY PROTECTION: I have been trained in accordance with the criteria in my employer's Respiratory Protection program. I have been trained in the proper work procedures and use and limitations of the respirator(s) I will wear. I have been trained in and will abide by the facial hair policy.

____

RESPIRATOR FIT-TEST TRAINING: I have been trained in the proper selection, fit, use, care, cleaning, and maintenance, and storage of the respirator(s) that I will wear. I have been fit-tested in accordance with the criteria in my employer's Respiratory Program and have received a satisfactory fit. I have been taught how to properly perform positive and negative pressure fit-check upon donning negative pressure respirators each time.

____

MEDICAL EXAMINATION: I have had a medical examination within the last twelve month which was paid for by my employer. The examination included: health history, pulmonary function tests, and may have included an evaluation of a chest x-ray. A physician made determination regarding my physical capacity to perform work tasks on the project while wearing protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination. My employer's industrial hygienist evaluated the medical certification provided by the physician and checked the appropriate blank below. The physician determined that there:

___ were no limitations to performing the required work task;
___ were identified physical limitations to performing the required work tasks.

Date medical exam completed
[Employee's] [Visitor's] Signature____
Date___________________________ Printed Name___________________________________
Social Security Number ____
Contractor's Site Safety and Health Officer Signature________________________________
Date___________________________ Printed Name____________________________________
Social Security Number____

Attachment 01351-C

SAMPLE FORM FOR TRAINING CERTIFICATE

FORMAL TRAINING: I have completed the following formal training courses that meet OSHA'S requirements:
Date completed 40 Hour:______________________
8 hour supervisory:_____________
8 hour refresher:_______________

SITE-SPECIFIC TRAINING: I have been provided and have completed the site-specific training required by this Contract. The Site Safety and Health Officer conducted the training.

____

RESPIRATORY PROTECTION: I have been trained in accordance with the criteria in [Contractor's] [My Employer's] Respiratory Protection program. I have been trained in the proper work procedures and use and limitations of the respirator(s) I will wear. I have been trained in and will abide by the facial hair policy.

____

RESPIRATOR FIT-TEST TRAINING: I have been trained in the proper selection, fit, use, care, cleaning, and maintenance, and storage of the respirator(s) that I will wear. I have been fit-tested in accordance with the criteria in [Contractor's] [my employer's] Respiratory Program and have received a satisfactory fit. [I have been assigned my individual respirator.] I have been taught how to properly perform positive and negative pressure fit-check upon donning negative pressure respirators each time.

____

MEDICAL EXAMINATION: I have had a medical examination within the last twelve month which was paid for by my employer. The examination included: health history, pulmonary function tests, and may have included an evaluation of a chest x-ray. A physician made determination regarding my physical capacity to perform work tasks on the project while wearing protective equipment including a respirator. I was personally provided a copy and informed of the results of that examination. My employer's industrial hygienist evaluated the medical certification provided by the physician and checked the appropriate blank below. The physician determined that there:

___ were no limitations to performing the required work task;
___ were identified physical limitations to performing the required work tasks.

Date medical exam completed
[Employee's] [Visitor's] Signature____
Date__________________________ Printed Name__________________________________
Social Security Number ____
Contractor's Site Safety and Health Officer Signature_______________________________
Date__________________________ Printed Name___________________________________
Social Security Number____

Attachment 01351-D
ACCIDENT INVESTIGATION REPORT

This report is to be completed following the injury or illness or TN&A personnel. Answer all questions as completely as possible. Forward this report to the TN&A Corporate Safety and Health office within 24 hours of the accident. See instructions for directions to complete this form.

IDENTIFICATION			
Date and Time of Accident:		**Date Reported:**	
Employee Involved:	**Position:**		**Date Employed:** **Experience on the Job:**
Location:			
Name of Project/Project No.:			
Supervisor:		**Witnesses:**	

INCIDENT			
Accident Resulted in: ❑ **Injury** ❑ **Illness** ❑ **Property Damage**	**Recordability:** ❑ **First Aid** ❑ **Medical** ❑ **Lost Time**	**Nature of Injury:** **Part of Body:**	**Type of Accident:**
Description of Accident:			

ANALYSIS
Describe Hazards, Unsafe Condition(s) or Acts:
Describe Underlying Cause(s) or Failures:

CONTROLS	
Recommended Corrective Action:	
Action Taken:	
FOLLOW UP: Scheduled:	**Conducted By:**

Investigated by:	**Print Name**	**Signature**	**Date**
Employee			
Supervisor			
Reviewed by:	**Print Name**	**Signature**	**Date**
Corp. SHM			

ACCIDENT INVESTIGATION REPORT

Distribution by SSHO:
- -USACE SSHO
- -Contractor SSHO
- -Project Manager
- --Personnel Office (medical treatment cases only)

INSTRUCTIONS:
Remember, an accident investigation is not designed to find fault or blame. It is an analysis to determine causes that can be controlled or eliminated.

IDENTIFICATION
This section is self-explanatory. When completing the form, complete the whole section.

INCIDENT
Accident resulting in: Check appropriate box
Recordability: Check appropriate box based on:
- First Aid – Resulted in a minor injury/treatment administered by trained first aider-on premises.
- Medical Treatment – Resulted in more serious injury/treatment administered by physician, emergency room-off premises.
- Lost Time – Employee missed more than ½ day from work.

Provide a brief description of the following:
- Nature of the injury – Principle physical characteristics/what happened to employee, i.e.; sprain, contusion, burn, laceration, etc.
- Part of body – Body part directly affected by injury, i.e.; hand, fingers, arm, back, shoulder, etc. Be specific.
- Type of accident – Brief classification of type of accident, i.e.; material handling (lifting, pulling, pushing), contact with hot substance, slip/trip/fall, struck by/against, fall from elevator, etc.

Description of Accident: Describe in detail what happened; where it happened; why it happened; how it happened; what materials, equipment or conditions were involved; when it happened, etc. Provide prompt, accurate, thorough information.

ANALYSIS
Describe all hazard(s), condition(s) or act(s) which contributed to the accident:
- Unsafe conditions – hazardous or unsafe physical condition or circumstance, i.e.; congested production area, improperly designed workstation or tools, spill (grease, oil, water, etc.) on the floor, inadequate lighting, poor housekeeping, defective equipment, weights handled, poor ventilation, etc.
- Unsafe acts – Unsafe work practice, i.e.; failure to place warning signs/tags/signals, leaving spills on floor, using defective equipment, horseplay, substance abuse, failure to use personal protective equipment, etc.

Describe all underlying cause(s) or failure(s) which contributed to the accident:
- Underlying causes/failures – Frequency or repetition of a task, improper postures, possible safety program deficiencies, i.e.; ineffective rules/regulations, ineffective employee training, inadequate or unsafe job procedure, etc.

CONTROLS
Unsafe conditions and unsafe acts are symptoms of the underlying causes of accidents. Accident investigations should strive to identify the *underlying* causes, and recommendations should address corrective actions, both administrative and physical in nature. Consideration should be given to the physical work environment, managerial controls, and individual characteristics all of which contribute to industrial actions.

FOLLOW UP
Once investigations are completed, they should be periodically reviewed. This will ensure that proper controls were implemented and that the corrective actions remain a part of the safety program.

The CSHM is a good source to assist in conducting this review. The CSHM can determine if the investigations are completed in a timely manner, if they are thorough and if they are accurate. The CSHM will recommend any additional corrective action needed and monitor the implementation of any recommended controls.

SECTION 01355A

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

U.S. AIR FORCE (USAF)
AFI 32-1053 (1999) Pest Management Program

U.S. ARMY (DA)
DA AR 200-5 (1999) Pest Management

U.S. ARMY CORPS OF ENGINEERS (USACE)
EM 385-1-1 (2003) Safety -- Safety and Health Requirements
WETLAND MANUAL Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
33 CFR 328 Definitions of Waters of the United States
40 CFR 152 - 186 Pesticide Programs
40 CFR 260 Hazardous Waste Management System: General
40 CFR 261 Identification and Listing of Hazardous Waste
40 CFR 262 Standards Applicable to Generators of Hazardous Waste
40 CFR 279 Standards for the Management of Used Oil
40 CFR 302 Designation, Reportable Quantities, and Notification
40 CFR 355 Emergency Planning and Notification
40 CFR 68 Chemical Accident Prevention Provisions
49 CFR 171 - 178 Hazardous Materials Regulations

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval.

Section SD-01 Preconstruction Submittals
Environmental Protection Plan; G

1.3 DEFINITIONS

1.3.1 Environmental Pollution and Damage

Environmental pollution and damage is the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.3.2 Environmental Protection

Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.3.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means materials that, if abandoned or disposed of, may meet the definition of a hazardous waste. These waste streams would typically consist of material brought on site by the Contractor to execute work, but are not fully consumed during the course of construction. Examples include, but are not limited to, excess paint thinners (i.e. methyl ethyl ketone, toluene etc.), waste thinners, excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.3.4 Installation Pest Management Coordinator (not applicable)

1.3.5 Project Pesticide Coordinator (not applicable)

1.3.6 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor shall discharge water at a rate which allows the water to percolate into the soil. No sheeting action, soil erosion, discharge into storm sewers, discharge into defined drainage areas, or discharge into the "waters of the United States" shall occur. Land Application shall be in compliance with all applicable Federal, State, and local laws and regulations.

1.3.7 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant or desiccant.

1.3.8 Pests

The term "pests" means arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, marine borers, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect readiness, military operations, or the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

1.3.9 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.3.10 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.3.11 Wetlands (not applicable)

1.4 GENERAL REQUIREMENTS

The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations.

1.4.1 Equipment Inspection

All construction equipment shall be inspected on a daily basis prior to the start of work, with attention paid to the condition of hydraulic lines and fittings so as to help prevent spills related to line failure.

1.5 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.6 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the EPA. The below described elements of the Environmental Protection Plan will be incorporated into the Remedial Action Plan (see paragraph 1.6.2 CONTENTS). The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction and implementation of the remedial action. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Project Engineer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan shall be current and maintained onsite by the Contractor.

1.6.1 Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.6.2 Contents

The environmental protection plan shall include, but shall not be limited to, the following:

A. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.

B. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

C. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

D. Description of the Contractor's environmental protection personnel training program.

E. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan shall include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

F. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

G. Traffic control plans including measures to reduce erosion by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

H. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

I. The spill control plan, to be included in the Site Safety and Health Plan (SSHP), shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations (see SECTION 01351 SAFETY, HEALTH, AND EMERGENCY RESPONSE).

J. The spill control plan supplements the requirements of EM 385-1-1. This plan shall include as a minimum:

1. The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately notify the Project Engineer, Construction Manager, and the local Fire Department and Facility Response Personnel, in addition to the legally required Federal, State, and local reporting channels (including the National Response Center at 1-800-424-8802) if a reportable quantity is released to the environment. The plan shall contain a list of the required reporting channels and telephone numbers.

2. The name and qualifications of the individual who will be responsible for implementing and supervising the containment and cleanup.

3. Training requirements for Contractor's personnel and methods of accomplishing the training.

4. A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

5. The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

6. The methods and procedures to be used for expeditious contaminant cleanup.

K. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including construction debris will be incorporated into the Remedial Action Plan. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. The Contractor will report to the Project

Engineer or QC Engineer regarding the amounts of non-hazardous solid waste that are disposed of for each phase of the project.

L. An air pollution control plan describing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site. The plan must comply with Los Angeles Air quality Management District regulations.

M. A contaminant prevention plan will be incorporated into the SSHP. The plan will identify potentially hazardous substances to be used on the job site and describe provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be attached to the SSHP. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.

N. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters that are derived from project activities will be incorporated into the Remedial Action plan. The plan will specify testing requirements of waste water for possible pollutants. If land application will be the method of disposal for the waste water, the plan shall include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, a copy of the permit and associated documents shall be included as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan shall include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

1.6.3 Appendix

Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents shall be attached, as an appendix, to the Environmental Protection Plan.

1.7 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Project Engineer or QC Engineer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the Contractor and the Project Engineer or QC Engineer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.8 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings, plans and specifications which may have an environmental impact will be subject to approval by the EPA and may require an extended review, processing, and approval time. The EPA reserves the right to disapprove alternate methods, even if they are more cost effective, if the EPA determines that the proposed alternate method will have an adverse environmental impact.

1.9 NOTIFICATION

The EPA will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. The Contractor shall, after receipt of such notice, inform the EPA of the proposed corrective action and take such action when approved by the EPA. The EPA may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the EPA may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS

The Contractor shall be responsible for complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations.

3.2 LAND RESOURCES

The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into areas outside the designated work areas shall be removed by the Contractor.

3.2.1 Work Area Limits

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.2.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs). BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Any temporary measures shall be removed after the area has been stabilized.

3.2.4 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Project Engineer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by local, State, or Federally issued Clean Water Act permits.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all Federal, State, and local air emission and performance laws and standards.

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from project activities; and processing and preparation of materials shall be controlled at all times, including weekends, holidays and hours when work is not in progress. Sprinkling, chemical treatment of an approved type, baghouse, scrubbers, electrostatic precipitators or other methods will be permitted to control particulates in the work area. Sprinkling, to be efficient, must be repeated to keep the disturbed area damp at all times. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

3.4.3 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the State of California and local rules.

3.4.4 Burning

Burning will not be allowed on the project site unless specified in other sections of the specifications or authorized in writing by the EPA. The specific time, location, and manner of burning shall be subject to approval.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.5.1 Solid Wastes

Solid wastes (excluding construction debris) shall be placed in containers that are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill shall be the minimum acceptable off-site solid waste disposal option. The Contractor shall verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate. Waste materials shall be hauled to the appropriate licensed landfill site approved by the EPA. The Contractor shall comply with Federal, State, and local laws and regulations pertaining to the use of landfill areas.

3.5.2 Chemicals and Chemical Wastes

Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. Chemical waste shall be collected in corrosion resistant, compatible containers. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be classified, managed, stored, and disposed of in accordance with Federal, State, and local laws and regulations.

3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures, such as secondary containment, against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations. The Contractor shall transport Contractor generated hazardous waste off Government property within 90 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and local laws and regulations. Spills of hazardous or toxic materials shall be immediately reported to the Project Engineer and Construction Manager. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility. The Contractor shall report the disposition of hazardous material to the EPA.

3.5.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. Storage of fuel on the project site shall be accordance with all Federal, State, and local laws and regulations.

3.5.5 Waste Water

Disposal of waste water shall be as specified below.

A. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.

B. Groundwater discharge shall be retained in 55-gallon drums, FRAC tank, or other appropriate container for testing, treatment, and disposal. Treated waste water that has been appropriately sampled and tested in accordance with the approved waste management plan

C. Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing shall be land applied in accordance with all Federal, State, and local laws and regulations for land application, or stored in 55-gallon drums, FRAC tank, or other appropriate container.

3.6 RECYCLING AND WASTE MINIMIZATION

The Contractor shall participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project.

3.7 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

The Contractor shall maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. The Contractor shall report non-hazardous solid waste disposal volumes to the Project Engineer as part of regular project activity reports.

3.8 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal, or other deposits; rock or coral alignments, pavings, wall, or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the EPA so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.9 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations.

3.10 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds.

3.11 MILITARY MUNITIONS

In the event the Contractor discovers or uncovers military munitions as defined in 40 CFR 260, the Contractor shall immediately stop work in that area and immediately inform the EPA.

3.12 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution; familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control; anticipated hazardous or toxic chemicals or wastes, and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.13 CONTAMINATED MEDIA MANAGEMENT

Contaminated environmental media consisting of, but not limited to, ground water, soils, and sediments shall be managed in accordance with this Section and SECTION 02111-EXCAVATION OF CONTAMINATED MATERIAL.

3.14 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the EPA, obliterate all signs of temporary construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated.

END OF SECTION

SECTION 01450

CHEMICAL DATA QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The most recent version of the reference shall be applicable in all cases.

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 172 Hazardous Material Table, Special Provisions, Hazardous Material Communications, Emergency Response Information, and Training Requirements

49 CFR 178 Specifications for Packaging

40 CFR 230 Section 404 Guidelines for Specification of Disposal Sites for Dredged or Fill Material

40 CFR 261 Identification and Listing of Hazardous Wastes

40 CFR 262 Standards Applicable to Generators of Hazardous Wastes

40 CFR 268 Land Disposal Restrictions

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 200-1-1 Validation of Analytical Chemistry Laboratories

EM 200-1-2 Technical Project Planning Guidance for Hazardous, Toxic, and Radiological Waste (HTRW) Data Quality Design

EM 200-1-3 Requirements for the Preparation of Sampling and Analysis Plans

EM 200-1-6 Chemical Quality Assurance Shell for Analytical Chemistry Memorandum for Record. Interim Chemical Data Quality Management (CDQM) Policy for USACE HTRW Projects. November 23, 1998.

ER 1110-1-263 Chemical Data Quality Management for Hazardous, Toxic, Radioactive Waste Remedial Activities

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 540-R-01/008 Contract Laboratory Program National Functional Guidelines for Inorganic Data Review

EPA 540/R-99/008 Contract Laboratory Program National Functional Guidelines for Organic Data Review

EPA SW-846 (Rev O; updates I, II, IIA, IIB, III, and IIIA) Test Methods for Evaluating Solid Waste (Vol. IA, IB, IC, and II)

1.2 ACRONYMS

The definition of acronyms used by Contractor that pertain to chemical data quality control shall be clearly defined for all contract-related products and communications.

1.3 CHEMISTRY REQUIREMENTS

Chemical Data Quality Control (CDQC) shall be as defined in ER 1110-1-263; this ER, which integrates USACE guidance on the subject, shall be supplemented by EM 200-1-6 for detail technical guidance on CDQC. Tables and charts defining specific chemistry shall be according to or consistent with EM 200-1-3. Analyses shall be in accordance with the USACE Shell (Appendix I, EM200-1-3). The “Shell” provides necessary clarification of the EPA, Office of Solid Waste Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846 Third Edition and subsequent updates and is designed to keep pace with the rapidly developing regulatory and industry move toward performance based measurement systems. The “Shell” asks that project-specific data quality requirements be achievable by the laboratory to be used and if not the differences are resolved or corrected. For the method in use, the laboratory must demonstrate the ability to detect the chemical of concern in the matrix of concern at a level of concentration below the action level for that chemical in order that when concentrations of that chemical are reported near the action level, action decisions are made reliably with minimum of error. The “Shell” outlines general procedures for most methods to be used for the laboratory to follow in order to demonstrate that preparation, subsampling and measurement procedures used in generating the data were in control. It also requires that corrective action procedures be detailed. By using the “Shell” to specify performance expectations, the quality of the laboratory product will be improved.

1.4 DATA QUALITY OBJECTIVES (DQOS)

Sample acquisition, chemical analysis, and chemical parameter measurements shall be performed so that the resulting data meet and support data use requirements. The chemical data shall be acquired, documented, verified, and reported to ensure that the specified precision, accuracy, representativeness, comparability, and completeness as specified in the "Shell" are achieved. Sensitivity requirements, as indicated by laboratory method detection limits and reporting limits, must be below the benchmarks indicated in 1.3.3. Final decisions regarding DQOs, and QC protocols will be made by the Contractor and Government after completing the systematic planning process for analytical and sampling design during the Sampling and Analysis Plan development.

1.5 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

SD-09 Reports
Sampling and Analysis Plan (SAP); G.
The SAP, including the FSP and the QAPP, no later than 60 days after receipt of notice to proceed, to be submitted with the Remedial Action Work Plan.

Remedial Action Work Plan (RAWP); G
The RAWP, including the Remedial Action Management Plan and the Construction Quality Control Plan no later than 60 days after receipt of notice to proceed, to be submitted with the SAP.

1.6 COORDINATION MEETING

After the pre-construction conference, before any sampling or testing, Contractor and the EPA will meet at the construction site to discuss the RAWP and the SAP. The coordination meeting will be simultaneous to any QC coordination meeting required in SECTION 01451-CONTRACTOR QUALITY CONTROL unless otherwise indicated or directed. A list of definable features that involve chemical measurements shall be agreed upon. At a minimum, each matrix (soil, water, air, containerized wastes, radioactive wastes, instrumental chemical parameter measurement, etc.) shall be a definable work feature. Management of the chemical data quality system including project DQO, project submittals, chemical data documentation, chemical data assessment, required sampling and analysis protocols, and minimum data reporting requirements shall be agreed upon. The meeting will establish an interrelationship between Contractor's chemical data quality management and Government chemical quality assurance requirements. Minutes of the meeting will be documented by the Government and shall be signed by both Contractor and the EPA. The minutes will include any or all unresolved chemical issues along with the conditions for resolution and will become a part of the contract file.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Contractor shall be responsible for chemical sample acquisition, sample analysis, instrumental measurements of chemical parameters, and for chemical data quality control. An effective chemical data quality control system shall be established that meets the requirements for the chemical measurement DQOs applicable to the project. The system shall cover chemical measurements pertaining to and required for Contractor- and subcontractor-produced chemical data. Contractor shall control field screening, sampling, and testing in conjunction with remedial activities to meet all DQOs; minimize the amount of excavated material requiring temporary storage; prevent dilution of contaminated soils with clean soils; and ensure completion of work within the required time.

3.2 REMEDIAL ACTION WORK PLAN

3.2.1 General

In addition to the quality control requirements specified in Section 01451-CONTRACTOR QUALITY CONTROL, the RAWP shall incorporate the qualifications, authority, and responsibilities of all chemical quality management and support personnel. Chemical measurements including sampling and/or chemical parameter measurement will not be permitted to begin until after production and acceptance of the RAWP, and Government approval of the SAP.

3.2.2 Chemistry Elements of the RAWP

To cover contract-related chemical measurements by Contractor and all subcontractors, the CQC Plan shall include the following as a minimum.

3.2.2.1 Qualifications
Names, education, experience qualifications, authorities, and decision-making responsibilities of all chemical quality management and support personnel. The RAWP shall contain a copy of a letter from the project QC manager designating and authorizing a Chemical Quality Control Officer and chemical quality control organization staff.

3.2.2.2 Authority and Responsibility
A diagram, flow chart, or figure clearly depicting the chemical data quality management and support staff, and the authority and responsibility of each for chemical sampling and analysis, procedures for corrective actions, deliverables and submittals, deviations and changes, chemical quality documentation, data validation, minimum data reporting requirements, and DQO for chemical parameter measurement by Contractor and subcontractors. The contents of this section of the RAWP shall be included in the applicable "Project Organization" elements of the FSP and the QAPP.

3.3 SAMPLING AND ANALYSIS PLAN
The SAP shall be prepared in accordance with US EPA requirements and EM 200-1-3. The SAP shall be a single document that contains two distinct elements: FSP and QAPP. Sections of the FSP and QAPP shall be cross-referenced. The SAP shall confirm Contractor's understanding of the contract requirements for chemical data quality control, and shall describe procedures for field sampling and sample submittal for analysis, field chemical parameter measurement, data documentation, data assessment, and data reporting requirements. The SAP shall delineate the methods Contractor intends to use to accomplish the chemical quality control items to assure accurate, precise, representative, complete, legally defensible, and comparable data. The SAP shall describe all chemical parameter measurements for all matrices for all phases of the remediation contract. As a single interrelated document, the SAP shall be provided to field and laboratory personnel. Contractor may propose original/innovative approaches to chemical parameter measurements for cost reduction and remediation efficiency by abbreviated sampling, contingency sampling and/or contingency analysis, indicator or tracer analysis, on-site analytical services, equivalency or screening methods. The SAP shall clearly identify Contractor-obtained laboratories. Contractor shall furnish copies of the Government-approved SAP to all laboratories and Contractor's field sampling crew. The SAP shall address all levels of the investigation with enough detail to become a document which may be used as an audit guide for field and laboratory work. Chemical data management is required to be described in the SAP. It assures that all data and information collected or generated during this project are processed and stored in a manner that assures data quality, security, integrity, and retrievability. The system described shall be used to store and track project data from collection through analysis, interpretation and reporting. Administrative data tracking shall also be addressed. The contractor shall describe the procedures to be used to document and track investigation data and results. Data management shall encompass all data gathering, analysis, control, inventory, and filing processes associated with data collection activities.

3.3.1 Field Sampling Plan (FSP)
The FSP shall contain necessary technical detail and direction for the field personnel to understand sampling and field measurement requirements. The FSP shall provide a comprehensive description and full detail for personnel to perform all on-site activities required to attain project DQOs, including: locations of samples, sampling procedures for on-site and off-site chemical analysis, summaries of analyses to be performed on samples, shipment of samples for off-site analyses, performance of on-site and off-site instrumental parameter measurements, data documentation, and reporting requirements.

3.3.2 Quality Assurance Project Plan (QAPP)

The QAPP shall contain necessary technical detail and direction for field and laboratory personnel to understand project sample analysis, quality control and data reporting requirements, analytical methods, required detection limits, QC requirements, and data validation and reporting requirements. Laboratory standard operating procedures (SOPs) shall be appended to the QAPP or transmitted separately to the USACE project chemist.

3.4 CONTROL OF CHEMICAL DATA QUALITY

Contractor chemical data quality control shall ensure that a quality control program is in place that assures sampling and analytical activities and the resulting chemical parameter measurement data comply with the DQOs and the requirements of the SAP. Contractor shall utilize the three-phase control system that includes a preparatory, initial, and follow-up phase for each definable feature of work. Contractor's three-phase chemical data control process shall ensure that data reporting requirements are achieved and shall be implemented according to SECTION 01451 CONTRACTOR QUALITY CONTROL. The three-phase chemical data control process shall be combined with that under SECTION 01451-CONTRACTOR QUALITY CONTROL.

3.5 ANALYTICAL TESTING LABORATORIES

Contractor shall propose the analytical laboratories to be used for the primary samples analyses. Laboratory validation requirements shall be in accordance with paragraph 1.4.1 LABORATORY VALIDATION REQUIREMENTS. Contractor may utilize own laboratory or utilize subcontract laboratories to achieve the primary required sample analyses.

3.5.1 Laboratory Analytical Requirements

Contractor shall provide the specified chemical analyses by Contractor's laboratory. Contractor shall provide chemical analyses to achieve the project DQOs for all parameters specified by the methods. The EPA SW-846 methods are generally the methods employed for the analytical testing of environmental samples. These methods are flexible and can be adapted to individual project-specific requirements.

3.5.2 Laboratory Performance

Contractor shall provide continued acceptable analytical performance and shall establish a procedure to address data deficiencies noted by review and/or quality assurance sample results. Contractor shall provide and implement a mechanism for providing analytical labs with the SAP or QAPP portion of the SAP, for monitoring the lab's performance, and for performing corrective action procedures.

3.6 NOTIFICATION OF NON-COMPLIANCE

The Contractor will notify the Project Engineer or QC Engineer of any detected non-compliance with the foregoing requirements. Contractor shall take immediate corrective action after detected non-compliance.

END OF SECTION

SECTION 01451

CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740 Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

ASTM E 329 Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

1.2 SUBMITTALS

Government approval is required for submittals having a "G" designation; all other submittals are for Contractor approval. The following shall be submitted in accordance with Section 01330 - SUBMITTAL PROCEDURES.

SD-01 Data
Contractor Quality Control Plan; G.

A plan detailing the manner in which quality control of work shall be managed, submitted in accordance with Section 01400, 60 calendar days after Notice to Proceed (NTP) as part of the Remedial Action Work Plan (RAWP). This plan shall include, as a minimum, the items described in paragraph 3.2.2 Content of the CQC Plan.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both on site and off site, and shall be keyed to the proposed construction sequence. The Construction Manager (C.M.) will be held responsible for the quality of work on the job and is subject to removal by the EPA for non-compliance with quality requirements specified in the contract. The C.M. in this context shall be the highest level manager responsible for overall construction activities at the Pemaco Superfund Site (Site), including quality and production. The C.M. or approved designee shall maintain a physical presence at the Site when production work is ongoing, except as otherwise acceptable to the EPA, and shall be responsible for all construction and construction related activities at the Site.

3.2 QUALITY CONTROL PLAN

Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.1 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all design and construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents subcontractors, designers of record, consultants, architect/engineers (AE), fabricators, suppliers, and purchasing agents:

a) A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC Engineer who shall report to the Construction Manager and Corporate QA/QC Manager.

b) The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c) A copy of the letter to the CQC Engineer signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC Engineer, including authority to stop work which is not in compliance with the contract. The CQC Engineer shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.

d) Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents, subcontractors, designers of record, consultants, architect engineers (AE), offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e) Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Only laboratory facilities approved by the EPA shall be used.)

f) Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g) Procedures for tracking construction design and construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

h) Reporting procedures, including proposed reporting formats.

i) A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's CQC Plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the EPA in writing of any proposed change. Proposed changes are subject to acceptance by the EPA.

3.3 COORDINATION MEETING

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC Engineer and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health Manager shall receive direction and authority from the CQC Engineer and shall serve as a member of the CQC staff. The Contractor shall provide a CQC organization which shall be at the Site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by the EPA. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, shop drawings submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents, Contractor prepared plans, and records at the Site at all times, except as otherwise acceptable to the EPA.

3.4.2 CQC System Manager

Contractor shall identify as CQC Engineer an individual within the on-site work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for Contractor. The CQC Engineer shall be a graduate engineer or a graduate of construction management, with a minimum of 5 years construction experience on construction similar to this contract or a construction person with a minimum of 10 years in related work. This CQC Engineer shall be on the Site at all times during construction and shall be employed by the prime Contractor. The CQC Engineer shall be assigned as System Manager but may have other duties such as Health and Safety Officer in addition to quality control, provided other such duties do not interfere with the CQC Engineer's ability to fulfill the responsibilities of the CQC position. An alternate for the CQC Engineer shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC Engineer.

3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager. These individuals may be employees of the prime or subcontractor; shall be responsible to the CQC

System Manager; shall be physically present at the construction Site during work on their areas of responsibility; and shall have the necessary education and/or experience in accordance with the experience matrix shown in Table 01451-1. These individuals may perform other duties but must be allowed sufficient time to perform their assigned quality control duties as described in the CQC Plan.

Table 01451-1
EXPERIENCE MATRIX

Area	Minimum Qualifications
Civil or Environmental	Graduate Civil or Environmental Engineer with 2 years experience in the type of work being performed on this project or technician with 5 years related experience
Mechanical or Electrical	Graduate Mechanical or Electrical Graduate Mechanical or Electrical Engineer with 2 years experience or person with 5 years related experience
Submittals	Submittal Clerk with 1 year experience

3.4.4 Additional Requirement
In addition to the above experience, the CQC System Manager shall have completed the course entitled “Construction Quality Management for Contractors.” This course is periodically offered at Corp of Engineers offices throughout the state of California.

3.4.5 Organizational Changes
Contractor shall maintain the CQC staff at sufficient strength to perform required CQC activities at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the EPA for acceptance.

3.5 SUBMITTALS AND DELIVERABLES
Submittals shall be made as specified in Section 01330 - SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals are in compliance with the contract requirements. All Contractor forms for submitting test results are subject to EPA approval.

3.6 CONTROL
CQC is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as noted below.

3.6.1 Preparatory Phase
This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work Site. This phase shall include:

a) A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained in the field and available for use by Government personnel until final acceptance of the work.

b) A review of the contract drawings.

c) A check to ensure that all materials and/or equipment have been tested, submitted, and approved.

d) Review of provisions that have been made to provide required control inspection and testing.

e) Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f) A physical examination and inventory of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g) A review of the appropriate activity hazard analysis to assure safety requirements are met.

h) Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i) A check to ensure that the portion of the plan for the work to be performed has been accepted by the EPA.

j) Discussion of the initial control phase.

k) The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a) A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b) Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c) Establish level of workmanship and verify that it meets minimum acceptable workmanship standards.

d) Resolve all differences.

e) Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity hazard analysis with each worker.

f) The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g) The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-Up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable, if there are changes in the applicable CQC staff, onsite production supervision or work crew, if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall perform the following activities and record and provide the following data:

a) Verify that testing procedures comply with contract requirements.

b) Verify that facilities and testing equipment are available and comply with testing standards.

c) Check test instrument calibration data against certified standards.

d) Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e) Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be provided on the CQC report. If approved by the EPA, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the EPA. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel shall meet criteria detailed in ASTM D 3740 and ASTM E 329.

3.8 COMPLETION INSPECTION

3.8.1 PUNCH-OUT INSPECTION

Near the completion of all work or any increment thereof established by a completion time stated in the specifications, the CQC System Manager shall conduct an inspection of the work and develop a punch list of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph 3.9 DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform this inspection to verify that the facility is complete and ready to be operated. A Government Pre-Final Punch List may be developed as a result of this inspection. The CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government so that a Final inspection with the Government can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The CQC Inspection personnel, plus the superintendent or other primary management person, and the EPA shall be in attendance at this inspection. Additional Government personnel may also be in attendance. The final acceptance inspection will be formally scheduled by the EPA based upon results of the Pre-Final inspection. Notice shall be given to the EPA at least 14 days prior to the final acceptance inspection and shall include the Contractor’s assurance that all specific items previously identified to Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of Contractor to have all contract work acceptably complete for this inspection will be cause for the EPA to bill the Contractor for the Government’s additional inspection cost in accordance with the contract clause titled “Inspection of Construction.”

3.9 DOCUMENTATION

Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a) Contractor/subcontractor and their area of responsibility.

b) Operating plant/equipment with hours worked, idle, or down for repair.

c) Work performed each day, giving location, description, and by whom. When Network Analysis System (NAS) is used, identify each phase of work performed each day by NAS activity number.

d) Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.

e) Quantity of materials received at the Site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f) Submittals reviewed, with contract reference, by whom, and action taken.

g) Off-site surveillance activities, including actions taken.

h) Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i) Instructions given/received and conflicts in plans and/or specifications.

j) Contractor's verification statement. These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.10 SAMPLE FORMS

Sample forms are attached at the end of this specification section (Attachments 01451-A and 01451-B).

3.11 NOTIFICATION OF NONCOMPLIANCE

The EPA will notify Contractor of any detected noncompliance with the foregoing requirements. Contractor shall take immediate corrective action after receipt of such notice or at the time Contractor becomes aware of such deficiency. Failure of the EPA to notify Contractor of any deficiency does not relieve Contractor of the Contractor's responsibility to correct the deficiency(ies). Such notice, when delivered to Contractor at the work Site, shall be deemed sufficient for the purpose of notification. If Contractor fails or refuses to comply promptly, the

EPA may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time or for excess costs or damages by Contractor.

END OF SECTION

Attachment 01451-A
SAMPLE OF DAILY CONSTRUCTION QUALITY CONTROL REPORT

Contract Number: ______________________ Date: __________ Rpt. No.____________
Contract Title: ______________________________ Location: ____________________
Weather: Clear __ P. Cloudy __ Cloudy __ Rainfall __ (__% of workday)
Temperature during workday: High ____ degrees F. Low ___ degrees F.
1. WORK PERFORMED BY CONTRACTOR/SUBCONTRACTOR(S):
Contractor Name No. of Workers Crafts/Hours Work performed

2. EQUIPMENT DATA:
Type, Size, Etc. Owned/Rented Hours Used Hours Standby

3. QUALITY CONTROL INSPECTIONS AND RESULTS: (Include a description of preparatory, initial, and/or follow up inspections or meetings; check of subcontractors work and materials delivered to the Site compared to submittals and/or specifications; inventories (attach to report); comments on the proper storage of materials; include comments on corrective actions to be taken):

4. QUALITY CONTROL TESTING AND RESULTS (comment on tests and attach test reports):

5. DAILY SAFETY INSPECTIONS (Include comments on new hazards to be added to the Hazard Analysis and corrective action of any safety issues):

6. REMARKS (Include conversations with or instructions from the Government representatives; delays of any kind that are impacting the job; conflicts in the contract documents; comments on change orders; environmental considerations; etc.):

____
____
____

CONTRACTOR'S VERIFICATION: The above report is complete and correct. All material, equipment used, and work performed during this reporting period are in compliance with the contract documents except as noted above.

____

CONTRACTOR QC REPRESENTATIVE

SAMPLE OF TEST REPORT
STRUCTURE OR BUILDING ______________
CONTRACT NO. ______________
DESCRIPTION OF ITEM, SYSTEM, OR PART OF SYSTEM TESTED:

____

____

DESCRIPTION OF TEST: ____
____

____

NAME AND TITLE OF PERSON IN CHARGE OF PERFORMING TESTS FOR THE CONTRACTOR:

NAME ______________________________

TITLE ______________________________

SIGNATURE _______________________

I HEREBY CERTIFY THAT THE ABOVE DESCRIBED ITEM, SYSTEM, OR PART OF SYSTEM HAS BEEN TESTED AS INDICATED ABOVE AND FOUND TO BE ENTIRELY SATISFACTORY AS REQUIRED IN THE CONTRACT SPECIFICATIONS.
SIGNATURE OF CONTRACTOR
QUALITY CONTROL INSPECTOR______________________
DATE ______________________________

REMARKS____

____

____

Attachment 01451-B
SAMPLE OF TEST REPORT

STRUCTURE OR BUILDING _______________
CONTRACT NO. _______________
DESCRIPTION OF ITEM, SYSTEM, OR PART OF SYSTEM TESTED:
____

____

DESCRIPTION OF TEST: ____

____

____

NAME AND TITLE OF PERSON IN CHARGE OF PERFORMING TESTS FOR THE CONTRACTOR:
NAME _______________________________
TITLE _______________________________
SIGNATURE _________________________

I HEREBY CERTIFY THAT THE ABOVE DESCRIBED ITEM, SYSTEM, OR PART OF SYSTEM HAS BEEN TESTED AS INDICATED ABOVE AND FOUND TO BE ENTIRELY SATISFACTORY AS REQUIRED IN THE CONTRACT SPECIFICATIONS.
SIGNATURE OF CONTRACTOR
QUALITY CONTROL INSPECTOR________________________
DATE _______________________________

REMARKS____

____

____

SECTION 01452

SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)
ACI 318/318R (2002) Building Code Requirements for Structural Concrete and Commentary

ACI 318M (2002) Metric Building Code Requirements for Structural Concrete and Commentary

ACI 530/530.1 (2002) Building Code Requirements for Masonry Structures and Specifications for Masonry Structures and Commentaries

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
AISC 341 (2002) Seismic Provisions for Structural Steel Buildings

AISC 350 (1999) Load and Resistance Factor Design (LRFD)Specification for Structural Steel Buildings

ASTM INTERNATIONAL (ASTM)
ASTM A 435/A (1990; R 2001) Straight-Beam Ultrasonic Examination of Steel Plates

ASTM A 615/A (2003a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 898/A (1991; R 2001) Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes

U.S. FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)
FEMA 302 (Feb 1998) NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval.

SD-07 Certificates
Special Inspector; G
Certification attesting that the Special Inspector is qualified by knowledge and experience to perform the specified Special Inspections. Information, which provides evidence of the knowledge and experience necessary to qualify a person as a Special Inspector for the category of work being certified, will accompany the qualification.

1.3 SPECIAL INSPECTOR

A Special Inspector shall be used to perform Special Inspections required by this section. The Special Inspector is a person employed by the Contractor and approved by the Government as being qualified by knowledge and experience to perform the Special Inspection for the category of work being constructed. Special Inspectors shall perform their duties independent from the construction quality control staff employed by the Contractor. More than one Special Inspector may be required to provide the varied knowledge and experience necessary to adequately inspect all of the categories of work requiring Special Inspection.

1.4 QUALITY ASSURANCE PLAN

The Contractor Quality Control (CQC) Plan will include the quality assurance special inspection and testing items outlined in this Section. The CQC plan will include a list of all items that require quality assurance or special Inspection and testing, including the type, frequency, extent, and duration of the special inspection for each item on the list;

1.5 SPECIAL INSPECTION

The Special Inspection for seismic-resisting system components shall be done as specified. Special Inspector personnel shall be in addition to the quality control inspections and inspectors required elsewhere in this section.

1.5.1 Periodic Special Inspection

Periodic special inspection is the intermittent observation of the work by a Special Inspector present in the work area while work is being performed. The intermittent observation periods shall be at times of significant work, shall be recurrent over the complete work period, and shall total at least 25 percent of the total work time. Periodic special inspection shall be performed only if specified by the Project Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PERFORMANCE OF INSPECTIONS

Special Inspections shall be performed for the following:

3.1.1 Reinforcing Steel

a) Periodic special inspection during and upon completion of the placement of reinforcing steel in the concrete pad.

3.1.2 Structural Concrete

Periodic special inspection during and on completion of the placement of concrete in the concrete pad.

3.1.3 Structural Steel

a) Continuous special inspection for all structural welding, except that periodic special inspection is permitted for single-pass or resistance welds and welds loaded to less than 50 percent of their design strength provided the qualifications of the welder and the welding electrodes are inspected at the beginning of the work and all welds are inspected for compliance with the approved construction documents at the completion of welding.

b) Periodic special inspection in accordance with AISC 350 for the installation of bolts in moment frames except that bolts not required to be fully tensioned need not be inspected for bolt tension, other than to ensure that the plies of the connected elements have been brought into snug contact.

3.1.4 Cold-Formed Steel Framing

a) Periodic special inspections during all welding operations of elements of the seismic-force-resisting system.

b) Periodic special inspections for screw attachment, bolting, anchoring, and other fastening of components within the seismic-force-resisting system, including struts, braces, and hold-downs.

3.1.5 Architectural Components

Special inspection of the architectural components shall assure that the methods of anchoring and fastening indicated on the Drawings are being complied with at the onset of construction of the components, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for architectural components shall be as follows:

a) Periodic special inspection during the erection and fastening of exterior cladding.

3.1.6 Mechanical and Electrical Components

Special inspection of the mechanical and electrical components shall assure that the methods of anchoring and fastening indicated are being complied with at the onset of construction of the component, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for mechanical and electrical components shall be as follows:

a) Periodic special inspection during the anchorage of electrical equipment for emergency or standby power systems.

b) Periodic special inspection during the installation of anchorage of all other electrical equipment.

c) Periodic special inspection during installation for flammable, combustible, or highly toxic piping systems and their associated mechanical units.

d) Periodic special inspection during the installation of HVAC ductwork that will contain hazardous materials.

3.1.7 Seismic Isolation System

Periodic special inspection during the fabrication and installation of isolator units.

3.1.8 Energy Dissipation System

Periodic special inspection during the fabrication and installation of energy dissipation devices.

3.2 TESTING

The special inspector shall be responsible for verifying that the testing requirements are performed by an approved testing agency for compliance with the following:

a) Reinforcing Steel: Special testing of reinforcing and prestressing steel shall be as follows:

   i) Examine certified mill test reports for each shipment of reinforcing steel used in reinforced concrete pad. The special inspector shall determine conformance with the construction documents.

   ii) Examine the reports for chemical tests, done in accordance with Sec. 3.5.2 of ACI 318M (ACI 318/318R), which were performed to determine the weldability of ASTM A 615/A reinforcing steel.

b) Structural Concrete: Verify that samples of structural concrete obtained at the project site, along with all material components obtained at the batch plant, have been tested in accordance with the requirements of ACI 318M (ACI 318/318R) and comply with all acceptance provisions contained therein.

c) Structural Steel:

   i) Verify that all quality assurance testing needed to confirm required material properties has been done in accordance with applicable provisions in AISC 341 and AISC 350 and that the test results comply with all acceptance provisions contained therein.

d) Seismically Isolated Structures: Verify that the required system and component tests for seismically isolated structures have been done in accordance with FEMA 302 and comply with all acceptance provisions contained therin.

e) Energy Dissipation Systems: Verify that the required system and component tests for seismic energy dissipation systems have been done in accordance with FEMA 302 and comply with all acceptance provisions contained therein.

3.3 REPORTING AND COMPLIANCE PROCEDURES

a) On the first day of each month, the Contractor shall furnish to the Government five copies of the combined progress reports of the special inspector's observations. These progress reports shall list all special inspections of construction or reviews of testing performed during that month, note all uncorrected deficiencies, and describe the corrections made both to these deficiencies and to previously reported deficiencies. Each monthly report shall be signed by all special inspectors who performed special inspections of construction or reviewed testing during that month, regardless of whether they reported any deficiencies. Each monthly report shall be signed by the Contractor.

b) At completion of construction, each special inspector shall prepare and sign a final report attesting that all work they inspected and all testing and test reports they reviewed were completed in accordance with the approved construction documents and that deficiencies identified were satisfactorily corrected. The Contractor shall submit a combined final report containing the signed final reports of all the special inspectors.

The Contractor shall sign the combined final report attesting that all final reports of special inspectors that performed work to comply with these construction documents are contained therein, and that the Contractor has reviewed and approved all of the individual inspector's final reports.

END OF SECTION

SECTION 01500

TEMPORARY CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-09 Site Plan; G

Contractor shall prepare a Site Plan indicating the proposed location and dimensions of any area to be fenced and used by Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. The Site Plan shall be submitted 90 calendar days after receiving Notice to Proceed (NTP) . Any areas which may have to be graveled to prevent the tracking of mud shall also be identified. Contractor shall also indicate if the use of a supplemental or other staging area is desired.

1.2 GENERAL REQUIREMENTS

Contractor shall be responsible for furnishing to each employee, and for requiring each employee engaged on the work to display identification as approved and directed by the Construction Manager. Prescribed identification shall immediately be delivered to the Construction Manager for cancellation upon release of any employee. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

1.2.1 Site Plan

Contractor shall prepare a Site Plan indicating the proposed location and dimensions of any area to be fenced and used by Contractor, the number of trailers to be used, avenues of ingress/egress to the fenced area and details of the fence installation. The Contractor shall also indicate if the use of a supplemental or other staging area is desired.

1.2.2 Identification of Employees

Contractor shall be responsible for furnishing to each employee, and for requiring each employee engaged on the work to display identification as approved and directed by the Construction Manager. Prescribed identification shall immediately be delivered to the Project Engineer for cancellation upon release of any employee. Contractor and subcontractor personnel shall wear identifying markings on hard hats clearly identifying the company for whom the employee works.

1.2.3 Employee Parking

Contractor employees shall park privately owned vehicles in a designated parking area. This area shall be within reasonable walking distance of the construction site. Contractor employee parking shall not interfere with existing and established parking requirements of the facilities.

1.3 AVAILABILITY AND USE OF UTILITY SERVICES

1.3.1 Temporary Water and Electricity

Contractor shall provide temporary water and electricity required for construction. Materials may be new or used and shall be adequate for the required usage, shall not create unsafe conditions, and shall not violate applicable codes and standards.

1.3.2 Sanitation

Contractor shall provide and maintain within the construction area, as a minimum, field-type sanitary facilities approved by the EPA. The number of sanitary facilities shall be matched to the maximum number of personnel working at the site as required by Federal, State, and local codes and regulations. Sanitary facilities shall be equipped with a hand-washing station. Government toilet facilities will not be available to Contractor's personnel.

1.3.3 Telephone

Contractor shall make arrangements and pay all costs for telephone facilities required.

1.4 BULLETIN BOARD, PROJECT SIGN, AND PROJECT SAFETY SIGN

1.4.1 Bulletin Board

Immediately upon beginning of work, Contractor shall provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the EPA. The bulletin board shall be located at the project site in a conspicuous place easily accessible to all employees. Legible copies of the aforementioned data shall be displayed until work is completed. Upon completion of work the bulletin board shall be removed by and remain the property of Contractor from the Site.

1.4.2 Project and Safety Signs

The requirements for the signs, their content, and location shall be detailed in the Site Safety and Health Plan. The signs shall be erected within 15 days after receipt of the notice to proceed. The data required by the safety sign shall be corrected daily, with light colored metallic or non-metallic numerals. Upon completion of the project, the signs shall be removed from the site.

1.5 PROTECTION AND MAINTENANCE OF TRAFFIC

During construction Contractor shall provide access and temporarily relocate roads as necessary to maintain traffic. Contractor shall maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Project Engineer. Measures for notification, any required hauling permits, the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment and the work, and the erection and maintenance of adequate warning, danger, and direction signs, shall be as required by the state and local authorities having jurisdiction. The traveling public shall be protected from damage to person and property. Contractor's traffic on roads selected for hauling material to and from the Site shall interfere as little as possible with public traffic. Contractor shall investigate the adequacy of existing roads and the allowable load limit on these roads. Contractor shall be responsible for the repair of any damage to roads caused by construction operations.

1.5.1 Haul Roads

Contractor shall, at its own expense, construct access and haul roads necessary for proper prosecution of the work under this contract. Haul roads shall be constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided. Contractor shall provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control shall be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and hauling roads shall be subject to approval by the Construction Manager. Lighting shall be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations. Upon completion of the work, haul roads shall be removed unless otherwise designated to remain by the Construction Manager.

1.5.2 Barricades

Contractor shall erect and maintain temporary barricades to limit public access to hazardous areas. Such barricades shall be required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Barricades shall be securely placed, clearly visible, and with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

1.6 CONTRACTOR'S TEMPORARY FACILITIES

1.6.1 Administrative Field Offices

Contractor shall provide and maintain administrative field office facilities within the construction area at the designated Site. Government office and warehouse facilities will not be available to Contractor's personnel.

1.6.2 Storage Area

The Contractor shall construct a temporary 6-foot high chain link fence around trailers and materials located in Contractor's storage area , trailers, equipment, and construction materials shall be located inside the fenced work area at the Site. or stored outside the fenced area. Trailers, equipment, or materials shall not be open to public view with the exception of those items which are in support of ongoing work on any given day. Materials shall not be stockpiled outside the fence in preparation for the next day's work. Mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment, shall be parked within the fenced area at the end of each work day.

1.6.3 Supplemental Storage Area

Upon Contractor's request, the Project Engineer or Construction Manager will designate another or supplemental area for Contractor's use and storage of trailers, equipment, and materials. This area is not restricted to be in close proximity to the construction site, but shall be within the military boundaries. Fencing of materials or equipment will not be required at this Site; however, Contractor shall be responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

1.6.4 Appearance of Trailers

Trailers utilized by Contractor for administrative or material storage purposes shall present a clean and neat exterior appearance and shall be in a state of good repair.

1.6.5 Maintenance of Storage Area

Fencing shall be kept in a state of good repair and proper alignment. Should Contractor elect to traverse, with construction equipment or other vehicles, grassed or unpaved areas which are not established roadways within the storage area, such areas shall be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways. Gravel gradation shall be at Contractor's discretion.

1.6.6 Security Provisions

Adequate outside security lighting shall be provided at Contractor's temporary facilities. Contractor shall be responsible for the security of its own equipment; in addition, Contractor shall notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

1.7 TRAILER-TYPE MOBILE OFFICE

Contractor may, at its option, furnish and maintain a trailer-type mobile office acceptable to the EPA. The trailer shall be securely anchored to the ground at all four corners to guard against movement during high winds. The sanitation facilities meeting State and local codes and regulations shall be provided and maintained for all onsite personnel. Sanitation facilities shall be removed at the completion of construction.

1.8 TEMPORARY PROJECT SAFETY FENCING

Fencing or construction barrier and barrier tape shall be provided along the construction site at all open excavations to control access by unauthorized people. In addition, prior to the start of work, enclose those areas at the construction site which are not within the construction fence with a temporary safety fence, including gates and warning signs as needed, to protect the public from construction activities.

1.8 CLEANUP

Construction debris, waste materials, packaging material and trash shall be removed from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways shall be cleaned away. If the contractor anticipates frequent movement of vehicles from the site to the road way under conditions where muddy tires can be expected, a rocked construction entrance should be provided to facilitate cleaning of tires prior to the vehicle leaving the site.

Materials resulting from demolition activities which are salvageable shall be stored within the fenced area described above or at the supplemental storage area. Stored material not in trailers, whether new or salvaged, shall be neatly stacked when stored.

1.9 RESTORATION OF STORAGE AREA

Upon completion of the project and after removal of trailers, materials, sanitation facilities, and equipment from within the fenced area, the fence shall be removed and will become the property of Contractor. Areas used by Contractor for the storage of equipment or material, or other use, shall be restored to the original or better condition. Gravel used to traverse grassed areas shall be removed and the area restored to its original condition, including topsoil and seeding as necessary.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 02111

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL

PART 1 GENERAL

1.1 REFERENCES
The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)
ASTM D 1556 (2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557 (2002e1) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft.)

ASTM D 2167 (1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D 2487 (2000) Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 2922 (2004) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 422 (1963; R 2002) Particle-Size Analysis of Soils

ASTM D 5434 (2003) Field Logging of Subsurface Explorations of Soil and Rock

ASTM D 698 (2000ae1) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft.)

U.S. ARMY CORPS OF ENGINEERS (USACE) EM 385-1-1 (2003) Safety -- Safety and Health Requirements

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA) 29 CFR 1926 Safety and Health Regulations for Construction 40 CFR 302 Designation, Reportable Quantities, and Notification

1.2 SUBMITTALS
Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor approval. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION 01330-SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Surveys;
Separate cross-sections of each area before and after excavation and after backfilling.

SD-06 Reports
Backfill; G
Disposal Materials; G
Surveys; G
Confirmation Sampling and Analysis Results; G

1.3 SURVEYS

Surveys shall be performed immediately prior to and after excavation of contaminated material to determine the volume of contaminated material removed. Surveys shall also be performed immediately after backfill of each excavation of the surface area. Locations of confirmation samples shall also be surveyed and shown on the drawings. Surveys shall be performed in accordance with coordinate system Zone 5, North American Datum 1983 and North American Vertical Datum 1988.

1.4 REGULATORY REQUIREMENTS

Air emissions shall be monitored and controlled in accordance with SECTION 01351 - SAFETY, HEALTH, AND EMERGENCY RESPONSE.

1.5 DESCRIPTION OF WORK

In the event contaminated soil is identified during excavation activities it will be handled according to the details of this Section. The contaminants of concern are identified in SECTION 0115 - SITE DESCRIPTION. All onsite Contractor personnel will be trained in the identification of contaminated soil. Contaminated soil shall be removed from trench and excavation areas only to the extent necessary to protect Site workers. The EPA shall be notified within 24 hours, and before excavation, if contaminated material is discovered that has not been previously identified or if other discrepancies between data provided and actual field conditions are discovered. Backfill of material will be performed in accordance with SECTION 02221 - TRENCHING and related sections.

1.6 CHEMICAL TESTING

Required sampling and chemical analysis shall be conducted in accordance with SECTION 01450A - CHEMICAL DATA QUALITY CONTROL and the disposal facility data requirements.

1.7 SCHEDULING

The Contractor shall notify the EPA in the event contaminated soil is identified. The contaminated soil shall be characterized and disposed as soon as possible after identification so as to not delay construction.

PART 2 PRODUCTS

2.1 BACKFILL

Backfill material shall be obtained from onsite or offsite sources as long as it is sampled in accordance with the California EPA DTSC “Information Advisory, Clean Imported Fill Material,” (October 2001). Backfill shall be classified in accordance with ASTM D 2487 as GW, GP, GM, GC, SW, SP, or SM and shall be free from roots and other organic matter, trash, debris, or frozen materials.

Backfill shall not be used until borrow source chemical and physical test results have been submitted and approved.

2.2 Spill Response Materials

The Contractor shall provide appropriate spill response materials including, but not limited to the following: containers, adsorbents, shovels, and personal protective equipment. Spill response materials shall be available at all times when contaminated materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of materials and contaminants being handled.

PART 3 EXECUTION

3.1 Existing Structures And Utilities

No excavation shall be performed until site utilities have been field located. The Contractor shall take the necessary precautions to ensure no damage occurs to existing structures and utilities. Damage to existing structures and utilities resulting from the Contractor's operations shall be repaired at no additional cost to the Government. Utilities encountered that were not previously shown or otherwise located shall not be disturbed without approval from the EPA.

3.2 Excavation

Areas of contamination shall be excavated to a depth and extent as estimated by a “competent person” that all contamination is removed. Excavation shall be performed in a manner that will limit spills and the potential for contaminated material to be mixed with uncontaminated material. An excavation log describing visible signs of contamination encountered shall be maintained for each area of excavation. The final extent of excavation shall be determined by the EPA and Project Engineer.

3.2.1 Shoring

If workers must enter the excavation, it shall be evaluated, shored, sloped or braced as required by EM 385-1-1 and 29 CFR 1926 section 650.

3.2.2 Dewatering

Surface water shall be diverted to prevent entry into the excavation. All removed water shall be properly characterized and disposed in accordance with Federal, State, and City of Maywood regulations.

3.3 Confirmation Sampling And Analysis

Field screening methods, using real-time vapor monitoring instruments, shall be used to confirm no safety risk to Site workers. No confirmation samples will be collected since the Site has been adequately characterized in the Remedial Investigation and Feasibility Study phases.

3.4 Contaminated Material Storage

Soil excavated from trenching and cuttings generated from well installation borings constitute the anticipated extent of potential contaminated material generation on Site. Containers will be provided for soil (construction rolloff or equivalent) and 55-gallon drums for containing liquids.

Soil generated from drilling and excavation activities will be transported to containers placed in the central staging area of the site. The following paragraphs describe acceptable methods of material storage.

3.4.1 Stockpiles

Stockpiles shall be constructed to isolate stored contaminated material from the environment. The maximum stockpile size shall be 1,000 cubic yards. Stockpiles shall be constructed to include:

a) A chemically resistant plastic liner free of holes and other damage. Non-reinforced geomembrane liners shall have a minimum thickness of 4 mils. The ground surface on which the linen is to be placed shall be free of rocks greater than 0.5 inches in diameter and any other object which could damage the membrane.

b) Visqueen plastic cover free of holes or other damage to prevent precipitation from entering the stockpile. Non-reinforced geomembrane covers shall have a minimum thickness of 4 mils. The cover material shall be extended over the berms and anchored or ballasted to prevent it from being removed or damaged by wind.

3.4.2 Roll-Off Units

Roll-off units used to temporarily store contaminated material shall be water tight. A cover shall be placed over the units to prevent precipitation from contacting the stored material. The units shall be located in the central staging area of the site. Liquid which collects inside the units shall be removed and stored in accordance with paragraph Liquid Storage.

3.4.3 Liquid Storage

Groundwater, decontamination water, and other liquids generated during drilling activities will be containerized in 55-gallon drums or equivalent water-tight containers. After completing the drilling work, the contractor will stage the water drums on pallets at a location designated by the Contractor for storage at the site.

3.5 SAMPLING

3.5.1 Sampling of Stored Material

The sampling frequency and chemical parameters shall be determined by the disposal facility. The disposal facility shall be approved by the EPA.

3.6 SPILLS

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), the Contractor shall notify the EPA immediately. Immediate containment actions shall be taken to minimize the effect of any spill or leak. Cleanup shall be in accordance with applicable federal, state, and local regulations. As directed by the EPA, additional sampling and testing shall be performed to verify spills have been cleaned up. Spill cleanup and testing shall be done at no additional cost to the Government.

3.7 BACKFILL

Excavations shall be backfilled immediately after all contaminated materials have been removed and confirmation test results have been approved. Backfill shall be placed and compacted to the lines and existing grades. Compaction of backfill material shall be performed in accordance with SECTION 2300 - EARTHWORK.

END OF SECTION

SECTION 02205

SOIL MATERIALS

PART 1 GENERAL

These general provisions of the contract, including general and special conditions and the requirements and Division 1, apply to the work specified in this section. This section includes soil material specifications for foundation soil layers, aggregate base rock, and connection pipe bedding.

Related Sections: SECTION 02211 - EARTHWORK , SECTION 02225 - TRENCHING.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

Standard Specifications, State of California Department of Transportation, July, 1992

ASTM INTERNATIONAL (ASTM)
ASTM C 136; D 422; ASTM D 1140; ASTM D 5084; ASTM D 422; ASTM D1557

ASTM D2487 - Classification of Soils for Engineering Purposes

ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures

1.2 SUBMITTALS

Submittals shall conform to provisions of Section 01330. Submittals pertaining to source of imported materials are required to the QC Engineer prior to import of the material to the site. Submit name of imported materials suppliers and the following information:

Soil Type	Test Type	Test Method
Foundation Layer	Gradation	ASTM D 422 or C136
Aggregate Base	Gradation	
Pipe Bedding Material	Gradation	ASTM D 422 or C136

Submit results of Quality Control testing specified in Section 2.2.

1.3 DEFINITIONS

1.3.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP.

1.3.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or other frozen material.

1.3.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.3.4 Sand Cement Slurry (SCS)

Composed of Portland cement, water, an air-entraining admixture, and sand mixed with sufficient water to produce a workable mixture and an amount of admixture which will entrain sufficient air to produce durable grout, as determined by the QC Engineer. Sand cement slurry shall conform to the requirements of the California Department of Transportation specification for Class B bedding. Sand Cement Slurry shall consist of at least 1 sack of Portland cement per cubic yard of sand plus water, with a 7-inch slump plus or minus 1-1/2 inches. Sand cement slurry used beneath roads shall consist of at least 2 sacks of Portland cement per cubic yard of sand plus water.

1.4 QUALITY ASSURANCE

Contractor submittals demonstrating soil materials quality will be reviewed by the QC Engineer for approval prior to shipment to the site. QC Engineer will conduct Material Evaluation testing of material as it is shipped to site to verify compliance with these Specifications.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. Foundation Layer

The quality and gradation for foundation layer material, which is the lowest component of the foundation layer, shall be imported. Foundation layer material shall be granular and shall meet the following requirements:

Sieve Designation	Percent Passing
3 in	100
1-1/2 in	70-100
3/4 in	50-85
No. 4	30-60
No. 200	0-10

The maximum permeability is 1 X 10~2 cm/sec.

B. Aggregate Base Rock

This specification covers the quality and gradation for aggregate base rock material, which is to be installed under the concrete or shotcrete surfaces, as shown on the Drawings. Aggregate base rock material shall be imported.

Aggregate base rock material shall consist of Class 2 aggregate base material, as defined in Cal Trans specifications (Cal Trans Standard Specification, Section 26 - Aggregate Bases). Documentation shall be submitted from the material source to demonstrate aggregate base material grading characteristics, resistance, sand equivalent, and durability index in compliance Cal Trans specifications.

C. Pipe Bedding

This specification covers the quality and gradation for pipe bedding material, which is to be installed under gas collection, subdrain, and SVE pipes. Pipe bedding material shall be sand, free from clay or organic material, suitable for the purpose intended, and shall be of such size that 90 percent to 100 percent will pass a No. 4 sieve and not above 5 percent will pass a No. 200 sieve.

2.2 SOURCE QUALITY CONTROL

A. Contractor shall conduct the following tests on the soil materials and submit the test results to the QC Engineer prior to shipment (as described in Section 1.4):

Soil Type	Test Type	Test Method
Foundation Layer	Gradation	ASTM D 422 or C136
Aggregate Base	Gradation	ASTM D422
Pipe Bedding Material	Gradation	ASTM D 422 or C136

2.3 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil. Warning Tape Color Codes Red: Electric, Yellow: Gas, Oil; Dangerous Materials; Orange: Telephone and Other Communications; Blue: Water Systems; Green: Sewer Systems; White: Steam Systems; Gray: Compressed Air.

2.3.1 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.4 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 BURIED TAPE AND DETECTION WIRE

3.1.1 Buried Warning and Identification Tape
Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.1.2 Buried Detection Wire
Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over its entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.2 STOCKPILING

A. Stockpile materials on-site at locations approved by the QC Engineer.

B. Stockpile in sufficient quantities to meet project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.3 STOCKPILE CLEANUP

A. Remove stockpile and leave area in a clean and neat condition. Grade site surface to prevent free-standing surface water. Good drainage shall be provided at all times.

B. If a borrow area is indicated, leave area in a clean and neat condition. Grade site surface to prevent free-standing surface water.

C. All unsuitable material shall be removed off-site or to a designated disposal area.

END OF SECTION

SECTION 02210

SUBSURFACE DRILLING, SAMPLING, AND TESTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)
ASTM D 1452 (1980; R 2000) Soil Investigation and Sampling by Auger Borings
ASTM D 1586 (1999) Penetration Test and Split-Barrel Sampling of Soils
ASTM D 1587 (2000) Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
ASTM D 2113 (1999) Rock Core Drilling and Sampling of Rock for Site Investigation
ASTM D 2487 (2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488 (2000) Description and Identification of Soils (Visual-Manual Procedure)

U.S. ARMY CORPS OF ENGINEERS (USACE)
EM 1110-1-1906 (1996) Soil Sampling

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Drilling Log; G
The Contractor shall submit complete, legible copies of DRILLING LOG, ENG FORM 1836 and 1836A and records to the EPA upon completion of the work or at such other time or times as he may be directed.

SD-03 Product Data
Permits, Certifications, and Licenses
Copies of all permits, certifications, and licenses prior to starting work.

Schedule of Drilling, Sampling, and Testing; G
Prior to starting work, the Contractor shall submit a plan for drilling, sampling, testing, and safety. The plan shall include, but shall not be limited to, the proposed method of drilling and sampling including a description of the equipment and sampling tools that will be used, a listing of any subcontractors to include a description of how the subcontractors will be used and a description of all methods and procedures that will be utilized to insure a safe operation and to protect the environment. This submittal shall also include a statement of the prior experience, in the type of work described in these specifications, of the person or persons designated to perform the work specified herein. No work shall be performed until this plan has been approved and no deviation from the approved plan will be permitted without prior approval by the EPA.

1.3 SYSTEM DESCRIPTION

The Contractor shall provide the data to determine the type, nature, and characteristics of subsurface materials and the extent and conditions of the various materials as they exist to the depths and at the locations specified. This is to be accomplished by means of auger borings, drive sample borings, undisturbed sample borings, core drilling, pressure testing, test pits, etc.

1.3.1 Auger Borings and Sampling

An auger boring is any boring made in unconsolidated soils with a conventional manually or power-driven earth auger for the purpose of obtaining samples of subsurface materials. Auger boring and sampling shall be performed in accordance with ASTM D 1452 and as directed by the Project Engineer.

1.3.2 Drive Sample Borings and Sampling

A drive sample boring is a boring made through unconsolidated or partly consolidated sediments or decomposed rock by means of a mechanically driven sampler. The purpose of these borings is to obtain knowledge of the composition, the thickness, the depth, the sequence, the structure, and the pertinent physical properties of foundation or borrow materials. Drive sample boring and sampling shall be performed in accordance with ASTM D 1587 and as directed by the Project Engineer. Standard Penetration Tests (SPT) shall be performed in accordance with ASTM D 1586.

1.3.3 Undisturbed Sample Borings and Sampling

An undisturbed sample boring is a boring made to obtain soil samples which, when tested, will show properties as close to the in situ (in place) properties as any sample which can be obtained. All undisturbed sampling shall be accomplished in accordance with ASTM D 1587 and as directed by the Project Engineer.

1.3.4 Core Drilling

Drilling of cores shall be by any approved standard and accepted method of rotary rock core drilling that will provide continuous and complete rock cores of the required diameter from any subsurface interval of bedrock specified for investigation. The method used shall provide equally good recovery of cores from both hard and soft rocks.

1.3.5 Pressure Testing (Hydraulic)

Hydraulic pressure testing is the process of forcing water under pressure into subsurface rock formations through pre-drilled holes for the purpose of determining the subsurface leakage conditions and possible grouting requirements.

1.3.6 Test Pit Excavation and Sampling

A test pit is any excavation in soil, hardpan, decomposed rock, or other unconsolidated or partially consolidated overburden materials which has an open cross-sectional area large enough to permit efficient excavation and shoring/lining, engineering and geological inspection and photographing of the subsurface soils and manual undisturbed sampling from within the test pit. All test pits shall be excavated, dewatered (if necessary), shored/lined and protected from surface water drainage in accordance with all applicable Federal, State, local, Corps of Engineers, and OSHA safety regulations.

1.4 CARE AND DELIVERY OF SAMPLES

1.4.1 General
The Contractor shall be solely responsible for preserving all samples in good condition. Samples shall be kept from freezing and from undue exposure to the weather, and shall keep all descriptive labels and designations on sample jars, tubes, and boxes clean and legible until final delivery of samples to, and acceptance by, the EPA.

Samples shall be delivered within the time limits specified for each type of investigation or in accordance with schedules prepared by the EPA.

1.4.2 Undisturbed Samples
Every precaution shall be taken to avoid damage to samples as a result of careless handling and undue delay in shipping. Samples shall be shipped in containers approved by the EPA and shall be of sufficient durability to protect the samples from any damage during shipment. The sample tubes shall be well packed in vermiculite or other equal material approved by the EPA to protect the samples against vibration. The Contractor shall avoid exposing sealed and crated samples to precipitation, direct sunlight, freezing and temperatures in excess of 100 degrees F. Samples permitted to freeze, even partially, shall be replaced by the Contractor. In general, no undisturbed samples shall remain on the site of sampling for more than one week before shipment.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Environmental Requirements
In order to prevent and to provide for abatement and control of any environmental pollution arising from Contractor activities in the performance of this contract, the Contractor and its subcontractors shall comply with all applicable Federal, State, and local laws, regulations, and ordinances concerning environmental pollution control and abatement.

a) The Contractor shall be responsible for keeping informed of all updates and changes in all applicable laws, regulations, and ordinances.

b) The Contractor shall not pollute lakes, ditches, rivers, springs, canals, waterways, groundwaters, or reservoirs with drill fluids, fuels, oils, bitumens, calcium chloride, insecticides, herbicides, or other materials that may be harmful to the environment or a detriment to outdoor recreation.]

1.5.2 Field Measurements
The approximate locations of borings, test pits, etc, will be established in the field by the Project Engineer. The elevations of the established locations will also be provided by the Project Engineer prior to the start of work. The Contractor will provide access to the locations as necessary for the prosecution of the work. Since no separate payment will be made for access construction, all costs associated with this shall be included in the cost of drilling and or excavating.

1.6 SEQUENCING AND SCHEDULING

1.6.1 Order of Work

The order in which the work is to be accomplished will be determined in the field by the Project Engineer. It is intended that the drilling and excavating be accomplished in the manner deemed best by the Project Engineer for accomplishing the work and in accordance with work contracts.

a) The Contractor shall provide a qualified, licensed Geologist experienced in subsurface exploration for each drill unit to oversee all drilling, sampling, and field testing operations. This individual shall be responsible for the preparation of a separate log and/or report for each boring, pressure test, or test pit. This individual shall also be responsible for the preparation of all soil and rock samples for delivery to the designated point.

b) The presence of a Government representative or the keeping of separate drilling records by the Project Engineer shall not relieve the Contractor of the responsibility for the work specified in this specification.

1.7 PERMITS, CERTIFICATIONS, AND LICENSES

The Contractor shall comply with all Federal, State and local laws, regulations and ordinances relating to the performance of this work. The Contractor shall procure all required permits, certifications and licenses required by Federal, State, and local law for the execution of this work.

PART 2 PRODUCTS

2.1 CONTAINERS

The Contractor shall furnish jars, tubes, and boxes that meet the following requirements. All such containers will become the property of the Government and the cost thereof shall be included in the contract price for the applicable item for which payment is provided.

2.1.1 Shipping Boxes

Boxes for shipping sample jars shall have the capacity to hold no more than 12 sample jars and the strength to contain and protect the jars and their contents under ordinary handling and environmental conditions.

2.1.2 Tubes and Crates

Undisturbed samples shall be shipped in thin walled Shelby tubes packed in crates.

2.1.3 Core Boxes

Longitudinally partitioned, hinged top, wooden core boxes constructed of plywood and dressed lumber or other approved materials in general accordance with the arrangement and dimensions shown in FIGURE 1 shall be used for all rock cores. As many core boxes as may be required shall be used to box all core. Core boxes shall be completely equipped with all necessary partitions, hinges, and a hasp for holding down the cover. In addition, the Contractor shall provide wood spacers made of surfaced lumber (not plywood) and having dimensions that are 1/8 inch less than the inside dimensions of the individual core box troughs and no less than 3/4 inch thick for blocking the core in the boxes and for providing a marking space to identify core runs and pull depths/elevations. The quantities of these blocks that are required are: ten blocks per core box for 3 inch or smaller core, five blocks per core box for 4 inch and PQ core, and three blocks per core box for 6 inch core.

The maximum length of a core box shall be 4 feet for 3 inch or smaller core and shall be dimensioned so that a box will hold 12 to 16 feet of core. The maximum length of a core box for core that is larger than 3 inches shall be 5 feet.

2.2 LABELS

2.2.1 Sample Jar Labels
A printed or type-written, fade resistant and waterproof label shall be affixed to the outside of each jar and shall contain the following information:

PROJECT LOCATION ___________________________
(Such as Table Rock Dam) (Such as Borrow Area B)
HOLE NO. __________________________
STATION _____________________________
JAR NO. _________ of _________ JARS
TOP ELEV. OF HOLE ________________
DEPTH OF SAMPLE ____________________
DESCRIPTION OF MATERIAL ____
(Such as Moist, silty, medium sand)

2.2.2 Shipping Box Labels
Each box of jar samples shall be identified with weatherproof and wear-proof labels indicating project name, location, and jar sample identification.

2.2.3 Core Box Labels
Core boxes shall be identified with stenciled labels. The information on this label shall contain the project name, hole number, box number, and total number of boxes for the hole.

PART 3 EXECUTION

3.1 MOBILIZATION AND DEMOBILIZATION

3.1.1 Mobilization
Mobilization shall consist of the delivery to the site of all plant, equipment, materials and supplies to be furnished by the Contractor, the complete assembly in satisfactory working order of all such plant and equipment at the jobsite and the satisfactory storage at the site of all such materials and supplies.

3.1.2 Demobilization
Demobilization shall consist of the removal from the site of all plant, equipment, materials and supplies after completion of the work and also includes, at the direction of the Project Engineer, the cleanup and removal of all scrap, waste backfill material, waste drilling fluid, soil contaminated with engine/hydraulic oil, backfilling all sumps or excavations resulting from the operations and, in general, returning the site as close to its original condition as possible.

3.2 EQUIPMENT AND SUPPLIES

3.2.1 Auger Boring and Sampling
The equipment to be furnished by the Contractor for making auger borings shall include, but not be limited to, standard continuous flight augers and/or standard cup-type earth augers, similar or equal to the Iwan Auger and not less than 4 inches in diameter unless otherwise approved.

The augers shall be completely equipped with all the accessories necessary for boring and sampling of overburden materials to the depths and diameters specified or shown on the drawings.

3.2.2 Drive Sample Boring and Sampling

Equipment to be furnished by the Contractor for making drive sample borings shall include, but not be limited to, standard 2-inch OD split or solid barrel drive samplers and power-driven drilling machinery of a type or types approved by the EPA. The drive shoe for the split barrel samplers shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. Supplies shall include, but not be limited to, all casing, drill stem, drill bits, drill fluid and additives, pumps, and power necessary to accomplish the required boring and sampling.

3.2.3 Undisturbed Sample Boring and Sampling

Equipment to be furnished by the Contractor for making undisturbed sample borings shall include, but not be limited to, power-driven drilling machinery of an approved type or types complete with the special devices and accessories enumerated and described hereinafter. Drilling machinery shall be of the hydraulic feed type. Supplies shall include, but not be limited to, all samplers, casing, drill stem, drill bits, drill fluid and additives, pumps, and power necessary to accomplish the required boring and sampling. Drill casing, if used, shall be of such minimum inside diameter as to allow use of the selected sampler.

a) Sands and Cohesive Soils: The sampling device used to sample fine to medium grain sands and cohesive soils shall be a fixed or stationary piston type that uses a 3-inch or 5-inch diameter thin-wall Shelby tube. Subject to the approval of the EPA, floating or free piston and non-piston type samplers may be used provided adequate means, such as check valve or vacuum system, are provided to prevent loss of samples.

b) Stiff and Dense Soils: The sampling device for obtaining samples of stiff and dense soils shall be similar or equal to a Denison double tube, swivel head core barrel, or a Pitcher sampler and must be approved by the EPA prior to use.

3.2.4 Core Drilling

Equipment to be furnished by the Contractor for core drilling shall include core-drilling machinery of a type or types approved by the EPA complete with all the accessories needed to take continuous rock cores of a diameter consistent with bit size to the depths specified. The Contractor shall use, as a minimum, a standard ball-bearing, swivel-head, double-tube core barrel, or equivalent. The capacity of the core barrel shall not exceed 10.5 feet of core. Supplies for core drilling to be furnished by the Contractor shall include, but not be limited to, all casing, drill rods, core barrels, coring bits, piping, pumps, water, tools, and power required for drilling and all boxes and containers required for core samples. Selection of the type of bit shall be at the Contractor's discretion provided that the selected bit produces high quality rock core.

3.2.5 Pressure Testing (Hydraulic)

Pressure testing equipment to be furnished by the Contractor shall include, but not be limited to, the following: water pump with a minimum capacity of 50 gpm that is capable of delivering a constant adequate discharge pressure, double expander packers with rubber expansion elements set 5 or 10 feet apart with piping so arranged that water may be admitted either below the bottom packer element or between the two packer elements, a pressure relief valve, a pressure gage capable of measuring water pressures and water meter capable of measuring gpm flows. Supplies shall include, but not be limited to, all accessory valves, gages, surge tanks, stopcocks, plugs, expanders, potable water for testing, standby pumps, fuels, pipes, pressure hose, and tools necessary for maintaining uninterrupted tests for each boring to be tested. The pressure test equipment shall be configured so that the pressure gage is located at the top of the hole, a by-pass water line and valve are located between the pump and the gage, a flow meter is located between the by-pass and the pressure gage, and a valve is located in the line between the flow meter and the pressure gage. All equipment and supplies used for pressure testing shall be approved by the EPA prior to use.

3.2.6 Test Pit Excavation and Sampling

Selection of the test pit excavation, shoring/lining and dewatering (if necessary) methods and equipment shall be at the Contractor's discretion but must be approved by the Project Engineer. When the number of test pits to be excavated is large, and when adaptable mechanical trenching equipment is available, the EPA may require that such mechanical excavating equipment be used to expedite completion of the pits. Supplies which the Contractor shall furnish for obtaining undisturbed samples shall include, but not be limited to, split metal cylinders and/or metal or wooden boxes of acceptable sizes and types. The Contractor shall also furnish all materials required for shoring/lining to comply with all applicable safety regulations. The EPA may require the Contractor to salvage and re-use this shoring/lining material in successive test pits.

3.3 IDENTIFYING SAMPLES

Sample jars, shipping boxes, and labels shall comply with PART 2, paragraphs SAMPLE JARS, SHIPPING BOXES, and LABELS, respectively. The Contractor shall take all precautions required to insure that the shipping boxes are not subjected to rough handling or damaging environmental conditions.

3.4 AUGER BORING AND SAMPLING

Samples shall be labeled in accordance with paragraph IDENTIFYING SAMPLES. Samples shall be obtained for each change of overburden material or as directed by the Project Engineer. In order to retain the natural moisture content of the material to the fullest extent possible, all samples shall be of sufficient volume to completely fill the sample jars and the samples shall be placed in the sample jars as soon as possible after they are taken from the hole. All sample jars shall be labeled. In general, no sample shall remain on the site of boring for more than 1 week after being taken from the boring and placed in a jar.

3.5 DRIVE SAMPLE BORING AND SAMPLING

Samples shall be labeled in accordance with paragraph IDENTIFYING SAMPLES. Drive sample borings drilled through overburden materials shall be suitably cased to permit obtaining drive samples of the size or sizes specified or as directed. Samples shall be taken either continuously as directed by the Project Engineer. The sampler shall be driven with the with a drive hammer. To minimize the compacting effect of casing driving when casing is used to stabilize a boring, the bottom of the casing shall be kept as high above the soil sampling zone as conditions permit. If hollow stem auger is used as a casing and/or to advance the boring, a plug assembly must be used to keep soil from entering the inside of the auger. Above the water table, samples shall be obtained from a dry hole. Below the water table, water shall be maintained within the hole at or above the groundwater level. Where information on the natural water content of soils above the water table is not needed and when approved by the Project Engineer, boreholes may be drilled without casing by using a suitable drilling fluid to prevent collapse of sidewalls. When a drilling fluid is used, soil sampling shall be done by such means that will prevent inclusion of drilling fluid in the samples. The samples shall be placed in sample jars as soon as possible after they are taken from the hole and, when possible, the volume of the sample shall be large enough to completely fill the sample jar in order that the natural moisture content of the material may be retained to the fullest extent possible. All samples shall be labeled. No sample shall remain at the site of boring for more than one week after being taken from the hole.

3.6 UNDISTURBED SAMPLE BORING AND SAMPLING

In general, labeling of undisturbed samples shall conform to paragraph IDENTIFYING SAMPLES. Particular care shall be taken to indicate the top and bottom of each sample tube. Tubes and crates for undisturbed samples shall be labeled "DO NOT JAR OR VIBRATE."

3.6.1 Procedure

The procedure for Undisturbed Sample Boring and Sampling shall be the same as outlined in paragraph DRIVE SAMPLE BORING AND SAMPLING, except that the sampling device shall be advanced downward by one continuous, smooth drive using the drill rig's hydraulic feed system. The hydraulic down pressure shall be read and recorded at 6 inch intervals during each sample drive. The sampling device for stiff and dense soils shall be advanced by continuous rotation of the outer cutting barrel in conjunction with use of drill fluid circulation. Driving of any undisturbed sampling device by means such as a drop hammer will not be permitted.

3.6.2 Sealing

The soil samples shall be sealed on both ends with Teflon tape and secured with plastic end caps.

3.6.2.1 Alternate 1

The soil sample obtained in a thin wall Shelby tube shall be retained in the tube and sealed on both ends with a mechanically expandable O-ring sealing disk of the appropriate size.

3.6.2.2 Alternate 2

The soil sample obtained in a thin wall Shelby tube shall be extruded from the tube in the field as soon as the tube is removed from the boring by a method approved by the EPA. The extruded soil sample shall immediately be wrapped in aluminum foil or thin plastic wrap and placed in the center of a metal bottomed, waxed cardboard or plastic tube that has a diameter of at least 1 inch larger than the diameter of the soil sample, is at least 1-inch longer than the length of the soil sample, and has at least 1/2-inch of congealed 50/50 mixture of paraffin and microcrystalline wax or microcrystalline wax in the bottom. The annular space between the soil sample and the tube shall be filled with a 50/50 mixture of paraffin and microcrystalline wax or microcrystalline wax only to a distance of at least 1/2-inch above the top of the soil sample.

3.6.2.3 Alternate 3

Both ends of the soil sample tube/liner obtained with a Denison barrel, or its equivalent, shall be cleaned out to remove all drill fluid contaminated and/or disturbed soil or to a minimum distance of 2 inches from the ends of the tube/liner. Any material removed that is not contaminated with drill fluid shall be placed in a sample jar and labeled in accordance with paragraph IDENTIFYING SAMPLES. The cleaned out ends of the sample liner tube shall then be sealed with a 50/50 mixture of paraffin and microcrystalline wax or microcrystalline wax only. A metal or wooden disk, having a diameter just slightly smaller than the inside diameter of the liner tube shall be inserted into the wax to a distance of 1/4-inch from the end of the soil sample. The wax plugs shall be flush with the ends of the tube and a final seal consisting of a metal cap or tape shall be placed over the ends of the tube.

3.7 CORE HOLE OVERBURDEN DRILLING

Where samples of overburden materials are required in connection with core drilling, the soil overburden shall be drilled and sampled in accordance with the applicable provisions for the type of samples required. Where sampling of the overburden materials is not required, the Contractor may utilize any method and equipment for drilling and, if required, casing through the overburden that will not affect the quality of the core drilling from the rock surface downward in accordance with these specifications. The method chosen must be approved by the EPA prior to starting any overburden drilling.

3.8 CORE DRILLING

3.8.1 Procedure

All holes shall be drilled vertically or at the inclined angles indicated by the Project Engineer to the bottom elevations or depths specified unless indicated in the schedule of borings or directed to be drilled otherwise. Off-setting of borings from the locations specified in the Plan of Borings or as shown on prepared drawings, will not be permitted without prior approval. Casing through the overburden may be required. This casing shall be sealed in the rock at the elevation where rock is encountered prior to commencement of rock coring. The Contractor shall operate his drills at such speeds and with such down pressures and shall control drill fluid pressures and quantities to insure maximum core quality and recovery in whatever kind of rock is encountered. Where soft or broken rock is encountered, the Contractor shall reduce the length of runs to 5 feet or less in order to reduce and/or keep core loss and core disturbance to the minimum. Failure to comply with the foregoing procedures shall constitute justification for the Project Engineer to require redrilling, at the Contractor's expense, of any boring from which the core recovery is unsatisfactory. The Contractor shall exercise particular care in recording zones of water loss, cavities, rod jerks, rough drilling and other unusual and non-ordinary coring experiences that, supplementing the core record, will throw light on the nature and the extent of any fracturing or abnormalities.

3.8.2 Arrangement of Core

Core boxes shall comply with PART 2, paragraph CORE BOXES. All cores shall be arranged neatly in the partitioned boxes in the same sequence in which they occurred before removal from the hole. Facing the open box with the hinged cover above and the open box below, cores shall be arranged in descending sequence beginning at the left end of the trough nearest the hinges and continuing in the other troughs from left to right. The highest part of the core shall be placed in box 1, and the lower portions of the core shall be placed in the other boxes in consecutive order.

3.8.3 Preservation of Core

Representative samples of core shall be wrapped in aluminum foil or thin plastic wrap and then sealed with teflon tape and end caps or by applying paraffin wax, microcrystalline wax, or a 50/50 mixture of paraffin and microcrystalline wax to the outside of the wrapping material prior to placing the core in the core box. This sealing process shall be accomplished as soon as possible after the core is removed from the core barrel. The minimum length of core that is preserved from each boring shall be no less than 2.5 times the core diameter. Spacer blocks shall be marked and placed in the core box to show where samples have been removed.

3.8.4 Labeling, Marking and Packing Core

Stenciled labels for core boxes complying with paragraph CORE BOX LABELS
shall be placed on the inside and outside of the top cover in addition to each end. In addition, the depths (or elevations) of each core run/pull shall be marked with a black waterproof pen on the spacer blocks that are placed between core pulls. When a box is full, the space between the core and the trough sides shall be filled with finely ground vermiculite or other packing material approved by the EPA.

3.8.5 Disposition of Core

While on site, the Contractor shall protect the filled core boxes from direct sunlight, precipitation, and freezing by some form of EPA approved shelter that allows ventilation to the boxes. Upon completion of core drilling and sampling operations, core boxes containing cores shall be stored in an area provided by the EPA near the site of drilling or shipped or delivered to an appropriate location.

3.9 PRESSURE TESTING (HYDRAULIC)

The Contractor shall record all gage and meter readings made during a pressure test on a suitable form approved by the EPA. A sample form is shown in FIGURE 2 - PRESSURE TEST DATA FORM.

The Contractor shall pressure-test each hole in 5 to 10-foot sections commencing at the top of bedrock and progressing downward to the bottom of the hole or to such depths as determined by the Project Engineer below which testing of the hole is not necessary. After the pressure test is completed, the packer assembly shall be removed and the next section cored and then pressure tested. This procedure shall be continued to the bottom of the hole or to depths determined by the Project Engineer. Where core data from the test holes indicate only isolated zones that are open or fractured, pressure testing may be limited by the Project Engineer to these zones only. Water pressure employed for each lift shall be determined in the field by the Project Engineer and shall not exceed one pound per square inch per foot of depth to the upper expander. The pressure test will be divided into two phases; the first phase will be a flow test which shall then be followed by the second phase which is a duration test. In performing the first phase, water is pumped slowly at first, and the flow then gradually increased to the point where the predetermined maximum pressure is maintained, by adjusting the valve on the by-pass line. The allowable pressure shall be held for 1 minute before any readings are taken. The volume of flow into the test section shall be measured for a period of 5 minutes during which time the pressure shall not vary by more than 5 psi. After this 5-minute test, the second phase shall be started by closing the valve located between the flow meter and the pressure gage. The drop in pressure is then read for a period of 5 minutes at 30-second intervals. In some situations, such as in a very tight formation, the Project Engineer may eliminate phase one of the test. The Contractor may be required to make check tests at his own expense if the testing equipment or its assembly and arrangement are found to be faulty during or after the testing of any holes.

3.10 TEST PIT EXCAVATION AND SAMPLING

3.10.1 Excavation

The test pits shall be excavated to depths and dimensions indicated on prepared drawings or as directed by the Project Engineer. Before excavating pits, the Contractor shall thoroughly familiarize himself with work site and with all available subsurface data, particularly groundwater conditions. Regardless of the method of excavation employed, the pits shall be excavated, dewatered, and shored/lined in conformance with all applicable safety regulations.

3.10.2 Sampling

Soil samples shall be obtained from each pit as indicated on prepared drawings or at as directed by the Project Engineer. In obtaining samples from test pits, the undisturbed in situ (in place) natural physical and structural characteristics of the sampled materials shall be preserved insofar as possible both while samples are being taken and during shipment to the point of testing. In cohesive and partially cohesive soils this may be accomplished by isolating the soil column or cube to be sampled by gently trenching around it and knife-trimming it to the required dimensions of the split cylinder or box. A thin coating of melted 50/50 mixture of paraffin and microcrystalline wax or microcrystalline wax only shall then be applied quickly but gently to the sample with a paint brush to seal it against loss of moisture. The metal or wooden sample container, with the top and bottom removed shall then be placed over the wax coated sample such that the sample is centered within the container and the top of the container sides are at least 1 inch above the top of the sample. The spaces between the sample and the side walls of the container shall then be filled with melted wax. After this wax has congealed, the space between the top of the sample container sides and the top of the sample shall be filled with the wax. After this wax has congealed, it shall be trimmed so that when the top of the sample container is installed there is no void between the container top and the wax. After the container top is installed, the soil column or cube shall then be cut off a few inches below the container, the sample and container inverted and removed from the pit and the sample trimmed at the base so that the bottom of the sample is at least 1 inch below the bottom of the container. This space shall be filled with wax and, after the wax has congealed, it shall be trimmed so that when the bottom of the container is installed, there shall be no void between the wax and the bottom of the container. Where overburden materials to be sampled are only partially cohesive, it is best not to expose the entire soil column before waxing. By exposing and waxing small sections at a time, the sample will be subjected to less disturbance. Where natural moisture content is an important factor, delay shall be avoided in taking the sample in order that the natural moisture content of the material may be retained to the fullest extent.

3.10.3 Disposition of Samples

Samples shall be packed in vermiculite or a packing material approved by the EPA and shipped in sturdy wooden boxes of strength and construction sufficient to guarantee against damage during shipment. Boxes should be no larger than is required for shipping two such samples. All sample boxes shall be marked FRAGILE-HANDLE WITH CARE and shall be identified by labels, similar to those as specified in paragraph IDENTIFYING SAMPLES, attached to the outside of each box. Extreme care shall be taken to indicate the top and bottom of each sample. The Contractor shall avoid exposing sealed and crated samples to precipitation and extremes of temperature. Undisturbed samples permitted to freeze, even partially, shall be replaced by the Contractor at his expense. The Contractor shall not hold these samples at the site of sampling for a period in excess of one week. Prior to shipment, each sealed and boxed sample shall be checked for correct labeling.

3.11 SUPPLEMENTAL BORINGS

Borings that are abandoned or from which unsatisfactory samples or cores are obtained will be supplemented by other borings or pits adjacent to the original in order that satisfactory samples or the required information will be obtained. Actual locations of any supplemental holes will be established by the Project Engineer. Penetration to the depth where the original was abandoned or to the depths where unsatisfactory samples were obtained may be made by any method selected by the Contractor that in the opinion of the Project Engineer will permit satisfactory completion and sampling below the elevation where the last satisfactory sample was obtained in the abandoned or satisfactory sampling in the reaches where satisfactory samples were not obtained from the original location. No payment will be made for supplemental borings or pits that were abandoned or from which satisfactory samples were not obtained because of mechanical failure of drilling and sampling equipment, negligence on the part of the Contractor, or other preventable cause for which the Contractor is responsible, except that payment will be made for acceptable portions of these supplementary borings below the depths or outside the reaches for which payment was made for the original borings.

3.12 BACKFILLING

3.12.1 Drill Holes

Unless otherwise noted in these specifications or directed by the Project Engineer, all drill holes shall be backfilled and abandoned in accordance with all Federal, State, and local laws, regulations and ordinances. The Contractor shall preserve all holes in good condition until final measurement and until the records and samples have been accepted. As a minimum, all holes shall be grouted from the bottom of the hole to within 2 feet of the ground surface using a grout mixture of six to eight gallons of water per sack 94 pounds of portland cement. All grout shall be pumped through a tremie that is inserted to the bottom of the boring to insure that the grout fills the full extent of the hole. The remaining ungrouted top 2 feet of the hole shall be backfilled with local soil and tamped. All backfilling operations shall be performed in the presence of the Project Engineer or QC Engineer and, if required by regulation, Federal, State, and local officials. No separate payment will be made for backfilling drill holes. The cost of this work shall be included in the drilling costs.

3.12.2 Test Pits

The Contractor shall backfill all test pits with local soil compacted to original densities as directed by the Project Engineer or Construction Manager. No separate payment will be made for backfilling test pits. The cost of this work shall be included in the test pit excavation costs.

3.13 RECORDS

The Contractor shall keep accurate driller's logs and records of all work accomplished under this contract and shall deliver complete, legible copies of these logs and records to the EPA upon completion of the work or at such other time or times as he may be directed. All such records shall be recorded during the actual performance of the work and shall be preserved in good condition and order by the Contractor until they are delivered and accepted. The EPA shall have the right to examine and review all such records at any time prior to their delivery to him and shall have the right to request changes to the record keeping procedure. The following information shall be included on the logs or in the records for each hole:

a) Hole number or designation and elevation of top of hole.

b) Driller's name and Geologist's name.

c) Make, size, and manufacturer's model designation of drilling and sampling/excavating equipment.

d) Type of drilling operation by depth.

e) Hole diameter.

f) Dates and time by depths when drilling, sampling, operations are performed.

g) Time required for drilling each run.

h) Drill action, rotation speed, hydraulic pressure, water pressure, tool drops, and any other unusual and non-ordinary experience which could indicate the subsurface conditions encountered.

i) Depths at which samples or cores were recovered or attempts made to sample or core including top and bottom depth of each run.

j) Classification or description by depths of the materials sampled, cored, or [penetrated using the Unified Soil Classification System (ASTM D 2487) and including a description of moisture conditions, consistency and other appropriate descriptive information described in paragraph SUPPLEMENTAL BORINGS of ASTM D 2488. This classification or description shall be made immediately after the samples or cores are retrieved.

k) Classification and description by depths of rock materials sampled or cored including rock type, composition, texture, presence and orientation of bedding, floiation, or fractures, presence of vugs or other interstices, and the RQD for each cored interval. Indication of penetration resistance such as drive-hammer blows given in blows per foot for driving sample spoons and casing.

l) Force Weight of drive hammer.

m) Percentage of sample or core recovered per run.

n) Depth at which groundwater is encountered initially and when stabilized.

o) Depths at which drill water is lost and regained and amounts.

p) Depths at which the color of the drill water return changes.

q) Type and weight of drill fluid.

r) Depth of bottom of hole.

s) Pressures employed in pressure testing.

END OF SECTION

SECTION 02211

EARTHWORK

PART 1 GENERAL

The general provisions of the contract, including the general and special conditions and the requirements of Division 1, apply to the work specified in this section. Grading and earthwork within the Maywood Riverfront Park boundary are the responsibility of the City of Maywood Park Contractor. The earthwork proposed in this section pertains to trenching and the treatment compound foundation and includes specifications for subgrade excavation, subgrade fill and pipe embedment placement, and disposal of excess/unsuitable excavated materials. Also see related sections, SECTION 02205 - SOIL MATERIALS and SECTION 02225 - TRENCHING.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
AASHTO T 180 (2001) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457-mm (18-in) Drop

AASHTO T 224 (2001) Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)
ASTM C 136 (2001) Sieve Analysis of Fine and Coarse Aggregates

ASTM C 33 (2003) Concrete Aggregates

ASTM D 1140 (2000) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve

ASTM D 1556 (2000) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557 (2002) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu.m.))

ASTM D 1883 (1999) CBR (California Bearing Ratio) of Laboratory-Compacted Soils

ASTM D 2167 (1994; R 2001) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D 2434 (1968; R 2000) Permeability of Granular Soils (Constant Head)

ASTM D 2487 (2000) Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D 2922 (2001) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937 (2000e1) Density of Soil in Place by the Drive-Cylinder Method

ASTM D 3017 (2001) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

ASTM D 422 (1963; R 2002) Particle-Size Analysis of Soils

ASTM D 4318 (2000) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D 698 (2000a) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ARMY CORPS OF ENGINEERS (USACE)
EM 385-1-1 (2003) Safety -- Safety and Health Requirements

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
EPA SW-846.3-3a (1999) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods; Third Edition; Final Update III-A

EPA 600/4-79/020 (1983) Methods for Chemical Analysis of Water and Wastes

U.S. GENERAL SERVICES ADMINISTRATION (GSA)
FS A-A-203 (Rev C; Notice 2) Paper, Kraft, Untreated

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

SD-03 Product Data
Utilization of Excavated Materials; G
Opening of any excavation and location for disposal of unused satisfactory material. Proposed source of borrow material. Notification of encountering rock in the project. Advance notice on the opening of excavation or borrow areas. Advance notice on shoulder construction for rigid pavements.

SD-06 Test Reports
Borrow site testing within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests. Results of testing at the borrow site.

SD-07 Certificates
Testing Qualifications of the commercial testing laboratory or Contractor's testing facilities.

1.3 QUALITY ASSURANCE

A. The QC Engineer will be responsible for observing and documenting earthwork activities. The QC Engineer will obtain soil samples and perform tests to evaluate that the work is being performed in compliance with these Specifications. The QC Engineer will obtain soil samples and conduct tests on earthwork as outlined in Tables 0221 1-1 and 0221 1-2. The Contractor will provide assistance as necessary to accomplish the required sampling and testing.

B. The following methods of field sampling and testing will be performed by the QC Engineer, as a minimum:

   1. In-place Density: ASTM D 2922

   2. Confirmation by Nuclear Gauge: ASTM D 2937

C. The following methods of laboratory testing will be performed by the Engineer on soil samples, as a minimum:

   1. Particle Size Analysis: ASTM D 422 and ASTM D 1 140

   2. Laboratory Moisture-Density Relation: ASTM D 1557

   3. Specific Gravity: ASTM D 854

   4. Permeability: ASTM D 5084

D. Prior to placement, all materials must be approved by the QC Engineer according to the specifications contained in SECTION 02205 – SOIL MATERIALS. The suitability of all materials will be determined by the QC Engineer by reviewing Contractor submittals and by conducting material evaluation testing as material is imported to the site in accordance with Table 02211-1.

E. All material placement must be approved by the QC Engineer according to the specifications contained in this section. The suitability of all material placement will be determined by the QC Engineer by conducting soil compaction testing in accordance with Table 02211-2. This does not relieve the Contractor of responsibility for adequate supervision and for installation of materials in compliance with these Specifications.

F. During construction, the QC Engineer may direct that inspection trenches or test pits be cut into fills to determine that the Specifications have been met. Such trenches or pits will be of limited depth and size, and shall be backfilled with the material excavated therefrom, or other fill material meeting the requirements for the zones cut into. Backfill shall be compacted to a density at least equal to that specified for contiguous fills.

G. When the QC Engineer directs inspection trenches or test pits to be excavated into fills and backfills, and materials are found to meet all Specification requirements, the excavation and refilling will be paid for as additional work pursuant to the California Department of Transportation (Caltrans) standard specifications, July 2002 or latest edition. Inspection trenches or test pits, and the refilling of the same will be at the Contractor's expense if it is found that the materials excavated do not meet the Specification requirements.

1.4 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of utilities remaining, by type, diameter of pipe (if appropriate), horizontal location dimensions, elevations or inverts at specified location(s), and slope gradients.

1.5 SUBSURFACE DATA

Subsurface soil boring logs are available in the November 2003 *Final Remedial Investigation Report* and February 2004 *Final Feasibility Study Report*. The logs represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.6 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

PART 2 PRODUCTS

2.1 MATERIALS (NOT USED)

PART 3 EXECUTION

3.1 GENERAL

A. Required lines, levels, contours, and datum will be identified by the Contractor before the start of earthwork operations.

B. Material will be graded to the lines and grades shown on the Drawings

C. Horizontal tolerances are plus or minus 0.1 foot. Vertical tolerances are plus or minus 0.1 foot.

D. Make top surface of each layer smooth and level.

3.2 PREPARATION

A. Identify required lines, levels, contours, and data.

B. Identify known underground, aboveground, and aerial utilities. Stake and flag locations.

C. Protect above- and below-grade utilities which are to remain.

D. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

E. Verify that subgrade cut/fill balances.

F. Each lift shall be thoroughly mixed to assure a uniform distribution of water content.

G. No fill shall be placed during the rain or when saturation of the fill will hinder proper compaction.

H. Jetting or flooding of the fill will not be permitted.

3.3 SUBGRADE EARTHWORK

A. Subgrade excavation

1. Where excavation is carried below the design grades, the Contractor will backfill to the required grade or to the indicated invert grade, as specified, and re-compact the backfill to 95 percent of the maximum dry density as determined by ASTM D 1557.

2. Unsuitable or low density subgrade material not readily capable of in-place compaction will be excavated as directed by the QC Engineer.
3. Excavation carried out for the convenience of the Contractor will conform the limits approved by the QC Engineer and will be at no additional expense to the Government.
4. Upon reaching design excavation grades, on slopes 3:1 and flatter, the subgrade will be scarified a minimum depth of 6 inches and compacted to at least 95 percent of the maximum dry density as determined by ASTM D 1557.
5. The Contractor will conduct operations to prevent ponding of surface water within the limits of excavation and fill. Good drainage shall be maintained at all times. Ditches will be excavated at the locations shown on the Drawings to collect and transport storm runoff. All dewatering will be the Contractor's responsibility.
6. The stockpile areas and locations for burying of debris and unsuitable materials will be designated by the QC Engineer.

3.4 FOUNDATION EXCAVATION REQUIREMENTS

A. General Requirements:

1. Foundation layer materials will be placed to the lines and grades shown on the Drawings.
2. If any portion of the foundation layer materials does not meet the specified requirements, the Contractor will remove such material and replace with material meeting the specification requirements at no additional cost to the Government.
3. During seasonal or extended shutdowns, all exposed surfaces will be protected from contamination which reduces permeability. Any contaminated materials will be removed and handled in accordance with SECTION 02111-EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL.

B. Placing Requirements:

1. Equipment used and placement method must be agreed upon and accepted by the QC Engineer prior to start of work. Approval does not absolve the Contractor of responsibility for damage to the site components. The Contractor is responsible for repairing damage to site components during foundation layer placement at no cost to the Government.
2. Foundation layer materials will be placed in a manner to minimize disturbance to the underlying subgrade.
3. Place and compact foundation layer material in continuous layers not exceeding 6 inches compacted depth, compacted to 95 percent of the maximum dry density as determined by ASTM D 1557.
4. Ensure that footing subgrades have been inspected and approved by the Project Engineer prior to concrete placement.

3.5 TRENCH EXCAVATION REQUIREMENTS

Trenching excavations shall be supervised by an “excavation competent” person who is familiar with the excavation/trenching requirements, who is able to recognize hazards, and who has the authority to make corrective measures. Trench excavations shall be performed in accordance with OSHA guidance for sloping, shoring, and shielding (CFR, Title 29, Part 1926.650-652).

Excavation specifications for the trenches are provided in Drawings C-2, C-4 and C-5, SECTION 02221-TRENCHING. Changes to the trench depth, width, and general excavation shall be made as designated by the construction manager or project engineer according to Site conditions or other factors encountered in the field.

Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 5 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content.

3.5.1 Underground Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Construction Manager. Report damage to utility lines or subsurface construction immediately to the Construction Manager.

3.5.2 Dewatering

Significant groundwater volumes not anticipated to be encountered during the excavation.

3.5.3 Removal of Unyielding Material

Unyielding material is defined as weathered rock, dense consolidated deposits, or conglomerate materials with stones greater than 3 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller. These materials usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

Where overdepth is not indicated and unyielding material is encountered in the bottom of the trench, such material shall be removed 4 inches below the required grade and replaced with suitable materials as provided in paragraph TRENCH BACKFILL.

3.5.4 Removal of Unstable Material

Unstable material consists of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph TRENCH BACKFILL. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.5.5 Removal of Hard Material

Solid homogeneous interlocking crystalline material with firmly cemented, laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding ½ cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

3.5.6 Excavation for Appurtenances

Excavation for manholes, vaults, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.6 TRENCH BACKFILL

Trenches shall be backfilled to the grade shown on the Drawings and as specified in this Section and SECTION 02221-TRENCHING. Backfilling will generally be to surface grade unless otherwise shown or specified by the Construction Manager or Project Engineer.

3.6.1 Initial Backfill Material

Initial backfill shall consist of sand-cement grout or other satisfactory material free from rocks 0.5 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller.

3.6.1.1 Sand Cement Slurry (SCS)

Composed of Portland cement, water, an air-entraining admixture, and sand mixed with sufficient water to produce a workable mixture and an amount of admixture which will entrain sufficient air to produce durable grout, as determined by the QC Engineer. Sand cement slurry shall conform to the requirements of the California Department of Transportation specification for Class B bedding. Sand Cement Slurry shall consist of at least 1 sack of Portland cement per cubic yard of sand plus water, with a 7-inch slump plus or minus 1-1/2 inches. Sand cement slurry used beneath roads shall consist of at least 2 sacks of Portland cement per cubic yard of sand plus water.

Slurry shall be mixed in a concrete mixer. Mixing time shall be sufficient to produce a mixture having a consistency permitting gravity flow into the interstices of the rip-rap with limited spading and brooming. Slurry backfill shall cover at least 4-inches above the top of piping.

3.6.2 Final Backfill Material

Following placement of initial backfill, final backfill shall be deposited in layers of a maximum of 8-inch loose thickness, and compacted to 90 percent density. This requirement shall also apply to all other areas not specifically designated below. Backfill material shall be placed and compacted as follows:

a) Roadways: Backfill shall be placed up to the required elevation as specified. Soil compaction for roadways to be at least 95 percent. Water flooding or jetting methods of compaction will not be permitted.

b) Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas

3.6.3 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve shall be expressed as a percentage of the maximum density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224. To maintain the same percentage of coarse material, the "remove and replace" procedure as described in the NOTE 8 in Paragraph 7.2 of AASHTO T 180 shall be used.

3.6.4 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.6.5 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.6.6 Backfill for Appurtenances

After the manhole, vault, inlet, or similar structure has been constructed, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.6.7 Disposition Of Surplus Material

Surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, and timber shall be wasted in an approved disposal Site as directed by the Construction Manager.

3.7 SHORING

3.7.1 General Requirements

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. If workers must enter the excavation, it shall be evaluated, shored, sloped or braced as required by EM 385-1-1 and 29 CFR 1926 section 650. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.7.2 Geotechnical Engineer

The Contractor is required to hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer shall be responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer shall update the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and shall submit an updated plan if necessary. A written report shall be submitted, at least monthly, informing the Contractor and EPA of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Geotechnical Engineer shall be available to meet with the EPA at any time throughout the contract duration.

3.8 FIELD QUALITY CONTROL

A. The QC Engineer will obtain samples and perform tests throughout the construction period. The Contractor will cooperate with the QC Engineer by providing access to testing areas and avoiding interference.

B. The QC Engineer will perform tests or obtain samples to be sent to a laboratory for testing on a regular basis, as specified in Tables 02200-1 and 02200-2. These testing methods and frequencies are the minimum requirement. Additional tests may be performed at the QC Engineers's discretion.

Table 02211-1
Material Evaluation Testing Frequency
Per Source

ASTM Test Designation	Foundation Layer (CY)	Pipe Embedment (CY)
C 136 (Particle Size)	5,000	5,000
Minimum one test per material type. Quarry certification required for foundation layer		

Table 02211-2
Soil Construction Testing Frequency
Per Source

ASTM Test Designation	Foundation Layer (CY)	Pipe Embedment (CY)
C 136 (Particle Size)	5,000	5,000
D 2922 (Compaction)	500 (sq. ft.)	75 (linear ft.)
D 3017 (Water Content)	500 (sq. ft.)	75 (linear ft.)
(1) Minimum one test per material type		

3.9 STORM WATER CONTROL

Storm water control for the Maywood Riverfront Park project is the responsibility of the City of Maywood. However, the Contractor shall implement such storm water control measures as ecessary, possibly including such erosion control measures as hay bales and silt fencing to prevent storm water runoff from flowing off site, to prevent storm water runoff from accumulating in the construction area, to prevent erosion of or damage to the prepared subgrade, and to prevent damage to any emplaced geosynthetic or soil component.

END OF SECTION

SECTION 02225

TRENCHING

PART 1 GENERAL

The general provisions of the contract, including general and special conditions and the requirements of Division 1, apply to the work specified in this section. This Section applies to all trench work as shown on the drawings, including excavation, compaction, backfilling, and utilities coordination.

Trenching shall be utilized for installation of connection piping to monitoring and extraction wells for the dual-phase extraction treatment system. Following piping installation, the backfilling of trenches and restoration of surfaces will be performed in accordance with this section. Also see the following related sections: SECTION 02225 – TRENCHING, SECTION 02300 - EARTHWORK.

1.1 REFERENCES

ASTM INTERNATIONAL (ASTM)
ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

ASTM D2922 - Test Method for Density of Soil in Place using by nuclear Methods.

ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb Rammer and 18 inch Drop.

1.2 UTILITIES AND TRENCH EXCAVATION PERMIT

The Underground Service Alert (USA) notification system, the individual utility companies, and the City of Maywood shall be contacted prior to performing all excavations by machine greater than 1-foot deep. A geophysical survey shall be performed throughout all excavation areas. No other permit or notification requirements exist for trench excavation. Before any excavation within an existing City street will be allowed, written approval by the City of Maywood shall be obtained and a copy of said approval shall be available at the site of the work. Signed and executed contracts for public improvements or sewer connections issued by the City shall constitute compliance with this Section.

1.3 EXISTING UTILITIES

All existing facilities shall be protected from damage. Any damage done to utility facilities shall be reported to the respective utility owner by the Contractor, and any repair work required shall be done by such company's repair crew. Prior to backfilling, all repair work shall be approved by the Project Engineer or Construction Manager. All sewer and utility lines that cross or lie along the trench shall be adequately supported during construction and such supports left in place. Care should be exercised when backfilling around such lines to avoid any damage to them. Any pipeline or lateral, storm or sanitary, cut or damaged in any way shall be replaced in kind. The damaged pipe shall be replaced between adjacent joints. No patching of damaged pipe will be permitted. When it is impossible to avoid damaging signal facilities installed in the pavement, coordination with the City Streets and Traffic Department is required. Damage to traffic signal loops, pads, interconnect cables, conduits or fire alarm conduits shall be repaired or replaced as directed by the City of Maywood. All traffic markers and markings damaged or destroyed shall be replaced unless otherwise directed by the City of Maywood.

1.4 FIELD MEASUREMENTS

A. Verify that work area and lines of trenching are as shown on Drawings.

1.5 QUALITY ASSURANCE

A. The QC Engineer will be responsible for observing and documenting trenching activities. The QC Engineer will obtain soil samples and perform tests and make field measurements to evaluate that the work is being performed in compliance with these Specifications. The Contractor will provide assistance as necessary to accomplish the required sampling and testing. This does not relieve the Contractor of responsibility for adequate supervision and for installation of materials in compliance with these Specifications.

B. The following methods of field sampling and testing will be performed by the QC Engineer, as a minimum: In-place Density: ASTM D 2922 (Nuclear Gauge), and Water Content: ASTM D 3017 (Nuclear Gauge).

C. The following methods of laboratory testing will be performed by the Engineer on soil samples, as a minimum: Particle Size Analysis: ASTM C 136; Laboratory Moisture-Density Relation: ASTM D 1557.

D. Prior to placement, all materials must be approved by the QC Engineer according to the specifications contained in Section 02205. The suitability of all materials will be determined by the QC Engineer by reviewing Contractor submittals and by conducting material evaluation testing as material is imported to the site in accordance with Table 02211-1.

E. All material placement must be approved by the QC Engineer according to the specifications contained in this sections. The suitability of all material placement will be determined by the QC Engineer by conducting soil compaction testing in accordance with Table 02211-2.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

A. Source quality control shall be conducted in accordance with the requirements of SECTION 02205 – SOIL MATERIALS.

2.2 FILL MATERIALS

A. Foundation Layer Material (as specified in section 02205)

B. Aggregate Base Material (as specified in section 02205)

C. Pipe Bedding Material (as specified in section 02205)

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify acceptability of fill materials to be reused. All placement of re-used material will be approved by the QC Engineer.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Maintain and protect existing utilities remaining, which pass through work area.

C. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.

D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.

E. Protect above and below grade utilities which are to remain.

F. Cut out soft areas of subgrade not capable of in-situ compaction. Backfill with one of backfill types defined as directed by the QC Engineer. Compact to density equal to or greater than requirements for subsequent backfill material.

3.3 EXCAVATION

A. Trench excavations shall be performed in accordance with OSHA guidance for sloping, shoring, and shielding (CFR, Title 29, Part 1926.650-652).

B. Excavate trenches for SVE pipe according to Drawings C-2, C-4, and C-5. Changes to the trench depth, width, and general excavation shall be made as designated by the construction manager or project engineer according to Site conditions or other factors encountered in the field.

C. Excavate subsoil required for all underground piping and utilities.

D. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Construction Manager. Report damage to utility lines or subsurface construction immediately to the Construction Manager.

E. Where rock or unsuitable soil is encountered, excavate rock or unsuitable material encountered six (6) inches below the pipe for bedding fill.

F. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 5 feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil.

G. The bottoms of trenches shall be graded and prepared to provide a firm unyielding and uniform bearing throughout the entire length of pipe conduit. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 3 inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing. The trench bottom shall be smooth and free from irregularities greater than 1/2-inch diameter such as rocks and large dirt clods.

H. Hand trim excavation. Remove loose matter.

I. Correct areas over-excavated by error.

J. Excavation for manholes, vaults, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown.

K. Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed.

L. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.4 STOCKPILING

A. Where indicated, work will be divided into stockpile areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills.

B. The Contractor shall not haul satisfactory material excavated in one excavation area to another excavation area except when so directed in writing. Stockpiles of satisfactory and unsatisfactory and wasted materials shall be placed and stockpiled as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times.

3.5 BEDDING

A. Support pipe and conduit during placement and compaction of bedding fill.

B. Compact size bedding by tamping or rodding to prevent settlement, exercising caution so as not to deform or crush the pipe.

3.6 BACKFILLING

A. Remove vegetation, debris, unsatisfactory materials and harmful materials prior to placement of fill. Plow, strip or break up sloped surfaces steeper than 4 to 1 so that fill material will bond with existing surface.

B. Obtain fill from excavation or imported in accordance with Sections 02205 and as appropriate for the closure cover layer.

C. Remove and place or scarify and air dry, soil material that is too wet to permit compaction to specified percentage of maximum density.

D. Soil material that has been removed as too wet to permit compaction may be stockpiled or spread to dry. When moisture content is reduced to a satisfactory value, soil material may be used as fill or backfill.

E. No flooding or jetting, no placement of fill during rain or when saturation will hinder proper compaction.

F. Trenches shall be backfilled to the grade shown on the Drawings. Backfilling will generally be to surface grade unless otherwise shown on the drawings or specified by the EPA.

G. When the existing ground surface has been disturbed and has a density of less than that specified for the particular area classification, scarify the ground surface, pulverize, adjust moisture condition to optimum moisture content and compact to required depth and percentage of maximum density. The upper six inches of material from the subgrade shall be compacted to a minimum dry density of 90 percent of the maximum dry density as defined by ASTM D 557.

H. Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

I. Backfill shall be deposited in layers of a maximum of 6-inch loose thickness, and compacted to 90 percent density. This requirement shall also apply all areas not otherwise designated.

J. Backfill material shall be placed and compacted as follows:

   1) Roadways: Backfill shall be placed up to the required elevation as specified. Soil compaction for roadways to be at least 95 percent. Water flooding or jetting methods of compaction will not be permitted.

   2) Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas

K. Place backfill and fill materials evenly adjacent to structures. Prevent wedging action of the backfill against structures by carrying the material uniformly around the structure to approximately the same elevation in each lift.

L. Place aggregate fill material under all building slabs, walks and steps on grade. Compact to density required for fill under buildings.

M. Compact soil materials using equipment suitable for materials to be compacted and work area locations. Use power driven hand tampers for compacting materials adjacent to structures, or as appropriate.

N. Where required, uniformly apply water to the surface of subgrade or layer of soil material in such manner as to prevent free water appearing on the surface, either during or subsequent to compaction operations.

O. Backfill and restoration of surface for trenches shall be performed in accordance with the type of backfill and surfacing materials required, depending on the location of the trench (beneath park surface or road surface).

3.6.1 Sand Cement Slurry (SCS)

A. Sand cement slurry shall conform to the requirements of the California Department of Transportation specification for Class B bedding. Sand Cement Slurry shall consist of at least 1 sack of Portland cement per cubic yard of sand plus water, with a 7-inch slump plus or minus 1-1/2 inches. Sand cement slurry used beneath roads shall consist of at least 2 sacks of Portland cement per cubic yard of sand plus water.

B. Slurry backfill shall cover at least 4-inches above the top of piping.

3.7 GRADING

A. Uniformly grade all areas within the limits designated on the Drawings, including adjacent transition area. Finish surfaces within specified tolerances with uniform levels or slopes between points where elevations are shown and existing grades.

B. Finish all surfaces free from irregular changes.

C. Shape subgrade under pavement to line, grade, and cross section to within 1/2 inch of required subgrade elevations.

D. Protect newly graded areas from traffic and erosion. Repair and reestablish grade in settled, eroded, or rotted areas to the specified tolerance.

E. Where compacted areas are disturbed by subsequent construction or adverse weather, scarify the surface, reshape and compact to the required density. Use hand tamper for recompaction over underground utilities and under floor subdrains.

3.8 EROSION CONTROL

A. All applicable erosion and siltation control measures shall be taken prior to grading.

B. No more than 500 feet of trench shall be open at any one time. Utilize steel plates to cover trench excavation as necessary.

C. Protect graded areas from the action of the elements. Settlement or other damage that occurs prior to acceptance of the work shall be repaired and grades satisfactorily re-established.

D. Upon completion of construction work, restore any areas disturbed by operations.

3.9 FIELD QUALITY CONTROL

A. The QC Engineer will obtain samples and perform tests throughout the construction period. The Contractor will cooperate with the QC Engineer by providing access to testing areas and avoiding interference.

B. Compaction testing will be performed by the QC Engineer in accordance with ASTM D2922. Tests and analysis of fill material will be performed in accordance with ASTM D1557.

C. If tests indicate work does not meet specified requirements, remove work, replace and retest at no cost to Owner.

D. Frequency of field compaction tests: One test per 500 feet of trench length (minimum).

END OF SECTION

SECTION 02373

GEOTEXTILE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)
ASTM D 4354 (1999) Sampling of Geosynthetics for Testing

ASTM D 4355 (2002) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus

ASTM D 4491 (1999a) Water Permeability of Geotextiles by Permittivity

ASTM D 4533 (1991; R 1996) Trapezoid Tearing Strength of Geotextiles

ASTM D 4632 (1991; R 1996) Grab Breaking Load and Elongation of Geotextiles

ASTM D 4751 (1999a) Determining Apparent Opening Size of a Geotextile

ASTM D 4759 (2002) Determining the Specification Conformance of Geosynthetics

ASTM D 4833 (2000e1) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products

ASTM D 4873 (2002) Identification, Storage, and Handling of Geosynthetic Rolls and Samples

1.2 SUBMITTALS

Government approval is required for submittals having a "G" designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data
Thread
A minimum of 7 days prior to scheduled use, proposed thread type for sewn seams along with data sheets showing the physical properties of the thread.

Manufacturing Quality Control Sampling and Testing
A minimum of 7 days prior to scheduled use, manufacturer's quality control manual.

SD-04 Samples
Quality Assurance Samples and Tests
Samples for quality assurance testing; 7 days shall be allotted in the schedule to allow for testing.

SD-07 Certificates
Geotextile
A minimum of 7 days prior to scheduled use, manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

1.3 DELIVERY, STORAGE AND HANDLING

Delivery, storage, and handling of geotextile shall be in accordance with ASTM D 4873.

1.3.1 Delivery

The EPA shall be notified a minimum of 24 hours prior to delivery and unloading of geotextile rolls. Rolls shall be packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, rolls shall be immediately rewrapped with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Each roll shall be labeled with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.3.2 Storage

Rolls of geotextile shall be protected from construction equipment, chemicals, sparks and flames, temperatures in excess of 160 degrees F, or any other environmental condition that may damage the physical properties of the geotextile. To protect geotextile from becoming saturated, rolls shall either be elevated off the ground or placed on a sacrificial sheet of plastic in an area where water will not accumulate.

1.3.3 Handling

Geotextile rolls shall be handled and unloaded with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

2.1.1 Geotextile

Geotextile shall be a nonwoven pervious sheet of polymeric material and shall consist of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Stabilizers and/or inhibitors shall be added to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material [may also] [shall not] be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the edges. Geotextiles shall meet the requirements specified in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 1
MINIMUM PHYSICAL REQUIREMENTS FOR DRAINAGE GEOTEXTILE

PROPERTY	UNITS	ACCEPTABLE VALUES	TEST METHOD
GRAB STRENGTH	LBS	160	ASTM D 4632
SEAM STRENGTH	LBS		ASTM D 4632
PUNCTURE	LBS	55	ASTM D 4833
TRAPEZOID TEAR	LBS	55	ASTM D 4533
APPARENT OPENING SIZE	U.S. SIEVE		ASTM D 4751
PERMITTIVITY	SEC -1		ASTM D 4491
ULTRAVIOLET DEGRADATION	PERCENT	50 AT 500 HRS	ASTM D 4355

2.1.2 Thread
Sewn seams shall be constructed with high-strength polyester, nylon, or other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING
The Manufacturer shall be responsible for establishing and maintaining a quality control program to assure compliance with the requirements of the specification. Documentation describing the quality control program shall be made available upon request. Manufacturing quality control sampling and testing shall be performed in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D 4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

PART 3 EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

3.1.1 Quality Assurance Samples
The Contractor shall provide assistance to the EPA in the collection of quality assurance samples. Samples shall be collected upon delivery to the site for quality assurance testing at the request of the EPA in accordance with ASTM D 4354, Procedure B. Lot size for quality assurance sampling shall be considered to be the shipment quantity of the product or a truckload of the product, whichever is smaller. The unit size shall be considered one roll of geotextile. Samples shall be identified with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. The date and a unique sample number shall also be noted on the sample. The outer layer of the geotextile roll shall be discarded prior to sampling a roll. Samples shall then be collected by cutting the full-width of the

geotextile sheet a minimum of 3 feet long in the machine direction. Rolls which are sampled shall be immediately resealed in their protective covering.

3.1.2 Quality Assurance Tests

The EPA will provide quality assurance samples to an Independent Laboratory. Samples will be tested to verify that geotextile meets the requirements specified in Table 1. Test method ASTM D 4355 shall not be performed on the collected samples. Geotextile product acceptance shall be based on ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile.

3.2.2 Placement

The Contractor shall notify the EPA a minimum of 24 hours prior to installation of geotextile. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles.

3.3 SEAMS

3.3.1 Overlap Seams

Geotextile panels shall be continuously overlapped a minimum of 12 inches at all joints. Where seams must be oriented across the slope, the upper panel shall be lapped over the lower panel.

3.4 PROTECTION

The geotextile shall be protected during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Adequate ballast (e.g. sand bags) shall be used to prevent uplift by wind. The geotextile shall not be left uncovered for more than 5 days after installation.

3.5 REPAIRS

Torn or damaged geotextile shall be repaired. Clogged areas of geotextile shall be removed. Repairs shall be performed by placing a patch of the same type of geotextile over the damaged area. The patch shall extend a minimum of 12 inches beyond the edge of the damaged area. Patches shall be continuously fastened using approved methods. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Geotextile rolls which cannot be repaired shall be removed and replaced. Repairs shall be performed at no additional cost to the Government

3.6 PENETRATIONS

Engineered penetrations of the geotextile shall be constructed by methods recommended by the geotextile manufacturer.

3.7 COVERING

Geotextile shall not be covered prior to inspection and approval by the QC Engineer, Project Engineer, or EPA. Cover soil shall be placed in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall not be dropped onto the geotextile from a height greater than 3 feet. No equipment shall be operated directly on top of the geotextile without approval of the EPA. Equipment with ground pressures less than 7 psi shall be used to place the first lift over the geotextile. A minimum of 6 inches of soil shall be maintained between full-scale construction equipment and the geotextile. Cover soil material shall be sand. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph.

END OF SECTION

SECTION 02525N

EXTRACTION AND MONITORING WELLS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)
ASTM A 312/A 312M (2004b) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 53 (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM C 117 (2004) Materials Finer than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136 (2004) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 150 (2004a) Portland Cement
ASTM D 1586 (1999) Penetration Test and Split-Barrel Sampling of Soils
ASTM D 1587 (2000) Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
ASTM D 1785 (2004a) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2487 (2000) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488 (2000) Description and Identification of Soils (Visual-Manual Procedure)
ASTM D 4397 (2002) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 5088 (2002) Decontamination of Field Equipment Used at Nonradioactive Waste Sites
ASTM D 5092 (2004e1) Design and Installation of Ground Water Monitoring Wells in Aquifers
ASTM F 480 (2002) Thermoplastic Well Casing Pipe and Couplings Made in Standard Dimension Ratios (SDR), SCH 40 and SCH 80
ASTM F 883 (2004) Padlocks

U.S. ARMY CORPS OF ENGINEERS (USACE)
EM 385-1-1 (2003) Safety -- Safety and Health Requirements

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
EPA 530/F-93/004 (1993; Rev O; Updates I, II, IIA, IIB, and III) Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 600-4-89-034 (1990) Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells
EPA 600/4-79/020 (1983) Methods for Chemical Analysis of Water and Wastes

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
29 CFR 1910 Occupational Safety and Health Standards

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Well construction

SD-03 Product Data
Well casing
Well screen
Filter pack
Neat cement grout
Bentonite seal

SD-07 Certificates
Well Drilling/Development Material Handling Plan; G
Health and Safety Plan; G
Field Sampling and Laboratory Testing Plan; G
Treatment facility permit
Installation Survey Report
Well Development Report
Borehole Analysis Report

SD-11 Closeout Submittals
Well Construction Permit
Shipment manifests
Delivery certificates
Treatment and disposal certificates

1.3 DESCRIPTION OF WORK

Installation of monitoring or extraction wells as specified by contract under oversight of the RPM. Installation activities include drilling, installing well casing and screen, gravel-packing of annular space, grouting, and surface completion. Following installation of the wells, Contractor will develop the wells as specified by contract.

Tables 1 and 2 provided at the end of this Section list names, depth, and construction materials to be used for each monitoring well installation. Table 02525N-1 summarizes wells to be installed in the “Perched” subsurface zone and Table 02525N-2 summarizes wells to be installed in the “Exposition” zone.

1.4 GENERALREQUIREMENTS

Each system, including equipment, materials, installation, and performance, shall be in accordance with local, State, and Federal regulations, ASTM D 5092, and EPA 600-4-89-034 except as modified herein. Consider the advisory or recommended provisions to be mandatory, as though the word "shall" has been substituted for the word "should" wherever it appears. Reference to the "Project Representative" and the "Owner" shall be interpreted to mean the RPM. Additional requirements are included under SECTION 01500 - TEMPORARY CONSTRUCTION FACILITIES. Installed monitoring wells are to be mark and secured to avoid unauthorized access and tampering.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials in an undamaged condition. Unload and store with minimal handling. Store materials in on-site enclosures or under protective coverings. Materials and hardware such as plastic piping and jointing materials and rubber gaskets are to be stored under cover, out of direct sunlight. Store materials off the ground. Keep insides of pipes and fittings free of dirt and debris. Replace defective or damaged materials with new materials.

1.6 QUALITYASSURANCE

1.6.1 Required Drawings

Submit well construction drawings showing components and details of well casing, well screen, filter pack, annular seal, and associated items. Drawings shall be prepared by a State certified professional geologist or hydrogeologist, or by a State registered professional civil engineer, hereafter referred to as the Contractor's Professional Consultant (CPC). Drawings shall be sealed.

1.6.2 Well Drilling/Development Material Handling Plan

A material handling plan shall be furnished by the Contractor 15 days prior to initiation of the work that describes phases of dealing with the potentially contaminated soil and groundwater, including the following: a schedule to be employed in the well drilling and development stages, a sequence of operations, the method of drilling and development, material hauling, proposed equipment, handling of the contaminated materials, soil and water testing requirements, and safety precautions and requirements.

1.6.3 Health and Safety Plan (HASP)

Describe safety precautions for each phase of the project as specifically related to handling of soil and water removed during well drilling and development operations. Identify appropriate requirements of 29 CFR 1910 and EM 385-1-1. Identify safety equipment and procedures to be available and used during the project. Furnish the name and qualifications based on education, training, and work experience of the proposed Health and Safety Officer (HASO) and the members of the drill crew. The CPC may perform the responsibilities of the HASO if properly qualified.

1.6.4 Field Sampling and Laboratory Testing Plan

Describe field sampling methods and quality control procedures. Identify laboratory and laboratory methods to be used for contamination testing. Sample reports shall show sample identification for location, date, time, sample method, contamination level, name of individual sampler, identification of laboratory, and quality control procedures.

1.6.5 Treatment Facility Permit

Verification that the proposed treatment facility is permitted to accept the contaminated materials specified, prior to the start of excavation.

1.6.6 Well Development Report

Provide report, containing the following data: project name and location, well designation, date and time of well installation, date and time of well development, static water level from top of well casing before development and 24 hours after development, field measurements of pH, temperature, and specific conductivity, depth of well from top of casing to bottom of well, screen length, description of development methodology size/capacity of pump or bailer, pumping rate, and recharge rate.

1.6.7 Well Construction Permit

Submit a completed permit application and a proposed method of construction to the appropriate state agency prior to construction of the well. Construction of the wells will not be allowed until an approved Well Construction Permit has been submitted to the RPM.

1.6.8 Shipment Manifests

Copies of manifests and other documentation required for shipment of waste materials within 24 hours after removal of waste from the site. Shipment manifests shall be signed by the RPM.

1.6.9 Delivery Certificates

Verification that the wastes were actually delivered to the approved treatment facility, within 7 days of shipment.

1.6.10 Treatment and Disposal Certificates

Verification that the wastes were successfully treated and remediated to the levels specified herein.

PART 2 PRODUCTS

2.1 WELL CASING

2.1.1 Stainless Steel Piping

ASTM A 312/A 312M, Type 304, Schedule 40S, with flush threaded joint end fittings. Threaded joints shall be wrapped with flouropolymer tape, and provided with nitrile O-ring gaskets.

2.1.2 PVC Piping

ASTM F 480, Type 1, Grade 1, PVC 12454, NSF wc or NSF pw, Schedule 40 or 80, with flush threaded joint fittings. Threaded joints shall be wrapped with flouropolymer tape, and provided with nitrile O-ring gaskets.

2.1.3 CPVC Piping

Schedule 40 or 80, with flush threaded joint fittings. CPVC or stainless steel piping will be used for wells that may be subjected to higher temperatures, i.e. wells constructed near ERH probes.

2.2 WELL SCREEN

Well screens shall be located as indicated on Table 02525N-1 and Table 02525N-2. The screen interval length shall also be as indicated. Slot size shall be 0.020-inch or as otherwise indicated. Slotted openings shall be distributed uniformly around the circumference of the screen. Open area shall approach the formation's natural porosity.

2.2.1 Stainless Steel Screens

ASTM A 312/A 312M, Type 304, Schedule 40S, continuous slot construction, wire wound, with flush threaded joint ends.

2.2.2 PVC Screens

ASTM D 1785, PVC 1120, Schedule 40 or 80, screen, Schedule 80, machine-slotted construction, flush threaded joint ends. Slots shall be even in width, length, and separation.

2.3 PRIMARY FILTER PACK

Provide clean sand. The filter pack shall not contain organic matter or friable materials. The filter pack shall allow free flow of water in the well, and shall prevent the infiltration of aquifer materials. Choose a filter pack material with a d-30 grain size (30 percent passing) 4 to 6 times larger than the d-30 grain size of the finest formation materials screened, and a uniformity coefficient of 2.5 or less, in accordance with ASTM C 117 and ASTM C 136.

2.4 SECONDARY FILTER PACK (NOT USED)

2.5 ANNULARSEALANTS

2.5.1 Bentonite Seal

Provide powdered, granular, pelletized, or chipped sodium or calcium montmorillonite in sealed containers from a commercial source, free of impurities. Diameter of pellets shall be less than one fifth the diameter of the borehole annular space to prevent bridging. Bentonite base grout shall be in accordance with ASTM D 5092.

2.5.2 Neat Cement Grout

Provide neat cement grout in accordance with ASTM D 5092. Cement shall be in accordance with ASTM C 150. Quick setting admixtures shall not be allowed. Drilling mud or cuttings shall not be used as a sealing material.

2.6 BOTTOM PLUGS

Provide flush threaded solid plug at the bottom of the well. Plug shall be the same material as the well casing to which it is attached. Joints shall be wrapped with fluoropolymer tape and provided with nitrile O-ring gaskets.

2.7 LOCKING WELL CAP

Provide flush threaded, weatherproof, and non-removable locking well cap on the top of the well. Well cap shall be of the same material as the well casing to which it is attached. Well cap shall accommodate padlock. Provide a long shackled padlock in accordance with ASTM F 883. Provide two keys for the padlock, and turn them over to the Project Engineer or Construction Manager.

2.8 WELL HEADCOMPLETIONS

Clearly mark and secure the well to avoid unauthorized access and tampering. The words "MONITORING WELL" or "EXTRACTION WELL" should be cast on the well head cover according to well type installed. Provide a sign reading, "WELL IS FOR MONITORING AND IS NOT SAFE FOR DRINKING." Provide stamped metal identification tag with the following information:

DO NOT DISTURB
ID #: Date:
Installed By:
Total Depth:
Screened Interval:
TOC Elevation:
Other:
For Information, Call:

2.8.1 Aboveground Completions

Provide protective outer casing around the well casing extending above grade. The diameter of the protective outer casing shall be a minimum of 4 inches larger than the well casing diameter. The top of the protective outer casing shall extend a minimum of 6 inches above the top of the well casing cap. The protective outer casing shall be set in cement grout and the bottom of the protective well casing shall extend to the depth indicated. A1/4 inch diameter weep hole shall be drilled in the protective outer casing 3 inches above the ground surface. The annular space between the protective outer casing and the well casing shall be filled with pea gravel or coarse sand to just below the level of the cap on the well casing. The locking well cap shall be provided on top of the protective outer casing.

2.8.1.1 Protective Outer Casing and Bollards

ASTM A 53, Type E or S, Grade B.

2.8.1.2 Well Casing Cap

Provide cap on top of the protective outer casing. Cap shall be flush threaded and of the same material as the protective outer casing. Threaded joints shall be wrapped with fluoropolymer tape and provided with nitrile O-ring gaskets.

2.8.2 At-Grade Completions

Provide cast iron or aluminum vault box as specified for the indicated dimensions with watertight frame and cover. Vault shall support H-20 loading for traffic areas. The frame shall be 6 inches deep, and shall be set in a concrete collar a minimum of 8 inches thick, and extending 4 inches beyond the edge of the frame in all directions. Frame and concrete collar shall be set flush with the level of the existing pavement or as indicated. Locking well cap shall be provided on top of the well casing, which will terminate inside the vault as indicated.

2.9 POLYETHYLENE SHEETING

ASTM D 4397.

PART 3 EXECUTION

3.1 GENERAL

Notify the RPM at least 15 days prior to commencement of work. Locations of wells shall be as indicated. Drilling, installation, and development of the wells shall be supervised, directed, and monitored by the CPC. Drilling, sampling, and well development equipment introduced to the well shall be decontaminated before and after each use in accordance with ASTM D 5088.

3.2 DRILLING

Borehole shall be advanced using conventional hollow-stem auger or other drilling method as specified by the RPM. If it is the opinion of the CPC that an alternate drilling method is required, justification for a boring method change shall be submitted to the RPM, and approval for the change granted prior to drilling. Drill crew shall be experienced and trained in drilling and safety requirements for contaminated sites.

3.2.1 Sampling

If required, obtain samples in accordance with ASTM D 1586 or ASTM D 1587. Perform standard penetration tests at the following depths: 0.0 to 1.5 feet; 1.5 to 3.0 feet; 3.0 to 4.5 feet; and 5 foot centers or at changes in soil formation thereafter. Each soil sample shall be screened in the field with an organic vapor analyzer/flame ionization device (OVA/FID) capable of detecting vapors to a minimum of one ppm. Log boring in accordance with ASTM D 2487 and ASTM D 2488. Groundwater elevation shall be indicated.

3.2.2 Analysis

The CPC shall review the log data from each borehole and compare the data with the well design requirements. The CPC shall verify the adequacy of the well design, or shall offer a proposed modification to the design based on the geologic and hydrogeologic data obtained from the borehole. This review and analysis shall be conducted for each borehole or as specified by the RPM. The CPC shall submit the borehole boring logs, the analysis of the well design, and any proposed design modifications to the RPM in a Borehole Analysis Report. Any modifications to the well design approved by the RPM shall be considered a change to the contract documents and shall be negotiated in accordance with the "CHANGES" clause.

3.2.3 Alignment

Verify that the well is straight by lowering a 10 foot section of steel pipe into the well. For wells deeper than 200 feet, Contractor shall verify that the well is plumb.

3.3 SOIL REMOVED FROM THE BOREHOLE

3.3.1 Containment of Soil Removed from the Borehole

Soil cuttings from drilling will be stored in 55-gallon drums or appropriate rolloff container.

3.3.2 Testing Requirements for Stockpiled Soils

3.3.2.1 Sampling

A minimum of one composite sample shall be developed and analyzed for each required test from a composite stockpile of soil removed fromall well sites. To develop a composite sample of the size necessary to run the required tests, the Contractor shall take several samples from different areas along the surface and in the center of the stockpile. These samples shall be combined and thoroughly mixed to develop the composite sample.

3.3.2.2 Testing

Soil samples will be analyzed according as specified by the RPM or according to the following:

a. Chlorinated VOCs, including TCE.
b. The soil shall contain no free liquid as demonstrated by EPA 530/F-93/004, Method 9095, paint filter liquids test.
c. The sum of benzene, toluene, ethyl benzene, and xylene (BTEX) concentrations shall be determined by using EPA 530/F-93/004, Method8020.
d. TPH (total petroleum hydrocarbons) concentrations shall be determined by using EPA 530/F-93/004, Method 8015, which has been modified for use with soil.
e. Material shall be tested for TOX (total organic halogens) in accordance with EPA 530/F-93/004, Method 9020.
f. Material shall be analyzed for full TCLP in accordance with EPA 530/F-93/004, Method 1311 and for ignitability, corrosivity, and reactivity.
g. Material shall be tested for polychlorinated biphenyls (PCB's) in accordance with EPA 530/F-93/004, Method 8080.
h. Moisture content of the sample shall be determined in accordance with EPA Method 160.3.

3.3.2.3 Disposal of Stockpiled Soils

a. Soils exhibiting TPH less than 100 ppm, BTEX less than 10 ppm, TOX less than 100 ppm, passing TCLP tests, and testing negative for PCB's shall be considered clean as shall be disposed of [on-site] [on station] as directed by the RPM.
b. Soils failing the TCLP test or exhibiting TOX greater than 100 ppm shall be managed in accordance with applicable State and local regulations. Payment for disposal of materials failing the TCLP metals test or TOX test shall be made in accordance with the "CHANGES" clause of the General Conditions.
c. If the concentration of total BTEX is greater than 10 ppm or TPH greater than 100 ppm, the soil shall be treated and disposed of at a permitted soil recycling facility.

3.4 WELL INSTALLATION

Well installation shall be in accordance with ASTM D 5092 and EPA 600-4-89-034, and as indicated on the well construction drawings submitted by the CPC and approved by the RPM. Borehole shall be stable and shall be verified straight before beginning installation.

3.4.1 Casings and Screens

Well casings, screens, plugs, and caps shall be decontaminated prior to delivery by the manufacturer and shall be certified clean. Materials shall be delivered, stored, and handled in such manner as to ensure that grease, oil, or other contaminants do not contact any portion of the well screen and casing assembly prior to installation. If directed by the QC Engineer or Project Engineer, the well screen and casing assembly shall be cleaned with high pressure water prior to installation. Personnel shall wear clean cotton or surgical gloves while handling the assembly. Centralizers shall be used to ensure that the well screen and casing assembly is installed concentrically in the borehole. When the assembly has been installed at the appropriate elevation, it shall be adequately secured to preclude movement during placement of the filter packs and annular seals. The top of the well casing shall be capped during filter pack placement.

3.4.2 Primary and Secondary Filter Packs

Primary and secondary filter packs shall be placed as indicated on the approved well construction drawings to fill the entire annular space between the screen and casing assembly and the outside wall of the borehole. Place both the primary and secondary filters with a tremie pipe in accordance with EPA 600-4-89-034 and ASTM D 5092. Placement of the primary and secondary filters by gravity or free fall methods is not allowed. Control speed of filter placement to prevent bridging and to allow for settlement. Prior to commencement of work, equipment and methods required to place filters shall be approved by the RPM.

3.4.3 Bentonite Seal

Bentonite shall be placed as a slurry through a tremie pipe. Control speed of bentonite placement to prevent bridging or segregation of slurry. Additional water shall be added to the annular space as directed by the CPC to ensure complete hydration of the bentonite. Bentonite shall cure a minimum of 48 hours before the placement of cement grout to ensure complete hydration and expansion of the bentonite.

3.4.4 Neat Cement Grout

Cement grout shall be placed in the annular space above the bentonite seal as indicated on the well construction drawings. Cement grout shall be placed as a slurry through a tremie pipe, and injected under pressure to reduce chance of voids. Grout shall be injected in one continuous operation until full strength grout flows out at the ground surface without evidence of drilling cuttings or fluid. Cement grout shall cure a minimum of 48 hours before beginning well development operations.

3.4.5 Well Head Completions
Well head completions shall be as indicated and as specified herein.

3.5 WELL DEVELOPMENT
Well development shall be in accordance with EPA 600-4-89-034 and ASTM D 5092 except as modified herein. Bailing, surging, and pumping/overpumping/backwashing are acceptable development methods. Air surging and jetting are prohibited. Method of development shall be chosen by the CPC and approved by the RPM. Well development shall not begin until the well installation is complete and accepted by the RPM. Well development operations shall be conducted continuously until development water flows clear and free of drilling fluids, cuttings, or other materials. At such time representative water samples shall be tested for pH, temperature, and specific conductivity in accordance with EPA 600/4-79/020. Samples shall be taken every 3 hours. When stabilized readings of these parameters, as accepted by the RPM, have been achieved for 12 consecutive hours, well development operations shall cease.

3.6 WATERFROM WELL DEVELOPMENT OPERATIONS
Water from the well development operations shall be containerized in accordance with State and local regulations. One sample shall be taken and analyzed for each required test for every 1000 gallons of stored water from well development operations.

3.6.1 Testing

a. Select VOCs as specified by the RPM.
b. The sum of benzene, toluene, ethyl benzene, and xylene (BTEX) concentrations shall be determined by using EPA 530/F-93/004, Method 8020.
c. TPH (total petroleum hydrocarbons) concentrations shall be determined by using EPA 530/F-93/004, Method 8015.

3.6.2 Disposal of Containerized Water

a. Water exhibiting TPH less than 0.5 ppm and BTEX less than 1 ppb shall be considered clean and shall be disposed of as directed by the RPM.
b. If the concentration of total BTEX is greater than 1 ppb or TPH greater than 0.5 ppm, the water shall be treated and disposed of at a permitted facility.

3.7 TRANSPORTATION OF CONTAMINATED SOIL AND WATER
The Contractor shall be solely responsible for complying with Federal, State, and local requirements for transporting contaminated materials through the applicable jurisdictions and shall bear responsibility and cost for any noncompliance. In addition to those requirements, the Contractor shall do the following:

a. Inspect and document vehicles and containers for proper operation and covering.
b. Inspect vehicles and containers for proper markings, manifest documents, and other requirements for waste shipment.
c. Perform and document decontamination procedures prior to leaving the worksite and again before leaving the disposal site.

3.8 DISPOSAL OF CONTAMINATED SOIL AND WATER

Contaminated materials removed from the site shall be disposed of in a treatment/disposal facility permitted to accept such materials.

3.9 INSTALLATION SURVEY

Upon completion of well installation and development and acceptance by the RPM therefore, the Contractor vertical [and horizontal] position of each well shall be determined by a registered land surveyor licensed in the State of California. The survey shall document the vertical elevations of the top of the casing pipe and the ground surface elevation adjacent to each well. The survey shall also determine the horizontal location of each well based on the USGS coordinates. Survey shall be accurate to the nearest 0.1 foot. This data shall be submitted with a well location map as the Installation Survey Report.

3.10 CLEANUP

Upon completion of the well construction, remove debris and surplus materials from the jobsite.

END OF SECTION

TABLE 02525N-1
Perched Zone Well Construction Details
Pemaco Superfund Site, Maywood, California

Well I.D.	Header	Associated Hydrogeologic Unit	Casing Diameter (inches)	Screen Material	Well Casing Material	Anticipated Screen Interval (feet bgs)	Screen Slot Size (inches)	Filter Pack Sand Size	Anticipated Depth to Bottom of Well (feet bgs)	Anticipated Depth of Boring (feet bgs)
PA-1	DPE-A	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	19-29	0.020	2/12	29.5	30
PA-2	DPE-A	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	20-30	0.020	2/12	30.5	31
PA-3	DPE-A	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	19-29	0.020	2/12	29.5	30
PA-4	DPE-A	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	22-32	0.020	2/12	32.5	33
PA-5	DPE-A	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	20-30	0.020	2/12	30.5	31
PB-1	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	24-34	0.020	2/12	34.5	35
PB-2	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	25-35	0.020	2/12	35.5	36
PB-3	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	15-25	0.020	2/12	25.5	26
PB-4	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	15-25	0.020	2/12	25.5	26
PB-5	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	15-25	0.020	2/12	25.5	26
PB-6	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	19-29	0.020	2/12	29.5	30
PB-7	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	23-33	0.020	2/12	33.5	34
PC-1	DPE-C	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	16-26	0.020	2/12	26.5	27
PC-2	DPE-C	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	16-26	0.020	2/12	26.5	27
PC-5	DPE-C	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	19.5-29.5	0.020	2/12	30	30.5
PC-6	DPE-C	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	17-27	0.020	2/12	27.5	28
PD-1	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	16-26	0.020	2/12	26.5	27
PD-4	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	14.5-24.5	0.020	2/12	25	25.5
PD-5	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	24.5-34.5	0.020	2/12	35	35.5
PD-6	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	23-33	0.020	2/12	33.5	34
PD-7	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	19-29	0.020	2/12	29.5	30
PD-8	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	11-21	0.020	2/12	21.5	22
PD-9	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	23-33	0.020	2/12	33.5	34

TABLE 02525N-2

Exposition Zone Well Construction Details

Pemaco Superfund Site, Maywood, California

Well I.D.		Associated Hydrogeologic Unit	Casing Diameter (inches)	Screen Material	Well Casing Material	Anticipated Screen Interval (feet bgs)	Screen Slot Size (inches)	Filter Pack Sand Size	Anticipated Depth to Bottom of Casing (feet bgs)	Anticipated Depth of Boring (feet bgs)
DA	-1	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	76-86	0.020	2/12	87	88
DA	-2	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	72-82	0.020	2/12	83	84
DA	-3	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	74-84	0.020	2/12	85	86
DA	-4	Exposition A Zone	6	**316 Stainless Steel**	**Low Carbon Steel**	57-67	0.020	2/12	68	69
DA	-5	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	66-76	0.020	2/12	77	78
DA	-6	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	60-70	0.020	2/12	71	72
DA	-7	Exposition A Zone	6	**316 Stainless Steel**	Schedule 80 PVC	55-65	0.020	2/12	66	67
DA	-8	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	65-75	0.020	2/12	76	77
DA	-9	Exposition A Zone	6	**316 Stainless Steel**	Schedule 80 PVC	68-78	0.020	2/12	79	80
DA	-10	Exposition A Zone	6	**316 Stainless Steel**	**Low Carbon Steel**	63-73	0.020	2/12	74	75
DA	-11	Exposition A Zone	6	**316 Stainless Steel**	**Low Carbon Steel**	64-74	0.020	2/12	75	76
DA	-12	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	66-76	0.020	2/12	77	78
DB	-1	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	93-103	0.020	2/12	104	105
DB	-2	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	86-96	0.020	2/12	97	98
DB	-3	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	80.5-100.5	0.020	2/12	101.5	102.5
DB	-4	Exposition B Zone	6	**316 Stainless Steel**	**Low Carbon Steel**	81-91	0.020	2/12	92	93
DB	-5	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	81-91	0.020	2/12	92	93
DB	-6	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	92-102	0.020	2/12	103	104
DB	-7	Exposition B Zone	6	**316 Stainless Steel**	Schedule 80 PVC	81-91	0.020	2/12	92	93
DB	-8	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	81-91	0.020	2/12	92	93
DB	-9	Exposition B Zone	6	**316 Stainless Steel**	Schedule 80 PVC	88-98	0.020	2/12	99	100
DB	-10	Exposition B Zone	6	**316 Stainless Steel**	**Low Carbon Steel**	74.5-84.5	0.020	2/12	85.5	86.5
DB	-11	Exposition B Zone	6	**316 Stainless Steel**	**Low Carbon Steel**	76-86	0.020	2/12	87	88
DB	-12	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	83.5-93.5	0.020	2/12	94.5	95.5
DAB	-1	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	70.5-90.5	0.020	2/12	89	90
DAB	-2	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	70.5-90.5	0.020	2/12	91.5	92.5
DAB	-3	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	71-91	0.020	2/12	92	93
DAB	-4	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	70-90	0.020	2/12	91	92
DAB	-5	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	69-89	0.020	2/12	90	91
DAB	-6	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	67-87	0.020	2/12	88	89
DAB	-7	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	68-88	0.020	2/12	89	90
DAB	-8	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	67-87	0.020	2/12	88	89

SECTION 02821N

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The most recent revision of the publication and test method shall be applicable in all cases.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
ASTM A 116 Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
ASTM A 153 Zinc-Coating (Hot Dip) on Iron and Steel Hardware
ASTM A 176 Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 392 Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 478 Chromium-Nickel Stainless Steel Weaving and Knitting Wire
ASTM A 491 Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 666 Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A 702 Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 780 Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824 Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM C 94 Ready-Mixed Concrete
ASTM D 4541 Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM F 626 Fence Fittings
ASTM F 883 Padlocks
ASTM F 900 Industrial and Commercial Swing Gates
ASTM F 1043 Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083 Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM G 23 Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 26 Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 53 Operating Light- and Water-Exposure Apparatus (Fluorescent UVCondensation Type) for Exposure of Nonmetallic Materials

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-13 Certificates
Chain Link Fence; G
Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

PART 2 PRODUCTS

2.1 FENCE FABRIC

Fence fabric shall conform to the following:
2.1.1 Chain Link Fence Fabric
ASTM A 392, Class 1, zinc-coated steel wire with minimum zinc coating weight of 1.2 ounces per square foot (oz/ft^2) of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire. Fabric shall be fabricated of 9-gauge wire woven in 2-inch mesh. Fabric height shall be 6 feet. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.2 GATES

Gates shall meet the requirements of ASTM F 900 unless otherwise specified. Gates frames shall conform to strength and coating requirements of ASTM F 1083 for Type I, steel pipe, with external coating Type A, nominal pipe size (NPS) 1 ½ inches. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Type II, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1 ½ inches. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 8 feet wide shall have either intermediate members and diagonal truss rods, or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position.

2.3 POSTS

2.3.1 Metal Posts for Chain Link Fence

All posts shall be Type I or Type II round steel pipe. Type I posts shall be hot dipped galvanized with a minimum average zinc coating of 1.8 oz/ft^2 in accordance with ASTM F 1083. Type II posts shall be steel pipe, cold formed and welded per ASTM F 1043 with external coating Type A or B, 0.90 oz/ft^2. Intermediate (line) posts shall have a minimum nominal outside diameter of 1.90 inches. Terminal (end, corner, and pull) posts shall have a minimum nominal outside diameter of 2.375 inches. Both terminal and intermediate posts shall be sized to allow for a minimum embedment depth of 30 inches below finish grade. Gate posts shall be for the gate type specified subject to the limitation specified in ASTM F 900. Gate posts shall be sized to allow for a minimum embedment depth of 36 inches below finish grade.

2.4 BRACES AND RAILS

ASTM F 1083, zinc-coated, Type I, steel pipe, size NPS 1 ¼ inches. Type II, Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Braces and rails shall be Type I or Type II, steel pipe, size NPS 1 ¼ inches and shall be zinc coated (Type A) conforming to the requirements of ASTM F 1043.

2.5 WIRE

2.5.1 Tension Wire

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

2.6 ACCESSORIES

ASTM F 626. Ferrous accessories shall be zinc or aluminum coated. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Tie wire for attaching fabric to rails, braces, and posts shall be 9-gauge steel wire and match the coating of the fence fabric. The tie wires shall be a double loop and 6.5 inches in length. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified.

2.7 CONCRETE

ASTM C 94, using ¾-inch maximum size aggregate, and having minimum compressive strength of 3000 psi at 28 calendar days. Grout shall consist of one part Portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.8 PADLOCKS

Padlocks shall conform to ASTM F 883, Type PO1, Size 2 inch, Master Lock #5 or equivalent. All padlocks shall be keyed alike.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

The general provisions of the contract, including general and special conditions and the requirements of Division 1, apply to the work specified in this section. This section includes specifications for concrete slopes, ditches, and berms; Control, and expansion and contraction joint devices associated with concrete work, including joint sealants; and Equipment pads, light pole base, bollards, and thrust blocks.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ACI INTERNATIONAL (ACI)
ACI 301 (1999) Specifications for Structural Concrete for Buildings
ACI 302 - Guide for Concrete Floor and Slab Construction.
ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.
ACI 305R - Hot Weather Concreting.
ACI 306R - Cold Weather Concreting.
ACI 308 - Standard Practice for Curing Concrete.
ACI 318 - Building Code Requirements for Reinforced Concrete.

ASTM INTERNATIONAL (ASTM)
ASTM C33 - Concrete Aggregates.
ASTM C94 - Ready-Mixed Concrete.
ASTM C150 - Portland Cement.
ASTM C330 - Lightweight Aggregates for Structural Concrete.

U.S. ARMY CORPS OF ENGINEERS (USACE)
COE CRD-C 400 (1963) Requirements for Water for Use in Mixing or Curing Concrete

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-03 Product Data
Provide data on joint devices, attachment accessories and admixtures.
Manufacturers installation procedures and interface required with adjacent Work.

1.3 PROJECT RECORD DOCUMENTS

Accurately record actual locations of embedded utilities and components which are concealed from view.

1.4 QUALITY ASSURANCE

Perform Work in accordance with ACI 301; Acquire cement and aggregate from same source for all work; Conform to ACI 305R when concreting during hot weather; Conform to ACI 306R when concreting during cold weather.

1.5 COORDINATION

Coordinate the placement of joint devices with erection of concrete formwork and placement of form accessories.

PART 2: PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150, Type I - Normal Portland Type

B. Fine and Coarse Aggregates: ASTM C330. Maximum size of coarse aggregates shall be 1 1/2 inches.

C. Water: Clean and not detrimental to concrete.

2.2 JOINT DEVICES AND FILLER MATERIALS

Joint Filler shall be polyurethane, subject to the approval of the QC Engineer. Construction Joint Devices shall be integral galvanized steel to tongue and groove profile, with removable top strip exposing sealant trough, knockout holes spaced at 6 inches ribbed steel spikes with tongue to fit top screened edge. Sealant shall conform with ASTM D1190 for hot applied rubber, synthetic rubber, asphalt, polymer based asphalt, coal tar and rubber compound.

2.3 CONCRETE MIX

Mix and deliver concrete in accordance with ASTM C94. Select aggregate proportions for light weight concrete in accordance with ACI 318.

2.4 PROVIDE CONCRETE TO THE FOLLOWING CRITERIA:

A. Compressive Strength 28 days: 3,000 psi.

B. Slump: 2 to 4 inches maximum.

C. Maximum Water/Cement Ratio: 0.50.

D. Use accelerating admixtures in cold weather only when approved by QC Engineer. Use of admixtures will not relax cold weather placement requirements.

E. Use calcium chloride only when approved by QC Engineer.

PART 3: EXECUTION

3.1 EXAMINATION

Verify requirements for concrete cover over reinforcement. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. In locations where new concrete is dowelled to existing work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

C. Conveying concrete from its point of release at mixer or conveyances shall not drop more than 6 feet. Deposit directly into conveyance.

3.3 PLACING CONCRETE

A. Place concrete in accordance with ACI 318. Pour concrete into forms immediately after mixing in a manner that will prevent separation of ingredients and in horizontal layers not over 12 inches thick.

B. Notify QC Engineer minimum 24 hours prior to commencement of operations. Before each pour, reinforcing shall be checked and approved by the QC Engineer.

C. Ensure reinforcement, inserts, embedded parts, formed joint fillers are not disturbed during concrete placement.

E. Install joint fillers primer and sealant in accordance with manufacturer's instructions.

F. Install joint devices in accordance with manufacturer's instructions.

H. Install joint device anchors. Maintain correct position to allow joint cover flush with floor and wall finish.

I. Install joint covers in longest practical length, when adjacent construction activity is complete.

J. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

K. Water shall be removed from excavation before concrete is deposited. Any flow of water shall be diverted without washing over freshly deposited concrete.

L. Hardened concrete, debris, and foreign materials shall be removed from interior of form and from inner surfaces of mixing and conveying equipment.

L. Place concrete continuously between predetermined expansion, control, and construction joints.

M. Do not interrupt successive placement; do not permit cold joints to occur.

N. Freshly placed concrete shall be tamped into place.

N. Place floor slabs in checkerboard pattern.

O. Saw cut joints within 24 hours after placing. Using 3/16 inch thick blade, cut into %-depth of slab thickness.

P. Compact concrete with approved mechanical equipment. Transmit vibration directly to concrete and in no case through forms. Compact and work concrete into all corners and angles of forms and around reinforcement and embedded fixtures.

Q. Joints will be constructed true to line with faces perpendicular to the surfaces of combination curbs and gutters. Transverse joints will be constructed at right angles to the centerline of curbs, and will vary not more than 1/8 inch from a true line.

R. Joints constructed adjacent to or integral with concrete pavement will be the same type, thickness, and material, and spaced to match the joints in the concrete pavement.

S. Longitudinal construction joints between combination curbs and gutters and concrete pavement will be bulkhead or keyed construction, with a 3/8-inch-wide by 1/2-inch-deep sealing groove.

T. Longitudinal construction joints between concrete curbs and gutters and bituminous-concrete pavement will be unbonded butt joints without dowels or sealing grooves.

U. Combination curbs and gutters will have transverse contraction joints at a 10-foot intervals. Joints may be constructed with metal separator plates, by use of a grooving tool, or saw cut. Depth of joints will average 2 inches or more.

V. Transverse expansion joints will be provided in gutters at a spacing of 25 feet on center unless otherwise indicated.

W. Expansion or isolation joints will be provided where combination curbs and gutters abut concrete sidewalks, manholes, catch basins, inlets, structures, or other fixed objects and at locations and spacing indicated.

3.4 CONCRETE FINISHING

Broom finish surfaces which are scheduled to be exposed. Joints shall be as located on the Drawings. Horizontal surfaces of all construction joints shall be cleaned and roughened by removing entire surface area exposing solid aggregate solidly embedded in mortar matrix. Hardened concrete shall be mortared and maintained wet for at least 24 hours before placing concrete. Expansion joints in slabs shall be located at intersection of concrete planes and at intervals where indicated.

3.5 CURING AND PROTECTION

Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

3.6 FIELD QUALITY CONTROL

Field inspection and testing will be performed in accordance with ACI 301 and under provisions of Section 01400. Provide free access to Work and cooperate with QC Engineer. Submit proposed mix design to QC Engineer for review prior to commencement of Work. Tests of cement and aggregates may be performed to ensure conformance with specified requirements. Three concrete test cylinders will be taken for every 50 or less cubic yards of each class of concrete placed. One slump test will be taken for each set of test cylinders taken by the QC Engineer.

3.7 PATCHING

Allow QC Engineer to inspect concrete surfaces immediately upon removal of forms. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify QC Engineer upon discovery. Patch imperfections in accordance with ACI 301.

3.8 DEFECTIVE CONCRETE

Defective concrete is defined as concrete not conforming to required lines, details, dimensions, tolerances or specified requirements. Repair or replacement of defective concrete will be determined by the Engineer. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of QC Engineer for each individual area.

END OF SECTION

SECTION 05055

METAL FABRICATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)
AA ADM1 (2000) Aluminum Design Manual

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)
AGMA 2005 (1996; Rev C) Design Manual for Bevel Gears

AGMA 6001 (1997; Rev D) Design and Selection of Components for Enclosed Gear Drives

AMERICAN WELDING SOCIETY (AWS)
AWS D1.1 (2004) Structural Welding Code - Steel

AWS D1.2 (2003) Structural Welding Code - Aluminum

ASME INTERNATIONAL (ASME)
ASME B4.1 (1967; R 2004) Preferred Limits and Fits for Cylindrical Parts

ASME B46.1 (2002) Surface Texture, (Surface Roughness, Waviness and Lay)

ASME BPVC SEC IX (2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)
ASTM A 123 (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 325 (2004b) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

ASTM A 380 (1999e1) Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems

ASTM A 490 (2004a) Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength

ASTM A 514 (2000a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding

ASTM A 780 (2001) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings

ASTM B 177 (2001) Engineering Chromium Electroplating

ASTM B 766 (1986; R 2003) Electrodeposited Coatings of Cadmium

ASTM D 962 (1981; R 2003) Aluminum Powder and Paste Pigments for Paints

ASTM E 165 (2002) Liquid Penetrant Examination

ASTM E 446 (1998; R 2004e1) Radiographs for Steel Castings Up to 2 In. in Thickness

ASTM E 709 (2001) Magnetic Particle Examination

ASTM E 94 (2004) Radiographic Examination

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Detail Drawings; G
Detail drawings for metalwork and machine work, prior to fabrication.

SD-03 Product Data
Welding of Structural Steel; G
Schedules of welding procedures for steel structures, prior to commencing fabrication.

Welding of Aluminum; G
Schedules of welding processes for aluminum fabrications, prior to commencing fabrication.
Structural Steel Welding Repairs; G Welding repair plans for steel, prior to making repairs.

Materials Orders
Copies of purchase orders, mill orders, shop orders and work orders for materials, prior to the use of the materials in the work.

Materials List
Materials list for fabricated items, at the time of submittal of detail drawings.

Shipping Bill
Shipping bill with the delivery of finished pieces to the site.

SD-06 Test Reports
Tests, Inspections, and Verifications Certified test reports for materials with all materials delivered to the site.

SD-07 Certificates Qualification of Welders and Welding Operators
Certifications for welders and welding operators prior to commencing fabrication.

Application Qualification for Steel Studs; G
Certified reports for the application qualification for steel studs prior to commencing fabrication.

Welding of Aluminum; G
Certified report for aluminum welding qualification tests prior to commencing welding.

1.3 DETAIL DRAWINGS

Detail drawings for metalwork and machine work shall include catalog cuts, templates, fabrication and assembly details and type, grade and class of material as appropriate. Elements of fabricated items inadvertently omitted on contract drawings shall be detailed by the fabricator.

1.4 QUALIFICATION OF WELDERS AND WELDING OPERATORS

The Contractor shall certify that the qualification of welders and welding operators and tack welders who will perform structural steel welding have been qualified for the particular type of work to be done in accordance with the requirements of AWS D1.1 Section 5 or ASME BPVC SEC IX, Section IX prior to commencing fabrication. The certificate shall list the qualified welders by name and shall specify the code and procedures under which qualified and the date of qualification. Prior qualification will be accepted if welders have performed satisfactory work under the code for which qualified within the preceding three months. The Contractor shall require welders to repeat the qualifying tests when their work indicates a reasonable doubt as to proficiency. Those passing the requalification tests will be recertified. Those not passing will be disqualified until passing. All expenses in connection with qualification and requalification shall be borne by the Contractor.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Materials Orders

The Contractor shall furnish six copies of purchase orders, mill orders, shop orders and work orders for all materials orders and items used in the work. Where mill tests are required purchase orders shall contain the test site address and the name of the testing agency.

2.1.2 Materials List

The Contractor shall furnish a materials list of the materials to be used in the fabrication of each item.

2.1.3 Shipping Bill

The Contractor shall furnish a shipping bill or memorandum of each shipment of finished pieces or members to the project site giving the designation mark and weight of each item, the number of items, the total weight, and the car initial and number if shipped by rail in carload lots.

2.2 FABRICATION

2.2.1 Structural Fabrication

Material must be straight before being laid off or worked. If straightening is necessary it shall be done by methods that will not impair the metal. Sharp kinks or bends shall be cause for rejection of the material. Material with welds will not be accepted except where welding is definitely specified, indicated or otherwise approved. Bends shall be made by approved dies, press brakes or bending rolls. Where heating is required, precautions shall be taken to avoid overheating the metal and it shall be allowed to cool in a manner that will not impair the original properties of the metal. Proposed flame cutting of material other than structural steel shall be subject to approval and shall be indicated on detail drawings. Shearing shall be accurate and all portions of the work shall be neatly finished. Corners shall be square and true unless otherwise shown. Re-entrant cuts shall be filleted to a minimum radius of 3/4 inch unless otherwise approved. Finished members shall be free of twists, bends and open joints. Bolts, nuts and screws shall be tight.

2.2.1.1 Dimensional Tolerances for Structural Work

Dimensions shall be measured by an approved calibrated steel tape of approximately the same temperature as the material being measured. The overall dimensions of an assembled structural unit shall be within the tolerances indicated on the drawings or as specified in the particular section of these specifications for the item of work. Where tolerances are not specified in other sections of these specifications or shown, an allowable variation of 1/32 inch is permissible in the overall length of component members with both ends milled and component members without milled ends shall not deviate from the dimensions shown by not more than 1/16 inch for members 30 feet or less in length and by more than 1/8 inch for members over 30 feet in length.

2.2.1.2 Structural Steel Fabrication

Structural steel may be cut by mechanically guided or hand-guided torches, provided an accurate profile with a surface that is smooth and free from cracks and notches is obtained. Surfaces and edges to be welded shall be prepared in accordance with AWS D1.1, Subsection 3.2. Where structural steel is not to be welded, chipping or grinding will not be required except as necessary to remove slag and sharp edges of mechanically guided or hand-guided cuts not exposed to view. Hand-guided cuts which are to be exposed or visible shall be chipped, ground or machined to sound metal.

2.2.1.3 Structural Aluminum Fabrication

Laying out and cutting of aluminum shall be in accordance with the AA ADM1, Section 6.

2.2.2 Welding

2.2.2.1 Welding of Structural Steel

a) Welding Procedures for Structural Steel - Welding procedures for structural steel shall be prequalified as described in AWS D1.1, Subsection 5.1 or shall be qualified by tests as prescribed in AWS D1.1, Section 5. Properly documented evidence of compliance with all requirements of these specifications for previous qualification tests shall establish a welding procedure as prequalified. For welding procedures qualified by tests, the test welding and specimen testing must be witnessed and the test report document signed by the Contracting Officer. Approval of any welding procedure will not relieve the Contractor of the responsibility for producing a finished structure meeting all requirements of these specifications. The Contractor will be directed or authorized to make any changes in previously approved welding procedures that are deemed necessary or desirable by the Contractor Officer. The Contractor shall submit a complete schedule of welding procedures for each steel structure to be welded. The schedule shall conform to the requirements specified in the provisions AWS D1.1, Sections 2, 3, 4, 7 and 9 and applicable provisions of Section 10. The schedule shall provide detailed procedure specifications and tables or diagrams showing the procedures to be used for each required joint. Welding procedures must include filler metal, preheat, interpass temperature and stress-relief heat treatment requirements. Each welding procedure shall be clearly identified as being prequalified or required to be qualified by tests. Welding procedures must show types and locations of welds designated or in the specifications to receive nondestructive examination.

b) Welding Process - Welding of structural steel shall be by an electric arc welding process using a method which excludes the atmosphere from the molten metal and shall conform to the applicable provisions of AWS D1.1, Sections 1 thru 7, 9, 10 and 11. Welding shall be such as to minimize residual stresses, distortion and shrinkage.

c) Welding Technique

   1) Filler Metal - The electrode, electrode-flux combination and grade of weld metal shall conform to the appropriate AWS specification for the base metal and welding process being used or shall be as shown where a specific choice of AWS specification allowables is required. The AWS designation of the electrodes to be used shall be included in the schedule of welding procedures. Only low hydrogen electrodes shall be used for manual shielded metal-arc welding regardless of the thickness of the steel. A controlled temperature storage oven shall be used at the job site as prescribed by AWS D1.1, Subsection 4.5 to maintain low moisture of low hydrogen electrodes.

   2) Preheat and Interpass Temperature - Preheating shall be performed as required by AWS D1.1, Subsection 4.2 and 4.3 or as otherwise specified except that the temperature of the base metal shall be at least 70 degrees F. The weldments to be preheated shall be slowly and uniformly heated by approved means to the prescribed temperature, held at that temperature until the welding is completed and then permitted to cool slowly in still air.

   3) Stress-Relief Heat Treatment - Where stress relief heat treatment is specified or shown, it shall be in accordance with the requirements of AWS D1.1, Subsection 4.4 unless otherwise authorized or directed.

d) Workmanship - Workmanship for welding shall be in accordance with AWS D1.1, Section 3 and other applicable requirements of these specifications.

   1) Preparation of Base Metal - Prior to welding the Contractor shall inspect surfaces to be welded to assure compliance with AWS D1.1, Subsection 3.2.

   2) Temporary Welds - Temporary welds required for fabrication and erection shall be made under the controlled conditions prescribed for permanent work. Temporary welds shall be made using low-hydrogen welding electrodes and by welders qualified for permanent work as specified in these specifications. Preheating for temporary welds shall be as required by AWS D1.1 for permanent welds except that the minimum temperature shall be 50 degrees C 120 degrees F in any case. In making temporary welds arcs shall not be struck in other than weld locations. Each temporary weld shall be removed and ground flush with adjacent surfaces after serving its purpose.

   3) Tack Welds - Tacks welds that are to be incorporated into the permanent work shall be subject to the same quality requirements as the permanent welds and shall be cleaned and thoroughly fused with permanent welds. Preheating shall be performed as specified above for temporary welds. Multiple-pass tack welds shall have cascaded ends. Defective tack welds shall be removed before permanent welding.

2.2.2.2 Welding of Steel Castings
Unsound material shall be removed from the surfaces of steel castings to be incorporated into welded connections by chipping, machining, air-arc gouging or grinding. Major connections designed for transfer of stresses shall not be welded if the temperature of the casting is lower than 100 degrees F. Castings containing over 0.35 percent carbon or over 0.75 percent manganese shall be preheated to a temperature not to exceed 450 degrees F and welding shall be accomplished while the castings are maintained at a temperature above 350 degrees F. Welding will not be permitted on castings containing carbon in excess of 0.45 percent except on written authorization. Castings requiring welding repairs after the first annealing and castings involving welding

2.2.2.3 Welding of Aluminum
Welding of aluminum shall conform to AA ADM1 or AWS D1.2, Sections 1 through 7, 9 and 10. The welding process and welding operators shall be prequalified as required by AWS D1.2, Section 5 or AA ADM1, Subsection 7.2.4 in accordance with the methods described in ASME BPVC SEC IX, Section IX. A certified report giving the results of the qualifying tests shall be furnished for approval. A complete schedule of the welding process for each aluminum fabrication to be welded shall be furnished for approval.

2.2.2.4 Welding of Steel Studs
The procedures for welding steel studs to structural steel, including mechanical, workmanship, technique, stud application qualification, production quality control and fabrication and verification inspection procedures shall conform to the requirements of AWS D1.1, Section 7, except as otherwise specified.

a) Application Qualification for Steel Studs - As a condition of approval of the stud application process, the Contractor shall furnish certified test reports and certification that the studs conform to the requirements of AWS D1.1, Subsections 7.2 and 7.3, certified results of the stud manufacturer's stud base qualification test, and certified results of the stud application qualification test as required by AWS D1.1, Subsection 7.6, except as otherwise specified.

b) Production Quality Control - Quality control for production welding of studs shall conform to the requirements of AWS D1.1, Subsection 7.7, except as otherwise specified. Studs on which pre-production testing is to be performed shall be welded in the same general position as required on production studs (flat, vertical, overhead or sloping). If the reduction of the length of studs becomes less than normal as they are welded, welding shall be stopped immediately and not resumed until the cause has been corrected.

2.2.3 Bolted Connections

2.2.3.1 Bolted Structural Steel Connections
Bolts, nuts and washers shall be of the type specified or indicated. All nuts shall be equipped with washers except for high strength bolts. Beveled washers shall be used where bearing faces have a slope of more than 1:20 with respect to a plane normal to the bolt axis. Where the use of high strength bolts is specified or indicated the materials, workmanship and installation shall conform to the applicable provisions of ASTM A 325 or ASTM A 490.

a) Bolt Holes - Bolt holes shall be accurately located, smooth, perpendicular to the member and cylindrical.

1) Holes for regular bolts shall be drilled or subdrilled and reamed in the shop and shall not be more than 1/16 inch larger than the diameter of the bolt.

2) Holes for fitted bolts shall be match-reamed or drilled in the shop. Burrs resulting from reaming shall be removed. The threads of bolts shall be entirely outside of the holes. The body diameter of bolts shall have tolerances as recommended by ASME B4.1 for the class of fit specified. Fitted bolts shall be fitted in reamed holes by selective assembly to provide an LN-2 fit.

3) Holes for high strength bolts shall have diameters of not more than 1/16 inch larger than bolt diameters. If the thickness of the material is not greater than the diameter of the bolts the holes may be punched. If the thickness of the material is greater than the diameter of the bolts the holes may be drilled full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the bolts and then reamed to full size. Poor matching of holes will be cause for rejection. Drifting occurring during assembly shall not distort the metal or enlarge the holes. Reaming to a larger diameter of the next standard size bolt will be allowed for slight mismatching.

2.2.3.2 Bolted Aluminum Connections
Punching, drilling, reaming and bolting for bolted aluminum connections shall conform to the requirements of AA ADM1, Section 6.

2.2.4 Riveted Connections

2.2.4.1 Riveted Structural Steel Connections

a) Rivet Holes - Rivet holes shall be accurately spaced, cylindrical and perpendicular to the member. Countersinking shall be true and square with the hole. Rivet holes shall be 1/16 inch larger than the diameter of the rivet. If the thickness of the material is not greater than the diameter of the rivet the holes may be punched full size. If the thickness of the material is greater than the diameter of the rivet the holes shall be drilled full size or subpunched or subdrilled at least 1/8 inch smaller than the diameter of the rivet and then reamed to full size in accordance with the following provisions unless otherwise specified or authorized. For shop connections rivet holes may be drilled full size if the component parts to be riveted are welded, bolted or clamped together before drilling of rivet holes. For field connections the holes required to be subpunched or subdrilled shall be reamed in the shop if the work is assembled and matchmarked in the shop. For field connections not assembled in the shop the holes required to be subpunched or subdrilled shall be reamed in the field after the work has been assembled and bolted together.

   1) Punched Holes - Punching shall be accurate. The diameter of the punch shall be not more than 1/16 inch greater than the diameter of the rivet. The diameter of the die opening shall not be more than 1/16 inch greater than the diameter of the punch. Holes shall be clean cut without torn or ragged edges.

   2) Reamed and Drilled Holes - Reaming and final drilling shall be done with the component parts of the member assembled and firmly fastened together. Drilling shall be done with twist drills. Reaming shall be done with short taper reamers having not less than four flutes. Reamed holes shall be made smooth by the

reamer touching the entire circumference of the hole. Outside burrs on reamed holes shall be removed to the extent of making a 1/16 inch chamfer.

3) Accuracy of Punched and Drilled Holes - The accuracy of holes punched or drilled full size shall be such that for assembled components with a group of contiguous holes in the same plane 75 percent of the holes shall admit a rod equal to the diameter of the cold rivet at right angles to the plane of the connection. The accuracy of holes required to be reamed or drilled after assembly shall be such that any group of contiguous holes in the same plane shall show no offset greater than 1/32 inch between adjacent thicknesses of metal. Drifting to enlarge holes will not be allowed. Poor matching of holes will be cause for rejection. Reaming to a larger diameter for the next standard size rivet will be allowed for slight mismatching.

b) Driving Rivets - Components to be riveted shall have all parts well pinned and firmly drawn together with bolts before riveting is commenced. Rivets shall be heated uniformly to a light cherry red color at a temperature not over 1950 degrees F in a gas, oil or electric furnace constructed so that it can be adjusted to the proper temperature except that an approved coal or coke furnace may be used for heating field rivets. Rivets shall not be driven after their temperature falls below 1000 degrees F. When heated and ready for driving rivets shall be free from slag, scale and adhesive materials. Rivets shall be hot driven with pressure tools. Driven rivets shall completely fill the holes. Rivet heads shall be neatly formed with dies of approved shape and shall be full size, concentric with the rivet hole and in full contact with the member. Loose, burned, badly formed or otherwise defective rivets shall be removed and replaced with care to avoid damage to adjacent metal. Recupping or caulking will not be permitted. Countersunk rivet heads shall be chipped or ground flush with the surface of the plate unless otherwise specified or authorized. Field rivets shall not be painted until they have been inspected and accepted.

2.2.4.2 Riveted Aluminum Connections

Punching, drilling, reaming and riveting for riveted aluminum connections shall conform to the requirements of AA ADM1, Section 6.

2.2.5 Castings

Each casting shall bear cast or stamped mark numbers. Castings weighing more than 500 required pounds shall also bear cast or stamped heat numbers. Deviations from the dimensions of castings shown shall not exceed amounts that will impair the strength of castings by more than 10 percent as computed from the dimensions shown. Dimensions of castings shown on approved detail drawings shall be finished dimensions. Castings that are warped or otherwise distorted or that are oversize to an extent that will interfere with proper fit with other parts of the machinery or structure will be rejected. The structure of metal in castings shall be homogeneous and free from excessive nonmetallic inclusions. Excessive segregation of impurities or alloys at critical points in castings will be cause for rejection. Repairs to castings shall not be made prior to approval. Minor surface imperfections not affecting the strength of casting may be welded in the "green" if approved. Surface imperfections shall be considered minor when the depth of the cavity prepared for welding is the lesser of 20 percent of the actual wall thickness or 1 inch. Defects other than minor surface imperfections may be welded only when specifically authorized in accordance with the following requirements:

a) The defects have been entirely removed and are judged not to affect the strength, use or machineability of the castings when properly welded and stress relieved.

b) The proposed welding procedure, stress relief and method of examination of the repair work have been submitted and approved.

2.2.7 Machine Work

Tolerances, allowances and gauges for metal fits between plain, non-threaded, cylindrical parts shall conform to ASME B4.1 for the class of fit shown or required unless otherwise shown on approved detail drawings. Where fits are not shown they shall be suitable as approved. Tolerances for machine-finished surfaces designated by non-decimal dimensions shall be within 1/64 inch. Sufficient machining stock shall be allowed on placing pads to ensure true surfaces of solid material. Finished contact or bearing surfaces shall be true and exact to secure full contact. Journal surfaces shall be polished and all surfaces shall be finished with sufficient smoothness and accuracy to ensure proper operation when assembled. Parts entering any machine shall be accurately machined and all like parts shall be interchangeable except that parts assembled together for drilling or reaming of holes or machining will not be required to be interchangeable with like parts. All drilled holes bolts shall be accurately located.

2.2.7.1 Finished Surfaces

Surface finishes indicated or specified shall be in accordance with ASME B46.1. Values of required roughness heights are arithmetical average deviations expressed in microinches. These values are maximum. Lesser degrees will be satisfactory unless otherwise indicated. Compliance with surface requirements shall be determined by sense of feel and visual inspection of the work compared to Roughness Comparison Specimens in accordance with the provisions of ASME B46.1. Values of roughness width and waviness height shall be consistent with the general type of finish specified by roughness height. Where the finish is not indicated or specified it shall be that which is most suitable for the particular surface, provide the class of fit required and be indicated on the detail drawings by a symbol which conforms to ASME B46.1 when machine finishing is provided. Flaws such as scratches, ridges, holes, peaks, cracks or checks which will make the part unsuitable for the intended use will be cause for rejection.

2.2.7.2 Unfinished Surfaces

All work shall be laid out to secure proper matching of adjoining unfinished surfaces unless otherwise directed. Where there is a large discrepancy between adjoining unfinished surfaces they shall be chipped and ground smooth or machined to secure proper alignment. Unfinished surfaces shall be true to the lines and dimensions shown and shall be chipped or ground free of all projections and rough spots. Depressions or holes not affecting the strength or usefulness of the parts shall be filled in an approved manner.

2.2.7.3 Pin Holes

Pin holes shall be bored true to gauges, smooth, straight and at right angles to the axis of the member. The boring shall be done after the member is securely fastened in position.

2.2.7.4 Gears

Gears shall have machine cut teeth of a form conforming to applicable design requirements of AGMA 2005 and AGMA 6001 unless otherwise specified or shown.

2.2.7.5 Shafting
All shafting shall be turned or ground hot-rolled or cold-rolled steel as required unless otherwise specified or authorized. Fillets shall be provided where changes in section occur. Cold-finished shafting may be used where keyseating is the only machine work required.

2.2.7.6 Bearings
Bearings may be lined with babbit or bronze unless otherwise specified or shown. Where the bearing pressure is in excess of 200 psi, bearings shall be lined with bronze. Pressures on lined bearings shall not exceed the recommended psi strength of projected area unless otherwise required or authorized. Anti-friction bearings of approved types and of sizes not less than those recommended by the bearing manufacturer for the duty intended will be permitted subject to approval. All bearings shall be properly aligned and provided with a suitable means of lubrication. Anti-friction bearings shall be so installed as to provide for retention of the lubricant and to exclude dirt and grit.

2.2.8 Miscellaneous Provisions

2.2.8.1 Metallic Coatings

a) Zinc Coatings - Zinc coatings shall be applied in a manner and of a thickness and quality conforming to ASTM A 123. Where zinc coatings are destroyed by cutting, welding or other causes the affected areas shall be regalvanized. Coatings 2 ounces or heavier shall be regalvanized with a suitable low-melting zinc base alloy similar to the recommendations of the American Hot-Dip Galvanizers Association to the thickness and quality specified for the original zinc coating. Coatings less than 2 ounces shall be repaired in accordance with ASTM A 780.

b) Cadmium Coatings - Cadmium coatings shall be of a quality and thickness conforming to the requirements of ASTM B 766 and inspection shall conform to the requirements of ASTM E 165.

c) Chromium Coatings - Chromium coatings for engineering use shall be applied in conformity with ASTM B 177.

2.2.8.2 Cleaning of Corrosion-Resisting Steel
Oil, paint and other foreign substances shall be removed from corrosion-resisting steel surfaces after fabrication. Cleaning shall be done by vapor degreasing or by the use of cleaners of the alkaline, emulsion or solvent type. After the surfaces have been cleaned they shall be given a final rinsing with clean water followed by a 24 hour period during which the surfaces are intermittently wet with clean water and then allowed to dry for the purpose of inspecting the clean surfaces. The surfaces shall be visually inspected for evidence of paint, oil, grease, welding slag, heat treatment scale, iron rust or other forms of contamination. If evidence of foreign substance exist the surface shall be cleaned in accordance with the applicable provisions of ASTM A 380. The proposed method of treatment shall be furnished for approval. After treatment the surfaces shall be visually reinspected. Brushes used to remove foreign substances shall have only stainless steel or nonmetallic bristles. Any contamination occurring subsequent to the initial cleaning shall be removed by one or more of the methods indicated above.

2.2.8.3 Lubrication
The arrangement and details for lubrication shall be as shown. Before erection or assembly all bearing surfaces shall be thoroughly cleaned and lubricated with an approved lubricant.

2.2.9 Shop Assembly
Each machinery and structural unit furnished shall be assembled in the shop to determine the correctness of the fabrication and matching of the component parts unless otherwise specified. Tolerances shall not exceed those shown. Each unit assembled shall be closely checked to ensure that all necessary clearances have been provided and that binding does not occur in any moving part. Assembly in the shop shall be in the same position as final installation in the field unless otherwise specified. Errors or defects disclosed shall be immediately remedied by the Contractor without cost to the Government. Before disassembly for shipment each piece of a machinery or structural unit shall be match-marked to facilitate erection in the field. The location of match-marks shall be indicated by circling with a ring of white paint after the shop coat of paint has been applied or as otherwise directed.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS
The Contractor shall have required material tests and analyses performed and certified by an approved laboratory to demonstrate that materials are in conformity with the specifications. These tests and analyses shall be performed and certified at the Contractor's expense. Tests, inspections, and verifications shall conform to the requirements of the particular sections of these specifications for the respective items of work unless otherwise specified or authorized. Tests shall be conducted in the presence of the Construction Manager, QC Engineer, or Project Engineer if so required. The Contractor shall furnish specimens and samples for additional independent tests and analyses upon request. Specimens and samples shall be properly labeled and prepared for shipment.

2.3.1 Nondestructive Testing
When doubt exists as to the soundness of any material part such part may be subjected to any form of nondestructive testing determined by the Construction Manager, QC Engineer, or Project Engineer. This may include ultrasonic, magnaflux, dye penetrant, x-ray, gamma ray or any other test that will thoroughly investigate the part in question. The cost of such investigation will be borne by the Government. Any defects will be cause for rejection and rejected parts shall be replaced and retested at the Contractor's expense.

2.3.2 Tests of Machinery and Structural Units
The details for tests of machinery and structural units shall conform to the requirements of the particular sections of these specifications covering these items. Each complete machinery and structural unit shall be assembled and tested in the shop in the presence of the Construction Manager or Project Engineer unless otherwise directed. Waiving of tests will not relieve the Contractor of responsibility for any fault in operation, workmanship or material that occurs before the completion of the contract or guarantee. After being installed at the site each complete machinery or structural unit shall be operated through a sufficient number of complete cycles to

2.3.3 Inspection of Structural Steel Welding
The Contractor shall maintain an approved inspection system and perform required inspections in accordance with Contract Clause CONTRACTOR INSPECTION SYSTEM. Welding shall be subject to inspection to determine conformance with the requirements of AWS D1.1, the approved welding procedures and provisions stated in other sections of these specifications.

Nondestructive examination of designated welds will be required. Supplemental examination of any joint or coupon cut from any location in any joint may be required.

2.3.3.1 Visual Examination
All visual examination of completed welds shall be cleaned and carefully examined for insufficient throat or leg sizes, cracks, undercutting, overlap, excessive convexity or reinforcement and other surface defects to ensure compliance with the requirements of AWS D1.1, Section 3 and Section 9, Part D.

2.3.3.2 Nondestructive Examination
The nondestructive examination of shop and field welds shall be performed as designated or described in the sections of these specifications covering the particular items of work.

a) Testing Agency - The nondestructive examination of welds and the evaluation of examination tests as to the acceptability of the welds shall be performed by a testing agency adequately equipped and competent to perform such services or by the Contractor using suitable equipment and qualified personnel. In either case written approval of the examination procedures is required and the examination tests shall be made in the presence of the Contracting Officer. The evaluation of examination tests shall be subject to the approval and all records shall become the property of the Government.

b) Examination Procedures - Examination procedures shall conform to the following requirements.

    1) Ultrasonic Testing - Making, evaluating and reporting ultrasonic testing of welds shall conform to the requirements of AWS D1.1, Section 6, Part C. The ultrasonic equipment shall be capable of making a permanent record of the test indications. A record shall be made of each weld tested.

    2) Radiographic Testing - Making, evaluating and reporting radiographic testing of welds shall conform to the requirements of AWS D1.1, Section 6, Part B.

    3) Magnetic Particle Inspection - Magnetic particle inspection of welds shall conform to the applicable provisions of ASTM E 709.

    4) Dye Penetrant Inspection - Dye penetrant inspection of welds shall conform to the applicable provisions of ASTM E 165.

c) Acceptability of Welds - Welds shall be unacceptable if shown to have defects prohibited by AWS D1.1, Subsection 9.25 or possess any degree of incomplete fusion, inadequate penetration or undercutting.

2.3.3.3 Test Coupons
The Government reserves the right to require the Contractor to remove coupons from completed work when doubt as to soundness cannot be resolved by nondestructive examination. Should tests of any two coupons cut from the work of any welder show strengths less than that specified for the base metal it will be considered evidence of negligence or incompetence and such welder shall be removed from the work. When coupons are removed from any part of a structure the members cut shall be repaired in a neat manner with joints of

the proper type to develop the full strength of the members. Repaired joints shall be peened as approved or directed to relieve residual stress. The expense for removing and testing coupons, repairing cut members and the nondestructive examination of repairs shall be borne by the Government or the Contractor in accordance with the Contract Clauses INSPECTION AND ACCEPTANCE.

2.3.3.4 Supplemental Examination

When the soundness of any weld is suspected of being deficient due to faulty welding or stresses that might occur during shipment or erection the Government reserves the right to perform nondestructive supplemental examinations before final acceptance. The cost of such inspection will be borne by the Government.

2.3.4 Structural Steel Welding Repairs

Defective welds in the structural steel welding repairs shall be repaired in accordance with AWS D1.1, Subsection 3.7. Defective weld metal shall be removed to sound metal by use of air carbon-arc or oxygen gouging. Oxygen gouging shall not be used on ASTM A 514 steel. The surfaces shall be thoroughly cleaned before welding. Welds that have been repaired shall be retested by the same methods used in the original inspection. Except for the repair of members cut to remove test coupons and found to have acceptable welds costs of repairs and retesting shall be borne by the Contractor.

2.3.5 Inspection and Testing of Steel Stud Welding

Fabrication and verification inspection and testing of steel stud welding shall conform to the requirements of AWS D1.1, Subsection 7.8 except as otherwise specified. The Construction Manager, Project Engineer or QC Engineer will serve as the verification inspector. One stud in every 100 and studs that do not show a full 360 degree weld flash, have been repaired by welding or whose reduction in length due to welding is less than normal shall be bent or torque tested as required by AWS D1.1, Subsection 7.8. If any of these studs fail two additional studs shall be bent or torque tested. If either of the two additional studs fail all of the studs represented by the tests shall be rejected. Studs that crack under testing in either the weld, base metal or shank shall be rejected and replaced by the Contractor at no additional cost.

2.3.6 Inspection of Steel Castings

The Contractor shall perform radiographic inspection of steel castings as designated and as described in the section of these specifications covering the particular item of work. The procedure for making, evaluating and reporting the radiographic inspection shall conform to the requirements of ASTM E 94. The applicable referenced standards shall be as illustrated in ASTM E 446. The evaluation of the radiographs shall be subject to approval and all records shall become the property of the Government.

PART 3 EXECUTION

3.1 INSTALLATION

All parts to be installed shall be thoroughly cleaned. Packing compounds, rust, dirt, grit and other foreign matter shall be removed. Holes and grooves for lubrication shall be cleaned. Enclosed chambers or passages shall be examined to make sure that they are free from damaging materials. Where units or items are shipped as assemblies they will be inspected prior to installation. Disassembly, cleaning and lubrication will not be required except where necessary to place the assembly in a clean and properly lubricated condition. Pipe wrenches, cold chisels or other tools likely to cause damage to the surfaces of rods, nuts or other parts shall not be used for assembling and tightening parts. Bolts and screws shall be tightened firmly and uniformly but care shall be taken not to overstress the threads. When a half nut is used for locking a full nut the half nut shall be placed first and followed by the full nut. Threads of all bolts except high strength bolts, nuts and screws shall be lubricated with an approved lubricant before assembly. Threads of corrosion-resisting steel bolts and nuts shall be coated with an approved antigalling compound. Driving and drifting bolts or keys will not be permitted.

3.1.1 Alignment and Setting

Each machinery or structural unit shall be accurately aligned by the use of steel shims or other approved methods so that no binding in any moving parts or distortion of any member occurs before it is fastened in place. The alignment of all parts with respect to each other shall be true within the respective tolerances required. Machines shall be set true to the elevations shown.

3.1.2 Blocking and Wedges

All blocking and wedges used during installation for the support of parts to be grouted in foundations shall be removed before final grouting unless otherwise directed. Blocking and wedges left in the foundations with approval shall be of steel or iron.

3.2 PROTECTION OF FINISHED WORK

3.2.1 Machined Surfaces

Machined surfaces shall be thoroughly cleaned of foreign matter. All finished surfaces shall be protected by suitable means. Unassembled pins and bolts shall be oiled and wrapped with moisture resistant paper or protected by other approved means. Finished surfaces of ferrous metals to be in bolted contact shall be washed with an approved rust inhibitor and coated with an approved rust resisting compound for temporary protection during fabrication, shipping and storage periods. Finished surfaces of metals which shall be exposed after installation except corrosion resisting steel or nonferrous metals shall be painted as specified in Section 09964 PAINTING: HYDRAULIC STRUCTURES.

3.2.2 Lubrication After Assembly

After assembly all lubricating systems shall be filled with the lubricant specified and additional lubricant shall be applied at intervals as required to maintain the equipment in satisfactory condition until acceptance of the work.

3.2.3 Aluminum

Aluminum that shall be in contact with grout or concrete shall be protected from galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. Aluminum in contact with structural steel shall be protected against galvanic or corrosive action by being given a coat of zinc-chromate primer and a coat of aluminum paint. The aluminum paint shall consist of a aluminum paste conforming to ASTM D 962, spar varnish and thinner compatible with the varnish. The aluminum paint shall be field mixed in proportion of 2 pounds of paste, not more than 4 L one gallon of spar varnish and not more than one pint of thinner.

3.3 TESTS

3.3.1 Workmanship

Workmanship shall be of the highest grade and in accordance with the best modern practices to conform with the specifications for the item of work being furnished.

3.3.2 Production Welding

Production welding shall conform to the requirements of AWS D1.1 or AWS D1.2as applicable. Studs on which pre-production testing is to be performed shall be welded in the same general position as required on production items (flat, vertical, overhead or sloping). Test and production stud welding will be subjected to visual examination or inspection. If the reduction of the length of studs becomes less than normal as they are welded, welding shall be stopped immediately and not resumed until the cause has been corrected.

END OF SECTION

SECTION 08110

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.3 (1999) Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames

ANSI A250.4 (2001) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcings

ANSI A250.6 (1997) Hardware on Steel Doors (Reinforcement - Application)

ASTM INTERNATIONAL (ASTM)
ASTM A 591 (1998) Steel Sheet, Electrolytic Zinc-Coated, for Light

ASTM A 653/A 653M (2003) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 924/A 924M (1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM C 578 (2003a) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 59/C 59M1 (2001) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612 (2000a) Mineral Fiber Block and Board Thermal Insulation

ASTM D 2863 (2000) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

ASTM E 283 (1991; R 1999) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)
BHMA A115 (Set - Spec dates Vary) Steel Preparation Standards (Incl A115.1 (1990), A115.2 (1987), A115.4 (1994), A115.5 (1992), A115.6 (1993), A115.12 (1994), A115.13 (1991), A115.14 (1994), A115.15 (1994), A115.16 (1990), A115.17 (1994), A115.18 (1994)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)
NAAMM HMMA HMM (1999) Hollow Metal Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 105 (2003) Installation of Smoke Door Assemblies

NFPA 252 (2003) Fire Tests of Door Assemblies

NFPA 80 (1999) Fire Doors and Fire Windows

STEEL DOOR INSTITUTE (SDI)
SDI 105 (2001) Recommended Erection Instructions for Steel Frames

SDI 111-B (2000) Recommended Standard Details for Dutch Doors

SDI 111-C (2000) Recommended Louver Details for Standard Steel Doors

SDI 111-F (2000) Recommended Existing Wall Anchors for Standard Steel Doors and Frames

SDI 113 (2001) Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies

SDI A250.8 (2003) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)
UL 10B (1997; Rev thru Oct 2001) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Doors; G
Frames; G
Accessories
Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G
Schedule of frames; G
Submit door and frame locations.

SD-03 Product Data
Doors; G
Frames; G
Accessories

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI A250.8 requirements.

1.3 DELIVERY, STORAGE, AND HANDLING
Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap knock-down frames in bundles. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS
SDI A250.8, except as specified otherwise. Undercut where indicated. Doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1 3/4 inches thick, unless otherwise indicated.

2.1.1 Classification - Level, Performance, Model

2.1.1.4 Maximum Duty Doors
SDI A250.8, Level 4, physical performance Level A, Model 1 with core construction as required by the manufacturer for exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation. Provide Level 4 for all doors.

2.2 CUSTOM HOLLOW METAL DOORS
Provide custom hollow metal doors where nonstandard steel doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of standard steel doors. Door size(s), design, materials, construction, gages, and finish shall be as specified for standard steel doors and shall comply with the requirement of NAAMM HMMA HMM. Fill all spaces in doors with insulation. Close top and bottom edges with steel channels not lighter than 16 gage. Close tops of all doors flush with an additional channel and seal to prevent water intrusion. Undercut doors where indicated. Doors shall be 1 3/4 inches thick, unless otherwise indicated.

2.3 ACCESSORIES

2.3.1 Astragals
For pairs of exterior steel doors provide overlapping steel astragals with the doors.

2.4 INSULATION CORES
Insulated cores shall be of type specified, and provide an apparent U-factor of .48 in accordance with SDI 113 and shall conform to:

a) Rigid Polyurethane Foam: ASTM C 59/C 59M1, Type 1 or 2, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863; or

b) Rigid Polystyrene Foam Board: ASTM C 578, Type I or II; or

c) Mineral board: ASTM C 612, Type I.

2.5 STANDARD STEEL FRAMES

SDI A250.8, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners or knock-down field-assembled corners. Provide steel frames for all doors.

2.5.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth. Welded frames shall be used for a exterior doors.

2.5.2 Knock-Down Frames

Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections. Knock-Down frames shall be used for interior doors.

2.5.3 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2.5.3.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a) Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

2.5.3.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

2.6 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in ANSI A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI A250.8 and ANSI A250.6. For additional requirements refer to BHMA A115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI A250.8, as applicable. Punch door frames to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.7 FINISHES

2.7.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI A250.8 or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.

2.7.2 Electrolytic Zinc-Coated Anchors and Accessories
Provide electrolytically deposited zinc-coated steel in accordance with ASTM A 591, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI A250.8.

2.7.3 Factory-Applied Enamel Finish
Coatings shall meet test procedures and acceptance criteria in accordance with ANSI A250.3. After factory priming, apply two coats of gloss enamel to exposed surfaces. Separately bake or oven-dry each coat. Drying time and temperature requirements shall be in accordance with the coating manufacturer's recommendations. Color(s) of finish coat shall be as indicated and shall match approved color sample(s).

2.8 FABRICATION AND WORKMANSHIP
Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames
Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction.

3.1.2 Doors
Hang doors in accordance with clearances specified in SDI A250.8. After erection and glazing, clean and adjust hardware.

3.2 PROTECTION
Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING
Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

END OF SECTION

SECTION 08330A

OVERHEAD ROLLING DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM A 653/A 653M (2003) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

1.2 DESCRIPTION

Overhead rolling doors shall be spring counterbalanced, rolling type, with interlocking slats, complete with guides, fastenings, hood, brackets, and operating mechanisms, and shall be designed for use on openings as indicated. Each door shall be provided with a permanent label showing the manufacturer's name and address and the model/serial number of the door. Doors in excess of the labeled size shall be deemed oversize and shall be provided with a listing agency oversize label, or a listing agency oversize certificate, or a certificate signed by an official of the manufacturing company certifying that the door and operator have been designed to meet the specified requirements.

1.2.1 Wind Load Requirements

Doors and components shall be designed to withstand the minimum design wind load of 20 psf. Doors shall be constructed to sustain a superimposed load, both inward and outward, equal to 1-1/2 times the minimum design wind load. Recovery shall be at least 3/4 of the maximum deflection within 24 hours after the load is removed. Sound engineering principles may be used to interpolate or extrapolate test results to door sizes not specifically tested

1.2.2 Operational Cycle Life

All portions of the door and door operating mechanism that are subject to movement, wear, or stress fatigue shall be designed to operate through a minimum number of 10 cycles per day. One complete cycle of door operation is defined as when the door is in the closed position, moves to the full open position, and returns to the closed position.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Approved Detail Drawings;
Installation;
Drawings showing the location of each door including schedules. Drawings shall include elevations of each door type, details and method of anchorage, details of construction, location and installation of hardware, shape and thickness of materials, details of joints and connections, and details of guides, power operators, controls, and other fittings.

SD-03 Product Data
Overhead Rolling Doors;
Manufacturer's catalog data, test data, and summary of forces and loads on the walls/jambs. Manufacturer's preprinted installation instructions.

SD-06 Test Reports
Tests;
Written record of fire door drop test.

SD-04 Samples
Overhead Rolling Doors;
Submit three color samples of factory applied finishes.

SD-07 Certificates
Fire Doors;
Oversize labels or certificates stating that the overhead rolling doors conform to requirements of this section. Certificates for oversize fire doors stating that the doors and hardware are manufactured in compliance with the requirements for doors of this type and class and have been tested and meet the requirements for the class indicated. Certificate is not required when fire door has a listing agency label or oversize label on the door bottom bar.

SD-10 Operation and Maintenance Data
Operation and Maintenance Manuals;
Submit six copies of the system operation manual for each type of door and control system.

1.4 DELIVERY AND STORAGE

Doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

1.6 OPERATION AND MAINTENANCE MANUALS

Operating instructions outlining the step-by-step procedures required for shutter operation for the overhead rolling door unit shall be provided. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed shall be provided. A complete list of parts and supplies, source of supply, and a list of the high mortality maintenance parts shall be provided.

PART 2 PRODUCTS

2.1 OVERHEAD ROLLING DOORS

Doors shall be surface-mounted type with guides at jambs set back a sufficient distance to clear the opening. Exterior doors shall be mounted on interior side of walls.

2.1.1 Curtains

The curtains shall roll up on a barrel supported at the head of opening on brackets, and shall be balanced by helical torsion springs. Steel slats for doors less than 15 feet wide shall be minimum bare metal thickness of 0.0281 inches. Slats shall be of the minimum bare metal decimal thickness required for the width indicated and the wind pressure specified above.

2.1.1.1 Non-Insulated Curtains

Curtains shall be formed of interlocking slats of shapes standard with the manufacturer. Slats for exterior doors shall be flat type.

2.1.2 Endlocks and Windlocks

The ends of each alternate slat for interior doors shall have steel or iron endlocks of manufacturer's stock design. In addition to endlocks, non-rated exterior doors shall have the manufacturer's standard windlocks as required to withstand the wind load. Windlocks shall prevent the curtain from leaving guides because of deflection from specified wind pressure.

2.1.3 Bottom Bar

The curtain shall have a standard] bottom bar consisting of two hot-dip galvanized steel angles for steel doors.

2.1.4 Guides

Guides shall be steel structural shapes or formed steel shapes, of a size and depth to provide proper clearance for operation and resistance under the design windload. Guides shall be attached to adjoining construction with fasteners recommended by the manufacturer. Spacing of fasteners shall be as required to meet the minimum design windload. Doors and guides shall have static grounding.

2.1.5 Barrel

The barrel shall be steel pipe or commercial welded steel tubing of proper diameter for the size of curtain. Deflection shall not exceed 0.03 inch per foot of span. Ends of the barrel shall be closed with metal plugs, machined to fit the pipe.

2.1.6 Springs

Oil tempered helical steel counter-balance torsion springs shall be installed within the barrel and shall be capable of producing sufficient torque to assure easy operation of the door curtain. Access shall be provided for spring tension adjustment from outside of the bracket without removing the hood.

2.1.7 Brackets

Brackets shall be of steel plates to close the ends of the roller-shaft housing, and to provide mounting surfaces for the hood. An operation bracket hub and shaft plugs shall have sealed prelubricated ball bearings.

2.1.8 Hoods

Hoods shall be steel with minimum bare metal thickness of 0.0219 inches formed to fit contour of the end brackets, and shall be reinforced with steel rods, rolled beads, or flanges at top and bottom edges. Multiple segment and single piece hoods shall be provided with support brackets of the manufacturer's standard design as required for adequate support.

2.1.9 Weatherstripping

Exterior doors will not require a weatherstrip.

2.1.10 Operation
Doors shall be operated by means of manual hand-chain. Equipment shall be designed and manufactured for usage in non-hazardous areas.

2.1.10.2 Manual Hand-Chain Operation
Operation shall be by means of a galvanized endless chain extending to within 3 feet of floor. Reduction shall be provided by use of roller chain and sprocket drive or suitable gearing, to reduce the pull required on hand chain to not over 35 lbf. Gears shall be high grade gray cast iron.

2.1.11 Locking
Locking shall consist of chain lock keeper, suitable for padlock by others, for chain operated doors.

2.1.12 Finish
Steel slats and hoods shall be hot-dip galvanized G60 in accordance with ASTM A 653/A 653M, and shall be treated for paint adhesion and shall receive a factory baked-on finish coat. Surfaces other than slats, hood, and faying surfaces shall be cleaned and treated to assure maximum paint adherence and shall be given a factory dip or spray coat of rust inhibitive metallic oxide or synthetic resin primer. Color shall be selected from manufacturers standard colors, preferably tan or brown. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 INSTALLATION
Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 283 (1991; R 1999) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM F 883 (1997) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1 (2000) Butts and Hinges

BHMA A156.12 (1999) Interconnected Locks & Latches

BHMA A156.13 (2002) Mortise Locks & Latches, Series 1000

BHMA A156.15 (2001) Closer Holder Release Devices

BHMA A156.16 (2002) Auxiliary Hardware

BHMA A156.17 (1999) Self Closing Hinges & Pivots

BHMA A156.18 (2000) Materials and Finishes

BHMA A156.2 (1996) Bored and Preassembled Locks and Latches

BHMA A156.21 (2001) Thresholds

BHMA A156.22 (2003) Door Gasketing and Edge Seal Systems

BHMA A156.3 (2001) Exit Devices

BHMA A156.4 (2000) Door Controls - Closers

BHMA A156.5 (2001) Auxiliary Locks & Associated Products

BHMA A156.6 (2001) Architectural Door Trim

BHMA A156.7 (2003) Template Hinge Dimensions

BHMA A156.8 (2000) Door Controls - Overhead Holders and Holders

STEEL DOOR INSTITUTE (SDI)

SDI 100 (1998) Standard Steel Doors and Frames

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Hardware schedule; G
Keying system

SD-03 Product Data
Hardware items; G

SD-08 Manufacturer's Instructions
Installation

SD-10 Operation and Maintenance Data
Hardware Schedule items, Data Package 1; G

SD-11 Closeout Submittals

1.3 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a) Complete listing of all keys (AA1, AA2, etc.).

b) Complete listing of all key cuts (AA1-123456, AA2-123458).

c) Tabulation showing which key fits which door.

d) Copy of floor plan showing doors and door numbers.

e) Listing of 20 percent more key cuts than are presently required in each master system.

1.4 QUALITY ASSURANCE

1.4.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the Contracting Officer, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware to be applied to metal doors shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 101 for exit doors, as well as to other requirements specified, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule."

2.3 HARDWARE ITEMS

Hinges, pivots, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

BHMA A156.1, 4 1/2 by 4 1/2 inches unless otherwise specified. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be nonremovable when door is closed. Other antifriction bearing hinges may be provided in lieu of ball-bearing hinges.

2.3.2 Pivots

BHMA A156.4.

2.3.3 Spring Hinges

BHMA A156.17.

2.3.4 Locks and Latches

2.3.4.1 Mortise Locks and Latches

BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 7 by 2 1/4 inches with a bushing at least 1/4 inch long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Knobs and roses of mortise locks shall have screwless shanks and no exposed screws.

2.3.4.2 Bored Locks and Latches

BHMA A156.2, Series 4000, Grade 1.

2.3.4.3 Auxiliary Locks

BHMA A156.5, Grade 1.

2.3.5 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores shall have six pin tumblers. Cylinders shall be interchangeable and fully compatible with products from Best Lock Corp., Arrow Lock Corp., or Falcon Lock which are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.6 Keying System

Provide a master keying system. Provide a construction master keying system.

2.3.7 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.7.1 Knobs and Roses
In addition to meeting test requirements of BHMA A156.2 and BHMA A156.13, knobs, roses, and escutcheons shall be 0.050 inch thick if unreinforced. If reinforced, outer shell shall be 0.035 inch thick and combined thickness shall be 0.070 inch, except knob shanks shall be 0.060-inch thick.

2.3.7.2 Lever Handles
Provide lever handles in lieu of knobs. Lever handles for exit devices shall meet the test requirements of BHMA A156.13 for mortise locks. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in BHMA A156.13 is applied to the lever handle. Lever handles shall return to within 1/2 inch of the door face.

2.3.7.3 Texture
Provide knurled or abrasive coated lever handles.

2.3.8 Keys
Furnish one file key, one duplicate key, and one working key for each key change. Furnish one additional working key for each lock of each keyed-alike group. Furnish 2 great grand master keys, 2 construction master keys, and 2 control keys for removable cores. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Do not place room number on keys.

2.3.9 Door Bolts
BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: BHMA A156.3, Type 25.

2.3.10 Closers
BHMA A156.4, Series C02000, Grade 1, with PT 4C. Provide with brackets, arms, mounting devices, fasteners, full size covers and other features necessary for the particular application. Size closers in accordance with manufacturer's recommendations, or provide multi-size closers, Sizes 1 through 6, and list sizes in the Hardware Schedule. Provide manufacturer's 10 year warranty.

2.3.10.1 Identification Marking
Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.11 Overhead Holders
BHMA A156.8.

2.3.12 Closer Holder-Release Devices
BHMA A156.15.

2.3.13 Door Protection Plates
BHMA A156.6.

2.3.13.1 Sizes of Kick Plates
Width for single doors shall be 2 inches less than door width; width for pairs of doors shall be one inch less than door width. Height of kick plates shall be 10 inches for flush doors.

2.3.14 Door Stops and Silencers
BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair.

2.3.15 Padlocks
ASTM F 883.

2.3.16 Special Tools
Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS
Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES
BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish (satin chromium plated) over brass or bronze, except surface door closers which shall have prime coat finish, and except steel hinges which shall have BHMA 652 finish (satin chromium plated). Hinges for exterior doors shall be stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Exit devices may be provided in BHMA 626 finish in lieu of BHMA 630 finish. Exposed parts of concealed closers shall have finish to match lock and door trim.

PART 3 EXECUTION

3.1 INSTALLATION
Install hardware in accordance with manufacturers' printed instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.2 Threshold Installation
Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws.

3.2 EXIT DOORS
Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS
SDI 100, unless indicated or specified otherwise.

Kick Plates: Push side of single-acting doors.

3.4 CONTROL SYSTEM
Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master key.

3.5 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

END OF SECTION

SECTION 11215

FANS/BLOWERS/PUMPS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)
AMCA 210 (1999) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300 (1996) Reverberant Room Method for Sound Testing of Fans
AMCA 301 (1990) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 99 (1999; R 2003) Standards Handbook

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
ABMA 11 (1990; R 1999) Load Ratings and Fatigue Life for Roller Bearings
ABMA 9 (1990; R 2000) Load Ratings and Fatigue Life for Ball Bearings

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
ACGIH-2092S (1998) Industrial Ventilation: A Manual of Recommended Practice

AMERICAN GEAR MANUFACTURERS ASSOCIATION (AGMA)
AGMA 6011 (1998; Rev H) Specifications for High Speed Helical Gear Units

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
ANSI B109.2 (2000) Diaphragm Type Gas Displacement Meters (500 Cubic Feet per Hour Capacity and Over)

ANSI S2.19 (1999) Mechanical Vibration - Balance Quality Requirements of Rigid Rotors, Part 1: Determination of Permissible Residual Unbalance, Including Marine Applications (Note: was ASA86, but that document refers to ANSI S2.19.)

AMERICAN PETROLEUM INSTITUTE (API)
API Spec 6D (2002) Specification for Pipeline Valves

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
ASHRAE 52.1 (1992) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

ASME INTERNATIONAL (ASME)
ASME B16.1 (1998) Cast Iron Pipe Flanges and Flanged Fittings

ASME B16.40 (2002) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems

ASME B16.5 (2003) Pipe Flanges and Flanged Fittings

ASME B40.100 (2000) Pressure Gauges and Gauge Attachments

ASME BPVC SEC VIII D1 (2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASME PTC 19.3 (1974; R 2004) Temperature Measurement

ASME PTC 25 (2002) Pressure Relief Devices

ASTM INTERNATIONAL (ASTM)
ASTM D 4167 (1997; R 2002) Fiber-Reinforced Plastic Fans and Blowers

ASTM F 1139 (1988; R 2004) Steam Traps and Drains

ASTM F 1508 (1996; R 2004) Angle Style, Pressure Relief Valves for Steam, Gas, and Liquid Services

ISA - THE INSTRUMENTATION, SYSTEMS AND AUTOMATION SOCIETY (ISA)
ISA MC96.1 (1982) Temperature Measurement Thermocouples

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
MSS SP-25 (1998) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-72 (1999) Ball Valves with Flanged or Butt-Welding Ends for General Service

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA ICS 1 (2000) Industrial Control and Systems: General Requirements

NEMA ICS 6 (1993; R 2001) Industrial Control and Systems: Enclosures

NEMA MG 1 (2003) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 70 (2005) National Electrical Code

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)
NIST SP 250 (1998) Calibration Services Users Guide

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
47 CFR 15 Radio Frequency Devices

WATER ENVIRONMENT FEDERATION (WEF)
WEF MOP OM-5(1984) Prime Movers: Engines, Motors, Turbines, Pumps, Blowers & Generators

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Detailed Drawings; G
Drawings showing dimensions of the equipment and layout of the off-gas system and subsystems, as specified.

Detailed Process Flow Diagrams; G
Flow diagram for process equipment associated with the off-gas system, as specified.

Piping and Instrumentation Diagram; G
Piping and instrumentation diagram (P&ID), as specified.

Control System; G
Wiring and ladder diagrams. Control sequences showing the control of the entire system.

SD-03 Product Data
Flame Arrestor; G
Rating, capacity and pressure differentials. Make and model, catalog cuts, manufacturer's descriptive and technical literature including installation instructions.

Instrumentation; G
Detailed manufacturer's data on the overall controls, sensors, process controllers, control operators, valves, interlocks and alarms. Data describing in detail the equipment used.

Air Moving Equipment; G
Capacities and pressure differentials; performance charts and curves (including the complete selection of impeller sizes for a given casing for centrifugal blowers). Make and model, catalog cuts, manufacturer's descriptive and technical literature, including installation instructions. Approved diagrams showing the complete layout of the entire system, including equipment, piping, valves, wiring and control sequence. Condensed operating instructions in typed form explaining preventative maintenance procedures, safe methods of checking the equipment for normal operation, and safe procedures for starting and stopping the equipment. Diagrams and instructions, framed under glass or in approved laminated plastic, shall be posted where directed before acceptance testing of the systems. Complete list of equipment and materials. A listing covering component items forming a system or items that are interrelated and scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. Data shall include tabular lists showing location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

Variable Speed Controls; G
Capacities and capacity ranges; performance charts and curves. Make and model, catalog cuts, manufacturer's descriptive and technical literature, including installation instructions.
Field Training
Training course curriculum and training instructions 14 days prior to the start of training.

SD-06 Test Reports
Testing
Test reports in booklet form showing field tests performed to adjust each component and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed equipment. Test methods used shall be identified and test results shall be recorded. Each test report shall indicate the final position of controls.

SD-07 Certificates
Air Moving Equipment
Written certification signed by an official authorized to certify on behalf of the manufacturer of the product, equipment or material, attesting that equipment has been tested and that it conforms to the specified requirements. Statements shall be dated after contract award, shall state the Contractor's name and address, the project and location, and the specific requirements which are being certified. The certificate shall indicate the methods of testing used. In lieu of a certificate, a seal or label from a nationally recognized testing agency will be acceptable as evidence that the equipment conforms to agency requirements.

Manufacturer's Representative
The names and qualifications of the manufacturer's representative and training engineers, and written certification from the manufacturer that the representative and trainers are qualified in the appropriate technical areas.

SD-10 Operation and Maintenance Data
Operating and Maintenance Instructions
Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The operating instructions shall include the following for system components: manufacturer's name, model number, service manual, parts list, and brief description of each piece of equipment and its basic operating features; flow diagrams; system layout showing piping, valves, and controls; [as-built] [approved] wiring and control diagrams; control sequence describing startup, operation, and shutdown; manufacturer's bulletins, cuts, and descriptive data.

Six complete copies of maintenance instructions for each piece of equipment including the following: manufacturer's complete list of parts, recommended spare parts and supplies, with current unit prices and source of supply; routine maintenance procedures, including the requirements of WEF MOP OM-5, as a minimum; possible breakdowns and repairs; a troubleshooting guide to help the operator determine what steps must be taken to correct any equipment problems.

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

Capacity and design of the air moving equipment and accessories shall be suitable for 24-hour full load service in an outdoor location, and shall meet the following criteria.

a) Design Life Minimum: 3 years.

b) Altitude (above MSL) Minimum: 100 ft.

c) Barometric pressure - Minimum 29 in Hg.

d) Ambient air temperature
Maximum 110 degrees F. Minimum 40 degrees F.

e) Seismic zone: 4

f) Soil bearing capacity - Maximum 2000 psf.

g) Wind speed - Maximum 100 mph.

h) Air relative humidity
Maximum 100 percent.
Minimum 50 percent.

1.3.2 Selection Criteria

Air moving equipment shall be designed using criteria based upon actual model developmental test data, and shall be selected at a point within the maximum efficiency for a given impeller/casing combination. Deviations within 3 percent of maximum efficiency are permissible. Air moving equipment having impeller diameters larger than 95 percent of the published maximum impeller diameter for the casing, or less than 5 percent larger than the published minimum impeller diameter for the casing, will be rejected. Acceptable maximum impeller diameter calculations shall not be based on percentage of impeller diameter range for a given casing.

1.3.3 Specifications and Performance Requirements

Drawing M-1 provides a schematic and specifications of air-moving equipment including pumps, blowers, and moisture separators. Equipment identification numbers and general specifications are summarized on the following table:

UNIT/EQUIPMENT ID	DESCRIPTION	SPECIFICATIONS
Blower Units P-101 and P-102	2 units operating in parallel. Blowers produce vacuum for dual-phase extraction network.	Type: Oil Liquid Ring Capacity: 1000 scfm ea. Inlet: 8” Outlet” 8” Motor: 75 hp Ultimate vacuum: 29.5" Hg
Pump P-201	Self Priming Centrifugal	Motor: 3-phase, 480 V Material: 316 SS Capacity: 30 GPM Discharge: 75’ Water
Pump P-202	Centrifugal	Motor: 3-phase, 480 V Material: 316 SS Capacity: 100 GPM Discharge: 75’ Water
Pump P-203	Centrifugal	Motor: 3-phase, 480 V Material: 316 SS Capacity: 110 GPM Discharge: 55’ Water
Moisture Separator V-101	Passive Centrifugal Water Droplets Removed to 250 Microns	Equipped with Low, High, High-High Level Switches. Capacity: 500 Gal
Heat Exchanger H-202	Vertical air flow configuration	Motor: 3-phase, 480 V Material: Copper Capacity: 20 GPM Inlet Temperature: 165 °F Outlet Temperature: 130 °F

Air Compressor P-301	Rotary screw compressor with receiver tank	Motor: 3-phase, 480 V Capacity: 125 psig Air Flow: 124 cfm Receiver Tank Capacity: 240 Gal

1.3.4 Service Conditions
The blowers, pump, and moisture separator service are components of the soil vapor extraction treatment system.

1.4 QUALIFICATIONS

1.4.1 Contractor
Contractor shall have a minimum of 2 years of experience in the construction of systems for handling sour gas, condensable gas, off-gas or vapor.

1.4.2 Single Source Supplier
The Contractor shall assign to a single supplier full responsibility for the furnishing of the off-gas moving system. The designated single supplier, however, need not manufacture the system but shall coordinate the selection, assembly, installation, and testing of the entire system as specified herein.

1.4.3 Manufacturer's Representative
Services of a manufacturer's field service representative who is experienced in the installation of the equipment furnished and who has complete knowledge of the proper operation and maintenance of the system shall be provided.

1.5 GENERAL REQUIREMENTS

1.5.1 Standard Products
Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate equipment that has been in satisfactory operation at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Project Engineer, reasonably convenient to the site. Pieces of equipment of the same types shall be products of the same manufacturer. Equipment shall be new and unused, except for test equipment. Materials may be reprocessed/recycled with equivalent durability and product warranty/guarantee.

1.5.2 Nameplates
Each piece of equipment shall have a standard nameplate securely affixed in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, the nameplate for each air moving unit shall show the capacity in standard cubic meters per second feet per minute (SCFM) at rated speed in rpm and head in inches of water. Nameplate for each electrical motor shall show, at least, the minimum information required by paragraph 10.38 of NEMA MG 1. Any other information that the manufacturer may consider necessary to complete identification shall be shown on the nameplate.

1.5.3 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify all dimensions in the field and shall advise the Project Engineer or QC Engineer of any discrepancy before performing the work.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored in a clean, dry location and covered for protection against dust and moisture. Equipment stored longer than 60 days shall have silica bags suspended in the outlet and inlet of unit, bearings shall be filled full of grease, unit shall be filled with oil, machine surfaces shall be coated with grease, and entire unit shall be enclosed with plastic or tarps. Shaft of rotating equipment including motors shall be turned every two weeks to prevent flat spots on bearings.

1.7 PARTNERING/PRE-INSTALLATION CONFERENCE

1.8 MAINTENANCE SERVICE

Maintenance service shall be performed according to the Operation and Maintenance Manual provided for the units and otherwise as needed.

PART 2 PRODUCTS

2.1 AIR MOVING EQUIPMENT

Air moving equipment shall be furnished and installed complete with drive units, filters, controls and appurtenances indicated or specified. Equipment shall be capable of operating at partial-load conditions without increased vibration over the normal vibration at full load operation and shall be capable of continuous operation down to the lowest step of unloading. Each unit shall be provided with unloading, vibration isolators, thermal overloads, high-and-low pressure safety cutoffs, low oil pressure cutout, internal motor-winding temperature sensing protection device, internal pressure relief valve, a complete oil charge, and protection against short cycling.

2.2 FANS

Fans shall be centrifugal or propeller type as best suited for the application.

2.2.1 Single-Stage

A single-stage fan is allowable for the capacity range 53 to 106,000 cfm at pressure ranges from 0.08 to 5 feet of water column.

2.2.2 Industrial Centrifugal

An industrial centrifugal fan is allowable for the capacity range over 95,000 cfm at pressure ranges from 2.5 to 4 feet of water column.

2.2.3 Pressure Blower

A pressure blower fan is allowable for the capacity range of less than 5,100 cfm at pressure ranges from 3.3 to 10 feet of water column.

2.2.4 Multiple Stage

A multi-stage pressure blower fan is allowable for the capacity of less than 7,000 cfm at pressure ranges up to 23 feet of water column or vacuum to -13 feet of water column.

2.2.5 Backwards Inclined Impeller

A backwards inclined impeller fan is allowable for the capacity range over 403,000 cfm and pressure ranges from 0.84 to 1.5 feet of water column.

2.3 DYNAMIC BLOWERS

Dynamic blowers shall be oil-free and of modular design with the required number of compression stages to comply with the specified operating requirements.

2.3.1 Single Stage Centrifugal

A single stage centrifugal blower is allowable for pressure ranges from 0.084 to 2.5 feet of water column.

2.3.2 Regenerative

A regenerative blower is allowable for capacity up to 10,000 cfm and pressure ranges of 6.7 to 20 feet of water column or vacuum up to -12 feet of water column.

2.3.3 Axial Flow

An axial flow blower is allowable for pressure ranges higher than 23 feet of water column or vacuum requirements greater than -13 feet of water column.

2.4 POSITIVE DISPLACEMENT BLOWERS

2.4.1 Rotary Lobe

A rotary lobe blower is allowable for capacity up to 30,000 cfm at pressures higher than feet of water column or up to 21,200 cfm at vacuum up to -41.8 feet of water column.

2.4.2 Helical Screw

A helical screw blower is allowable for capacity up to 2,100 cfm and pressure ranges of 10 to 20 feet of water column or vacuum up to -11.7 feet of water column.

2.5 VACUUM PUMPS

2.5.1 Dry Rotary Blower

A dry rotary blower vacuum pump is allowed for vacuum flows of 2,100 cfm at -30.1 feet of water column to 12,700 cfm at -20.1 feet of water column.

2.5.2 Water-Sealed Rotary Blower

A water-sealed rotary blower vacuum pump is allowed for vacuum flows of 2,100 cfm at -26.8 feet of water column 12,700 cfm at -23.4 feet of water column.

2.5.3 Rotary Vane

A rotary vane vacuum pump is allowed for vacuum flows of 5,300 cfm at -33.5 feet of water column to 9,000 cfm at -20.1 feet of water column. Oil injection and outlet demisting systems shall be included for each rotary vane vacuum pump.

2.5.4 Liquid Ring

A liquid ring vacuum pump is allowed for vacuum flows of 5,300 cfm at -26.8 feet of water column to 16,950 cfm at -20.1 feet of water column. Water injection systems and outlet water separation systems shall be included for each liquid ring vacuum pump.

2.6 CASING OR HOUSING

Casing or housing shall be of modular design to permit inspection or removal and replacement of wearing parts. Ample clearance shall be provided between the impeller or blades and casing. Casing shall incorporate ribbed construction to resist heat accumulation, deflection and distortion under the specified operating conditions.

2.6.1 Materials

Fabrication shall be from alloy steel, monel, 316 stainless steel, heavy gauge hot rolled low carbon steel with continuous welds, or fiberglass in accordance with ASTM D 4167. Construction shall be close grain cast iron or aluminum Type A, B, or C in accordance with AMCA 99, and of uniform quality and free from blowholes, porosity, hard spots, shrinkage defects, cracks, and other injurious defects.

2.6.2 Single Piece Casing

Single piece casings shall have separate head plates.

2.6.3 Horizontally Split Casing

Horizontally split casings shall be machined at the split to maintain the pressure without a gasket.

2.6.4 Vertically Split Casing

Vertically split casings shall consist of rigid sections secured between inlet and outlet heads by steel tie rods.

2.6.5 Connections

2.6.5.1 Inlet and Discharge Connections

Inlet and discharge connections shall be ASME B16.1 or ASME B16.5 Class 125 drilled and tapped flanges and shall be an integral part of the head. Connections 3 inches in diameter and smaller shall be threaded or sweat.

2.6.5.2 Casing Drains

Tapped and plugged drains shall be provided at the low points in the casing.

2.6.5.3 Lifting Eyes

Casing shall have lifting eyes capable of supporting the equipment for installation and maintenance purposes.

2.7 BLADES OR IMPELLERS

Blades, vanes or impellers shall be cast or ductile iron, fabricated steel, carbon steel, aluminum, stainless steel, PTFE coated steel, or similar.

2.7.1 Dynamic Impellers

Guide or diffuser vanes configured to receive and direct flow to the downstream impeller shall be provided at the inlet to each centrifugal blower stage. Multiple stage impeller hubs shall butt against each other either directly or through one piece metal spacers.

2.7.2 Rotary Lobe Impellers

Rotary lobe impellers shall be of the straight, two-lobe involute type and shall operate without rubbing, liquid seals, or lubrication.

2.8 SHAFT

Shaft shall be made of accurately machined, ground and polished high grade ductile iron casting, alloy steel, stainless steel or carbon steel. Impellers or blade assembly shall be mounted and keyed to the shaft and secured by a lock nut. Design shall permit inspection or replacement of the seals and bearings without disconnecting suction or discharge piping. The shaft shall be designed to operate at below 90 percent of the first critical speed. Shaft shall be of sufficient diameter, mass and strength to perform the work required with minimum vibration.

2.9 SEALS, GASKETS AND PACKING

Gasket and packing material selection shall be in accordance with Table 5-2 of WEF MOP OM-5. Gasket and seal ratings shall encompass the maximum pressure or vacuum capacity of the equipment and the ranges of temperature and quality of the off-gas or air.

2.9.1 Shaft Seals

Solid carbon mechanical ring shaft seals shall be provided where the shaft passes through the inlet and discharge heads. Seals shall be conform to specified service requirements. Ventilation to the atmosphere on the impeller side of shaft seals shall be provided to eliminate carry-over of lubricant into the air stream.

2.9.2 Internal Seals

Labyrinth seals shall be provided between blower stages.

2.9.3 Bearing Seals

A lip type oil or grease seal shall be provided at each bearing to prevent lubricant from leaking into the output. Ventilation of the impeller side of oil seals to atmosphere shall be provided to eliminate any carry-over of lubricant into the air stream.

2.10 BEARINGS

2.10.1 Shaft Bearings

Shaft shall be supported by anti-friction bearings designed for both radial and thrust loads and sized for a minimum L-10 life of 30,000 hours continuous operation as defined by ABMA 9 or ABMA 11.

2.10.2 Blower Bearings

Each blower shall be provided with two lubricated or pressure bearings. Bearings shall be self-aligning, shall be designed for both radial and thrust loads and shall be sized for an L-10 life of 30,000 hours continuous operation as defined by ABMA 9 or ABMA 11. It shall be possible to replace the bearings without disassembling the casing or disconnecting piping.

2.11 DRIVE CONNECTION

Each unit shall be close coupled, directly connected through a flexible coupling or driven by a V-belt.

2.11.1 Coupling

Coupling shall be heavy-duty, flexible forged steel spacer coupling, keyed or locked to the shaft. Disconnection shall be accomplished without removing the driver half of the driven unit half of the coupling from the shaft. Coupling outside surface shall be machined parallel to the axis of the shaft. Coupling faces shall be machined perpendicular to the axis of the shaft.

2.11.2 V-Belt Drive
V-belt drive shall be designed for not less than 150 percent of the driving motor capacity. When belt drive is provided, an adjustable sheave to furnish not less than 20 percent speed adjustment shall be provided. Sheaves shall be selected to provide the required capacity at the approximate midpoint of the adjustment. The drive belt shall be covered with an acoustically treated sheet metal guard or completely enclosed within the unit casing.

2.12 GEARS
Gears shall be made of hardened, helical, alloy steel, manufactured in accordance with AGMA 6011 with a minimum 1.5 service factor applied to full power rating of the motor. Timing gears shall be mounted on the impeller shafts on a tapered fit and secured by a lock nut.

2.13 LUBRICATION SYSTEM
Drive shall be pressure oil, splash oil, or grease lubricated. Timing gears and gear end bearings shall be pressure oil or splash oil lubricated Bearings and seals shall be lubricated as previously indicated. System shall be designed to prevent leakage and contamination. Oil-lubrication systems and vents shall be designed so that oil vapors do not enter the air stream or motor and the shaft bearings will be isolated. Each oil reservoir shall be provided with an opening for filling, an overflow opening with overflow container at the proper location to prevent overfilling, and a drain at the lowest point.

2.13.1 Pressure Oil
Pressure oil lubrication system shall be console mounted and shall include a main oil pump driven by the shaft, an auxiliary electric motor driven oil pump, an oil cooler, an oil, oil reservoir with 3-minute minimum retention time, and the switches, temperature and pressure gauges and controls necessary to protect unit. The electric motor driving the auxiliary oil pump shall be totally enclosed fan cooled (TEFC), Design Type B in accordance with NEMA MG 1, shall have Class F insulation and shall be equipped with 120 volts space heaters. Control shall be in accordance with NEMA ICS 1. The lubrication system shall be factory piped and wired with minimal interconnecting piping between the console and the oil pump required in the field.

2.13.2 Splash Oil
Splash lubrication shall be provided by a slinger on the shaft splashing oil into the bearing whenever the compressor is running. A constant level oiler located on the bearing housing or a metering orifice will be provided to maintain the oil level in the oil reservoir integral with the bearing housing. A sight level gauge shall be provided in the bearing housing. A labyrinth seal combined with an atmospheric vent shall be provided to prevent oil contamination of the air stream.

2.13.3 Grease
Grease type bearings shall be equipped with grease fittings. Grease tubing shall be extended to a convenient location if fittings are inaccessible. Grease fittings shall be the type which prevents over-lubrication and over-pressurization.

2.14 INTAKE FILTER
Intake filter shall be installed on inlet to each unit.

2.14.1 Efficiency
Intake filter shall be at least 90 percent efficient when tested in compliance with ASHRAE 52.1 dust spot method.

2.14.2 Surface Area
Minimum filter surface area shall be 1 square foot per 25 cubic feet/minute to produce a filter flow through velocity of less than 25 feet per minute.

2.14.3 Media
Filter media shall be washable or disposable dry type felt material made from fiber resistant to moisture and chemicals to which it will be exposed with 1 inch pleat separation.

2.14.4 Weather Hood
Steel intake hood and filter housings shall be coated with a chemically resistant coating and entire unit element shall be resistant to moisture and chemicals to which it will be exposed.

2.15 NOISE MINIMIZATION
See Paragraph 3.3.4 Noise Suppression.

2.16 MONITORING
Each unit shall be equipped for monitoring the flow downstream of any bypass connections. Calibration of sensors shall be with standards traceable to NIST and in conformance with NIST SP 250.

2.16.1 Flow
A turbine type flow meter equipped with transmitter and recorder shall be provided for continuous metering of the process flow. Accuracy shall be within 0.5 percent of full scale.

2.16.2 Temperature

2.16.2.1 Thermometers
Thermometers shall conform to ASME PTC 19.3 with wells and temperature range suitable for the use encountered. Thermometers shall be provided to indicate discharge air temperature. Thermometers shall be either red-reading mercury-in-glass type or dial type. Scale range shall include full range of expected operation and up to 125 percent, but not more than 150 percent of maximum. Accuracy shall be within 0.5 percent of full scale.

2.16.2.2 Thermocouples
Sensors shall conform to ISA MC96.1, Type K, and shall be provided downstream of each blower or as otherwise directed.

2.16.3 Pressure
High and low pressure connections shall be 1/4 inch NPT female with a suitable shutoff cock at each connection.

2.16.3.1 Draft Gauge
Gauge shall conform to ASME B40.100 with a diaphragm or bellows actuating system, a circular scale and a zero adjustment screw. Inlet gauges shall have a range of 0 to 30 inches water gauge vacuum. Gauges shall include the accessories for control panel mounting.

2.16.3.2 Pressure Gauge
Gauges shall conform to ASME B40.100 with a single Bourdon tube style actuating system, a circular scale and a zero adjustment screw. Discharge gauges shall have a range of 0 to 11 psi. Gauges shall include the accessories for control panel or pipe mounting.

2.16.3.3 Differential Pressure Gauge
The housing of each unit shall be equipped with a direct-reading gauge that measures the differential pressure range of 0 to 14.5 psi with an accuracy of plus or minus 2 percent of full scale, necessary to operate in conjunction with the corresponding venturi tube. During operating conditions the pointer shall be within the mid-range of the gauge. Accuracy shall be within 0.5 percent of full scale.

2.16.3.4 Piston Element
Piston type element shall consist of a spring-supported, corrosion resistant piston moving inside a glass cylinder with an operating pressure of 150 psi. The cylinder shall have stainless steel end flanges with Viton O-ring seals and a cylinder burst pressure of not less than 600 psi. Construction of the gauge shall be such that a 3-valve manifold is not necessary. If only one bar stock valve is closed, the gauge shall not be damaged by up to 300 psi differential pressure in either direction.

2.16.3.5 Bellows Element
Bellows pressure sensing element shall be installed to measure pressure differential across the air moving equipment and shall be dual opposed, liquid filled, rupture-proof type with bellows movement converted to rotation and transmitted by a torque tube. Bellows housing shall be stainless steel and shall have a rated working pressure of not less than 500 psi. Liquid used to fill the bellows shall be suitable for the expected maximum temperature of the off-gas and the minimum ambient temperature.

2.16.4 Contaminant Monitoring and Sampling

2.16.4.1 Explosimeter
Continuous monitoring and recording of percentages of upper and lower explosive limits shall be performed.

2.16.4.2 Hygrometer
Humidity sensor shall be located downstream of the heat exchanger or blower.

2.16.4.3 Sampler
Sampling port and equipment for collecting discrete and composite samples shall be provided with adequate access for personnel and equipment.

2.16.4.4 Transmitter
Transmitter shall provide an analog two-wire electrical 4-20 milliamp signal directly proportional to the differential pressure and accurate to within 0.25 percent of sensor indication. Transmitter shall be provided with built-in pulsation damper and suitable over-range protection. Transmitter shall not require recalibration due to power outages. Transmitter shall be UL listed for [Class 1, Division 1, Group D hazardous locations] [the electrical classification for the area as indicated on the drawings]. Each transmitter shall be supplied with a factory assembled five-valve stainless steel manifold. Vent valves shall be furnished on upper ports of each transmitter. Transmitter shall be mounted and installed according to manufacturer's recommendations.

2.16.4.5 Remote Indicator and Recorder
Monitored parameters and excursion alarms shall be displayed locally and displayed on the control panel. Digital data shall be recorded at intervals not exceeding one minute. Process data shall be maintained in the control room and recorded on magnetic media in the approved micro computer compatible digital format. Flow information shall include rate monitoring, integration

and totalizing. Hard copies of recorded data and summaries of recorded data shall be maintained in the control room. The copies shall be available upon request.

2.17 CONTROL SYSTEM

Unit shall have an automatic control system. Automatic controls shall be responsible for the balancing of the capacity with system requirements. These controls shall automatically balance the equipment capacity with the load. The system shall be provided with the necessary control devices required for normal operation. The automatic controls shall also include each of the following: a safe system operating mode when controls fail, indications for system failure, protective mechanisms and controls that are required for the safe operation of system equipment in an enclosure conforming to NEMA ICS 6.

2.17.1 Sequence of Equipment Operation

Logic shall be included to allow for automatic or manual alternation of lead/lag/standby assignments of units installed in parallel. Instrumentation to modulate the pressure and volume output as well as start or stop units shall be included to meet pressure and/or volume demands. Off-gas systems with safety, emission, or process controls shall be subject to automatic control logic permissives. Controls shall include start and stop push button switches, hand-off-automatic (HOA) switches where the system controls operation (Knockout Tank), safety features such as blade and belt guards, vibration or temperature switches, oil back pressure gauges. Additional controls or protective devices shall be as indicated.

2.17.2 Intake Volume Control

Automatically controlled adjustable guide vanes or a line sized butterfly valve (per manufacturer) shall be installed on blower inlet to create inlet head losses and reduce the volumetric flow rate.

2.17.3 Outlet Volume Control

Variable speed control shall be installed to control output volume automatically controlled bypass shall be provided to recirculate directly around the blower.

2.17.4 Panel

A NEMA control panel enclosing relays, contractor, timers, and selector switches shall be wall mounted or mounted with vibration isolators on the unit, and provided with hinged cover and latch. Instruments shall be of the direct reading type and shall be factory mounted and connected. Shutdown feature shall be connected to the annunciator on the instrument panel and each shutdown feature shall be identified. Panel shall include the following features and instruments:

a) Running time meter.

b) Alarm annunciator with single audible alarm and with contacts to operate a remote alarm.

2.17.5 Protective Devices

Blower protective devices, upon alarm condition, shall cause immediate de-energization of the motor, shall initiate the automatic shutdown sequence, and shall provide audible and visual alarm indication.

2.17.5.1 Bearing Temperature
Temperature sensors with switches shall be installed on each bearing. The control relay, selector switch, test push buttons, and running indicator, or light, on the panel shall indicate bearing status. High temperature of any bearing shall initiate protective shutdown and the indicator, or light, shall indicate the affected bearing.

2.17.5.2 Surge and Overload Protection
A set-point controller shall monitor current input to the motor. The controller shall open and close the inlet valve in response to current. The controller shall initiate automatic shutdown sequence and give visual indication of reason for shutdown if surge conditions are indicated by the motor current. Manual control and override shall be provided to enable equipment startup and shutdown.

2.17.5.3 Oil Temperature and Pressure
Temperature and pressure sensors with switches shall be installed on each oil pump. The control relay, selector switch, test push buttons, and running indicator, or light, on the panel shall indicate status. High oil temperature, high oil pressure or low oil pressure shall initiate protective shutdown and the indicator, or light, shall indicate the affected setting.

2.18 ELECTRICAL EQUIPMENT
Electrical equipment shall conform to SECTION 16402N - INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment herein specified shall be provided complete with motors, motor starters, and controls. Electrical equipment and wiring shall be in accordance with NFPA 70, with proper consideration given to environmental conditions such as moisture, dirt, corrosive agents, and hazardous area classification.

2.18.1 Electric Motors
Each electric motor-driven unit shall be driven by a weather-protected, continuous-duty electric motor. Motors shall be induction or synchronous type having normal-starting-torque and low-starting-current characteristics, and shall be sized to avoid exceeding the nameplate power rating throughout the entire published characteristic curve. Motor bearings shall provide smooth operations under the conditions encountered for the life of the motor. Adequate thrust bearing shall be provided in the motor to carry the weight of the rotating parts plus the hydraulic thrust and shall be capable of withstanding upthrust imposed during starting conditions specified. Motors shall be rated 460 volts, 3-phase, 60 Hz and such rating shall be stamped on the nameplate. Motors shall conform to NEMA MG 1.

2.18.2 Control Equipment
Manually controlled units shall have START-STOP pushbutton in cover. Additional controls or protective devices shall be as indicated.

2.18.3 Variable Speed Controls
The variable speed motor controller shall convert 460 volt plus 15 percent, minus 5 percent, three phase, 60 Hz (plus or minus 2 Hz) utility power to adjustable voltage/frequency, three phase, ac power for stepless motor control from 5 percent to 105 percent of base speed.

2.18.3.1 Description
The variable speed drive shall produce an adjustable ac voltage/frequency output for complete motor speed control. The variable speed drive shall be automatically controlled by a pneumatic 3 to 15 psig control signal or a grounded electronic control signal. The variable speed drive shall be self contained, totally enclosed in a NEMA MG 1 ventilated cabinet and shall be capable of

operation between 32 and 104 degrees F. The variable speed drive maximum output current rating shall be equal to or exceed the motor nameplate full load. The manufacturer shall advise the maximum recommended motor sine wave current for each controller rating. Variable speed drive multiple motor operation at same frequency/speed shall be possible as long as the sum of connected motor full load sine wave currents are less than or equal to the variable speed drive maximum continuous current rating. Variable speed drive shall be at least 85 percent efficient at 100 percent of rated output power.

2.18.3.2 Governing Requirements
Variable speed drive shall comply with 47 CFR 15 regulation of RF1/EM1 emission limits for Class A computing devices. The FCC label of compliance shall be displayed on the variable speed drive. Variable speed drive and option design and construction thereof shall comply with the applicable provisions of NFPA 70, Article 43D, Sections A-L.

2.18.3.3 Basic Features
The variable speed drive shall have the following basic features:

a) Hand/off/auto operation.

b) Manual/auto speed reference switch.

c) Minimum/maximum adjustable speeds.

d) Speed potentiometer.

e) Auto restart.

f) Linear timed acceleration and deceleration for soft starting and stopping.

g) Controlled speed range 3-63 Hz. (Factory set at 15 Hz minimum).

h) Terminal connections for time clock control, fire, smoke, freeze detectors, and EP relay pre-set speed override.

i) Output frequency terminals for remote metering.

2.18.3.4 Protective Circuits and Features
The variable speed drive controller shall include the following protective circuits/features:

a) Current limits to 100 percent design by slowing the down motor.

b) Instantaneous electronic trip to automatically shut down the motor if current exceeds 120 percent of design or phase-to-phase output short circuit occurs.

c) The variable speed drive will restart automatically when input line returns to normal in the event of intermittent power outage or phase loss or overvoltage shutdown.

d) Input power protection shuts down the unit on low input line voltage or loss of an input phase.

e) Insensitive to incoming power phase.

f) Fast acting current limiting input fuses, (Class J) rated with 200,000 interrupting amperes capability.

g) Isolated 115 volt control circuit and dedicated control transformer.

h) Line-to-line fault protection.

i) Line-to-ground short circuiting and accidental motor grounding protection.

j) Output thermal overload relay trip.

2.18.3.5 Adjustments
The variable speed drive shall have 0 to 75 percent of minimum speed, and 100 percent of maximum speed, adjustments available via potentiometers located on the faceplate of a single, regulator printed circuit board.

2.19 APPURTENANCES

2.19.1 Dielectric Fittings
Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.19.2 Isolation Joints
Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.19.2.1 Sleeve-type Couplings
Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

2.19.2.2 Split-sleeve Type Couplings
Split-sleeve type couplings shall be used in aboveground installations when approved in special situations, and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.19.3 Valves
Valve diameter shall be equal to the diameter of the pipe in which the valve is located unless otherwise indicated. Valves shall be screw, socket weld, buttweld, sweat, or flange connected, as recommended by the manufacturer. Rated operating conditions shall be 200 F and 125 psig, minimum. Materials of construction shall be aluminum, bronze or stainless steel body, bronze or 316 stainless steel trim, and Viton or PTFE elastomers. Valves shall be marked in accordance with MSS SP-25 to identify the manufacturer, valve sizes, pressure rating, body and seat material.

2.19.3.1 Relief Valve

Relief valve capable of maintaining a constant upstream pressure regardless of the downstream demand shall be provided for each air mover. Valve shall be either ASTM F 1508 angle spring loaded, weighted, or a pilot-operated diaphragm type differential pressure relief valve. Valve shall be rated to relieve the full capacity of the air moving equipment. Valve shall be factory-set to open at a pressure of 125 psi or appropriate vacuum setting, depending upon application location. Valve shall be located within 10 feet upstream of vacuum equipment or downstream of pressure equipment.

2.19.3.2 Unloading Valve

Unloading valve shall be butterfly valve type actuated by the system controls and shall be field adjustable within a minimum range of plus or minus 20 percent. Unloading valve shall be set to relieve 1200 cubic feet/minute at a set gage pressure of 150 psi or a vacuum of 30 inches Hg.

2.19.3.3 Combination Relief and Unloading Valve

Combination relief and unloading valve shall be set to relieve at a set pressure or vacuum.

2.19.3.4 Purge Valve

Each vacuum unit shall be equipped with a manually adjustable, normally closed automatic purge valve. Valve shall be factory-set to open at at the gauge pressure of 0.5 kPa 0.15 inches Hg and shall be field adjustable within a minimum range of plus or minus 20 percent. Valve shall be located within 3.3 feet downstream of vacuum equipment.

2.19.3.5 Vacuum Breaker

Butterfly valve actuated by blower system controls. Vacuum breaker shall be provided to protect blower or vacuum pump from surges. Valve shall be rated to relieve 1.76 cfm at a set gage pressure or vacuum. Materials shall be aluminum, bronze, or stainless steel body, 316 stainless steel trim, and EPR, Viton or Teflon elastomers. Rating shall be 200 degrees F and 125 psi, minimum.

2.19.3.6 Check Valve

Valve shall be a pilot-operated diaphragm valve with auxiliary solenoid operator or butterfly valve actuated by system controls with a closing time of 1 to 5 seconds, located on the discharge side of each air mover. Valve shall prevent reverse flow and shall open at a controlled rate to keep air mover starting surges from shocking downstream equipment. Opening rate shall be adjustable from 5 to 60 seconds.

2.19.3.7 Control Valve

Valve shall be a butterfly valve actuated by system controls.

2.19.3.8 Manual Valves

Manual valves shall be capable of maintaining a constant upstream pressure regardless of the downstream demand. Valve shall be installed at locations indicated on drawing M-1. Valves shall have a minimum temperature rating of 250 F. Vacuum and pressure ratings shall be appropriate for the ball valve location and application.

2.19.4 Inlet and Discharge Elbows

Inlet and discharge elbows shall be of the long sweep type with ASME B16.1, Class 125 flanges.

2.19.5 Expansion Coupling
The inlet and the outlet of each unit shall be provided with flexible expansion couplings of extra heavy gauge rubber, wire reinforced type suitable for temperature range of minus 20 to plus 250 degrees F and pressure range from 15 inches of mercury vacuum to 15 psig.

2.19.6 Heat Exchanger
An air-cooled heat exchanger shall be provided on the blower.

2.19.7 Flame Arrestor
Flame arrestor shall be located immediately upstream of any source of flame.

2.19.8 Drip Trap
Drip trap shall be in accordance with ASTM F 1139.

2.19.9 Air Receiver
Receiver shall be designed for 50 psi working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. Receivers shall be designed and constructed in accordance with ASME BPVC SEC VIII D1 and shall have the design working pressures specified herein. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided. The outside of air receivers shall be galvanized or supplied with commercial enamel finish.

2.20 BASE PLATE
Each unit shall be mounted on all-welded structural steel or cast iron base complete with vibration isolators with published load rating. The base plate shall have vertical jacking screws to facilitate leveling. The entire unit shall be isolated from the building structure.

2.21 WEATHERPROOF ENCLOSURE
A weatherproof enclosure shall be provided for the air moving equipment and motor assembly. The enclosure shall have lockable access doors and shall be louvered for ventilation. The enclosure shall be insulated and equipped with a thermostatically controlled electric heating and ventilation.

2.22 ATTACHMENTS
Shafts, chains or gear driven equipment shall be provided with all-metal guards enclosing the drive mechanism. Guard shall be constructed of galvanized sheet steel, or galvanized woven wire, or expanded metal set in galvanized steel frame. Guards shall be secured in position by steel braces or straps which will permit easy removal for servicing the equipment.

2.23 COATINGS OR FINISHES
Motors, casings and similar parts of equipment finished in the shop shall be cleaned, primed and given two finish coats with paint suitable for the environment in which the unit is to be placed. Ferrous surfaces not painted at the factory shall be given a shop coat of grease or other suitable rust resistant coating.

2.24 FACTORY TESTS
Equipment shall be subject to in-plant shop and quality control inspections before approval for shipment from manufacturer's facilities. Rotating parts of the equipment shall operate throughout the required range without excessive end thrust, vibration or noise.

2.24.1 Integrity
Each impeller assembly shall be tested by being operated at a speed to 20 percent above operating speed and checked for cracks using the dye penetrant method or similar method of equal accuracy.

2.24.2 Balance
Rotating parts shall be statically and dynamically balanced in accordance with ANSI S2.19. First critical speed shall be at least 150 percent of maximum operating speed. Rotating parts shall be statically and dynamically balanced. The shaft and impeller or blade assembly shall be statically and dynamically balanced as a unit. Removing of metal from the impeller or blades by boring is not an acceptable means of balancing the shaft and impeller unit. Impeller or blade assemblies shall be statically and dynamically balanced to within 0.5 percent of W times R squared, where W equals weight and R equals impeller radius.

2.24.3 Deflection
Total shaft peak-to-peak dynamic deflection measured by vibrometer at seal face shall not exceed 5.1 microns 2 mils under the complete range of operating conditions.

2.24.4 Vibration
Peak vibration velocity shall be less than 0.30 inches per second.

2.24.5 Capacity
Volume and pressure characteristics of air moving equipment shall be determined by the manufacturer in accordance with AMCA 210. Certified test results and sample calculation from test readings shall be submitted to the Project Engineer. Where two or more identical units are specified, the capacity of only one representative unit needs to be tested.

2.24.6 Noise
Air moving equipment shall be tested with sound attenuation devices installed by the manufacturer. Certified test results and sample calculation from test readings shall be submitted to the Project Engineer. Where two or more identical units are specified, only one representative unit needs to be tested. Fans shall be tested in accordance with AMCA 300 with results interpreted in accordance with AMCA 301.

2.24.7 Variable Speed Drive
Each variable speed drive shall be subjected to an in-plant quality control inspection. Integrated circuits shall undergo a 160-hour "burn-in" to test reliability. During the "burn-in" the temperature shall be cycled between 32 and 158 degrees F. Each completed unit shall undergo a fully loaded 24-hour "burn-in".

2.24.8 Continuity
Wiring and instrumentation assembled at the factory shall be checked for continuity prior to shipping.

2.24.9 Receivers
Receivers shall be factory air tested to 1.5 times the specified working pressure.

2.24.10 Valve Testing
Relief valves shall be tested in accordance with ASME PTC 25.

PART 3 EXECUTION

3.1 INSTALLATION

Vibration dampener shall be installed in sufficient quantity to isolate each unit from the structural base on which the unit is installed. Each air moving unit and motor shall be installed, aligned and leveled in accordance with the written instruction of the manufacturer and under the direct supervision of the manufacturer's representative or other contractor approved by the Project Engineer. Flexible couplings shall not be used to compensate for misalignment between driver and driven unit. Blower venting shall not violate the provisions of either ACGIH-2092S or AMCA 99.

3.1.1 Concrete Foundations

Concrete for equipment foundations shall be as specified in SECTION 03300 - CAST-IN-PLACE STRUCTURAL CONCRETE. Foundation bolts, as required, shall be furnished for proper positioning during the placement of the concrete.

3.1.2 Seismic Requirements

Equipment and attached valves shall be supported using a seismic restraint set to resist seismic loads. Seismic load requirements are further specified under SECTION 13080 - SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

3.1.3 Detailed Drawings

The Contactor shall submit detailed drawings including location of components, layout and anchorage of equipment and appurtenances, equipment relationship to other parts of the work, clearances for maintenance and operation. Drawings shall be to the approved scale.

3.1.4 Detailed Process Flow Diagrams

The Contractor shall submit detailed process flow diagrams and data including, but not limited to: air and off-gas stream flows, direction of flow, range of flow rate and range of composition, identified by lines and arrows denoting the direction and destination of the flow; material, mass and energy balances for the entire air and off-gas system; subsystem equipment, operating capacity and operating conditions; blowers and pumps, valves and other in-line devices; sizes of conveying devices (pipe, ducts, etc.); number of parallel components or lines.

3.1.5 Piping and Instrumentation Diagram

The Contractor shall submit a piping and instrumentation diagram indicating: process equipment; instrumentation; piping and valves; stacks, vents and dampers; control equipment (including sensors, process controllers, control operators, valves, interlocks, and alarms); labels and other necessary information to correlate to the process flow diagram. The P&ID shall include blowers and pumps, valves and other in-line devices.

3.2 FIELD PAINTING

Stainless steel, galvanized steel, and nonferrous surfaces shall not be painted.

3.3 TESTING

3.3.1 Deficiencies

If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests shall be reconducted.

3.3.2 Correct Installation

Tests shall assure that the units and appurtenances have been installed correctly, there is no objectionable heating or vibration, noise from any part is not excessive, and manual and automatic controls function properly.

3.3.3 Field Equipment Test

After installation of the air moving units and appurtenances is complete, operating tests shall be carried out to ensure that the installation operates properly. The Contractor shall make arrangements to have the manufacturer's representative present when field equipment tests are made. Each unit shall be given a running field test in the presence of the Project Engineer, Construction Manager, or QC Engineer for a minimum of 4 hours at its rated capacity or at the point of maximum power requirement indicated on the head-capacity curve or selected point on the curve. The Contractor shall provide an accurate and acceptable method of measuring the discharge flow and pressure.

3.3.4 Noise Suppression

Sound level shall be less than 80 dB measured at 5 feet from the source.

3.4 MANUFACTURER'S FIELD SERVICES

The Contractor shall obtain the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installing, adjusting, and testing of the equipment.

3.5 POSTING FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams shall be posted where directed. Condensed operating instructions shall be posted as specified.

3.6 FIELD TRAINING

The Contractor shall conduct a field training course for designated operating, maintenance and supervisory staff members. Training shall be provided for a total period of 16 hours of normal working time or as directed by the Project Engineer and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover the items contained in the operating and maintenance instructions.

END OF SECTION

SECTION 11225

LIQUID PHASE ACTIVATED CARBON ADSORPTION UNITS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION(AWWA)
AWWA B600 (1996) Powered Activated Carbon
AWWA B604 (1996) Granular Activated Carbon
AWWA B605 (1999) Reactivation of Granular Activated Carbon
AWWA C504 (2000) Rubber-Seated Butterfly Valves
AWWA C700 (2002) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C701 (2002) Cold-Water Meters - Turbine Type, for Customer Service
AWWA D100 (1996) Welded Steel Tanks for Water Storage
AWWA D102 (2003) Coating Steel Water-Storage Tanks
AWWA D120 (2002) Thermosetting Fiberglass-Reinforced Plastic Tanks
AWWA EWW (1998) Standard Methods for the Examination of Water and Wastewater

ASME INTERNATIONAL (ASME)
ASME B1.1 (2001; R 2003) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B40.100 (2000) Pressure Gauges and Gauge Attachments
ASME BPVC SEC VIII D1 (2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 – Basic Coverage

ASTM INTERNATIONAL (ASTM)
ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M (2004) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 312/A 312M (2004b) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 530/A 530M (2004a) General Requirements for Specialized Carbon and Alloy Steel Pipe
ASTM A 666 (2003) Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM D 1785 (2004a) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 1998 (1997) Polyethylene Upright Storage Tanks
ASTM D 2241 (2004b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2652 (1994; R 1999) Activated Carbon
ASTM D 2854 (1996; R 2000) Apparent Density of Activated Carbon
ASTM D 2862 (1997; R 2004) Particle Size Distribution of Granular Activated Carbon
ASTM D 3299 (2000) Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
ASTM D 3860 (1998; R 2003) Determination of Adsorptive Capacity of Activated Carbon by Aqueous Phase Isotherm Technique
ASTM D 4607 (1994; R 1999) Determination of Iodine Number of Activated Carbon
ASTM D 5158 (1998) Determination of the Particle Size of Powdered Activated Carbon by Air Jet Sieving
ASTM D 5421 (2000) Contact Molded "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Flanges
ASTM E 1067 (2001) Acoustic Emission Examination of Fiberglass Reinforced Plastic Resin (FRP) Tanks/Vessels

ASTM F 593 (2002e2) Stainless Steel Bolts, Hex Cap Screws, and Studs

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
MSS SP-70 (1998) Cast Iron Gate Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA ICS 1 (2000) Industrial Control and Systems: General Requirements
NEMA ICS 6 (1993; R 2001) Industrial Control and Systems: Enclosures
NEMA MG 1 (2003; R 2004) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 70 (2005) National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
29 CFR 1910 Occupational Safety and Health Standards

1.2 UNIT PRICES

Payment for water treated will be as described in the Payment Schedule of the Bid Form. Unit payment for each modular activated carbon unit will include delivery, installation and placement in service. Unit payment for reactivation and replacement of the activated carbon will include placement of the spare unit in service, disconnection of the exhausted unit, drainage and treatment of the free water, transport of the activated carbon to and from reactivation facility, reactivation and replacement of the activated carbon and placement of the fresh carbon filled unit in the spare position.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Adsorption Battery Components
Backwash System
Carbon Storage and Transfer System

Process flow diagrams and instrumentation diagrams(s) showing all major pieces of process equipment with controls. Drawings shall contain complete piping, wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. Drawings shall show shop and erection details, including cuts, copes, connections, holes, bolts, and welds.

SD-03 Product Data
Activated Carbon Adsorption Units

a. List of Federal, State, and local laws, regulations, and permits concerning activated carbon adsorption units that are applicable to operations and the requirements imposed by those laws, regulations, and permits.

b. Instrumentation and controls; capacities and pressure drop; make and model; complete list of equipment and materials, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts; and installation instructions.

c. Structural calculations for the adsorber shells, tanks and mounting and support details.

d. Designs for foundations, footings and supports.

e. A complete list of parts, supplies and recommended spare parts for each different item of material and equipment specified, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after one and three year(s) of service.

Activated Carbon; G
Iodine number; isotherm and column test data. Design calculations indicating removals of each of the listed compounds in the carbon bed. Reports of testing granular activated carbon in accordance with AWWA B604.

Material Safety Data Sheet
Material safety data sheet in conformance with 29 CFR 1910 Section 1200(g) for activated carbon.

Adsorption Battery Components; G
Demonstration of, or design calculations for, the total head loss through the carbon, adsorbers and appurtenant piping.

Posting Framed Instructions
Wiring and control diagrams, systems layouts and isometrics, instructions, and other sheets, prior to posting. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed and posted beside the diagrams.

Delivery, Storage, and Handling
Instructions for any required sampling, preparation and shipping of activated carbon to reactivation or disposal facility.

Discharge
Reports for discharge permit compliance.

SD-06 Test Reports
Activated Carbon
Adsorption Battery components
Backwash System
Carbon Storage and Transfer System

Test reports in booklet form showing all tests performed to demonstrate compliance with the specified performance criteria, upon completion and testing of the system.

SD-07 Certificates
Activated Carbon

Manufacturer's certificates, including the name and address of the production facility, attesting that the activated carbon furnished meets the specified requirements. Certification of the activated carbon [supplier] [transporter] [reactivation facility in accordance with AWWA B605]. Copies of the Department of Transportation licenses of carbon reactivation service.

Equipment
Verification from a Registered Professional Engineer, licensed to practice mechanical or structural engineering, as appropriate, in the State in which the system was fabricated, stating that: 1) The fabrication drawings and pressure calculations for the shells and tanks were designed for the listed conditions in accordance with the appropriate codes and standards. 2) The erection drawings for the shell and tank foundations and supports were designed for the listed conditions in accordance with the appropriate codes and standards.

Motors
Manufacturer's certificates attesting that the motors meet the specified requirements.

SD-10 Operation and Maintenance Data
Activated Carbon Adsorption System

Submit Operation and Maintenance Data. Removal and replacement instructions shall include handling and reactivation of spent activated carbon in accordance with AWWA B605. Preventive maintenance plan and schedule shall include routine recommended chemical preventive measures for handling contaminant/biofouling of the carbon adsorption unit under conditions of the application including strong acid/alkali/alternative chemical soaks and instructions for storage and handling of treatment chemicals and waste products.

1.4 ACTIVATED CARBON ADSORPTION UNITS

The activated carbon adsorption system shall be a complete unit process for removal of organic and inorganic contaminants from water as specified herein. Equipment shall include, but shall not be limited to, vessels containing activated carbon, supporting equipment and accessories. Terminology shall be in conformance with ASTM D 2652.

1.4.1 Design Requirements

Seismic details shall be in accordance with Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT as shown on the drawings.

Minimum design life, modular unit: 5 years.
Minimum design life, other equipment: 5 years

Adsorption system dimensions:
 Maximum vertical projection: 11 ft.
 Maximum ground surface coverage: 6 by 6 ft.

Soil bearing capacity: 2000 psf

Seismic zone: 4
Wind speed (maximum): 100 mph

Ambient air temperature:
Maximum: 110 degrees F
Minimum: 40 degrees F

1.5 QUALIFICATIONS

1.5.1 Regulatory Requirements

Pressure rated adsorption shells shall bear the ASME BPVC SEC VIII D1 code stamp.

1.5.2 Contractor

Contractor shall have had a cumulative minimum of 2 years of experience in the construction of water treatment plants, wastewater treatment plants, industrial wastewater treatment plants, or industrial wastewater pretreatment plants.

1.5.3 Single Source Supplier

Full responsibility for the furnishing of the adsorption system shall be assigned to a single supplier. The designated single supplier, however, need not manufacture the system but shall coordinate the selection, assembly, installation, and testing of the entire system as specified herein.

1.5.4 Manufacturer's Representative

Services of a manufacturer's field service representative who is experienced in the installation, adjustment, and operation of the equipment furnished and who has complete knowledge of the proper operation and maintenance of the system shall be provided.

1.5.5 Welding

Welding qualifications of welding procedures, welders, and welding operators shall be in accordance with Sections 8.2 and 8.8 of AWWA D100.

1.5.6 Reactivation Facility

Qualifications of reactivation facility procedures and operation shall be in accordance with AWWA B605.

1.6 GENERAL REQUIREMENTS

Materials and equipment shall be new and unused with the exceptions noted for reprocessed activated carbon, reprocessed materials and modular treatment units. An estimate or analysis of the pre-existing "heel" and the nature of any residual will be provided with the supply documentation if reprocessed carbon is to be supplied. The Contracting Officer will have the option to refuse delivery of reprocessed carbon if, in the opinion of the Contracting Officer, the quality might interfere with accomplishment or verification of the treatment.

1.6.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Materials and equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.6.2 Nameplates

Adsorption shells, pumps and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

1.6.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.7 DELIVERY, STORAGE, AND HANDLING

Materials and each chemical delivered to the site shall be accompanied by a copy of the material safety data sheet.

1.7.1 Granular Activated Carbon

Granular activated carbon for potable water treatment shall be packaged, marked, and shipped in accordance with AWWA B604, AWWA B604 and AWWA B605.

1.7.2 Powdered Activated Carbon

Powdered activated carbon for potable water treatment shall be packaged, marked, and shipped in accordance with AWWA B600.

1.7.3 Equipment and Accessories

Equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.8 SEQUENCING AND SCHEDULING

Sampling and analyses to demonstrate system performance and effluent compliance shall be performed in accordance with requirements developed in compliance with Section 01450 CHEMICAL DATA QUALITY CONTROL.

PART 2 PRODUCTS

2.1 MEDIA

2.1.1 Activated Carbon
Material shall be free from impurities that affect the serviceability and appearance of the finished product. Activated carbon shall not require dosing or addition of a chemical mixture or solution to the water to be treated or to the water used for backwashing. The following quantity:
3000 pounds of processed and graded activated carbon shall be furnished for groundwater treatment. Material shall conform to the following:

a. Adsorptive capacity, iodine number as determined by ASTM D 4607, not less than 1,100 milligrams per gram.

b. Apparent density, as determined by ASTM D 2854 or ASTM D 5158, 25 to 37 lb. per cu. ft., corrected for moisture.

c. Effective size 0.14 to 0.5 inches and uniformity coefficient not greater than 2.1 as determined by ASTM D 2862, with the following gradation:

Sieve No. 8 90% passing.
Sieve No. 12 85% passing.
Sieve No. 30 4% percent passing.
Sieve No. 40 4% passing.
Sieve No. 50 4% passing.

2.1.2 Powdered Activated Carbon
Powdered activated carbon for potable water service shall conform to AWWA B600.

2.1.3 Granular Activated Carbon
Granules shall be clean and hard.

2.1.3.1 Potable Water Service
Granular activated carbon for potable water service shall conform to AWWA B604 and AWWA B605, as appropriate.

2.1.3.2 Waste Water Service
Granular activated carbon for waste water service shall be of a type suitable for reactivation and supported by services for transportation of shell and spent carbon and reactivation of spent carbon. Documentation and copies of licenses shall be furnished to the Contracting Officer.

2.2 ADSORPTION BATTERY COMPONENTS
Adsorption battery shall consist of 2 units. Performance specified shall refer to each unit and not to the battery as a whole. Adsorption unit shall be a downflow liquid adsorption unit, having a capacity to treat 150 gpm of water.

2.2.1 Head Loss
Head loss in each unit at rated flow shall not exceed 8 psig when filled with fresh media.

2.2.2 Adsorption Shell
Each adsorber shell shall have a minimum height of 8 feet.

2.2.2.1 Permanent Units
Adsorption shells not equipped with an open vent or overflow shall be steel, designed, fabricated, and erected in accordance with ASME BPVC SEC VIII D1 for a maximum pressure of 75 psi and shall be so stamped. Adsorption shells equipped with an open vent or overflow may be fiberglass or polyethylene. Fiberglass shells shall be in accordance with AWWA D120 or with ASTM D 3299 with nozzle flanges in accordance with ASTM D 5421. Polyethylene shells shall conform to ASTM D 1998. Steel shell and both sides of false bottom shall be lined with nontoxic epoxy, vinyl ester or rubber. Shell shall have supports of cast-iron or steel. Supporting structures and shells shall be fabricated for the seismic and wind loads listed in the design requirements, plus live and dead loads of the shell full of water.

2.2.2.2 Connections
A vent and a rupture disc shall be provided on the influent of each adsorber. Each adsorber shall have provisions for carbon fill and removal and with permanent connections for water inlet, outlet, and backwash.

2.2.2.3 Openings
Each shell shall be provided with an access opening 11 x 15 inches or larger. Openings shall be provided with closure and positive seal adequate for the tank pressure rating.

2.2.2.4 Hardware
Bolts and attaching hardware shall be stainless steel, conforming with ASTM F 593.

2.2.3 Collection/Underdrain System
Underdrain system within the shell for collecting treated water shall be as specified below and shall distribute the backwash water uniformly over the entire bed cross-section at velocities that will prevent channeling of the carbon bed. Under actual operating conditions the activated carbon shall not be washed out of the apparatus regardless of the change of demand rate up to the maximum on the apparatus.

2.2.3.1 Nozzle Type
A collector/backwash nozzle shall be provided.

2.2.3.2 Deflector-Plate Type
Deflector-plate type shall be steel and nontoxic epoxy lined, fastened to the bottom of the shell, and arranged for discharge through radial slots. Pipe connections for treated water outlet or backwash inlet shall be on the underside between the deflector and the shell bottom.

2.2.3.3 False Bottom Type
False bottom type shall consist of a false bottom with attached strainers. Strainers and fasteners shall be stainless steel.

2.2.3.4 Header-Lateral-Distributor Head Type
Header-lateral-distributor head type shall consist of a circular, square or branched manifold or header, connected to laterals provided with strainer heads or strainers with openings placed radially so as to discharge horizontally or downward. Headers and laterals shall be polyvinyl chloride, conforming to ASTM D 1785 or ASTM D 2241. Strainer heads and strainers shall be manufactured of materials compatible with the header-lateral system, and shall be polyethylene, polypropylene, polyvinyl chloride or stainless steel. Laterals and strainer heads, after being placed, shall not protrude into the header or laterals. System shall be supported by a steel plate or steel angles conforming to ASTM A 666 with nontoxic epoxy linings or by concrete fill or directly on the bottom of the shell.

2.3 MODE OF OPERATION

2.3.1 Serial Operation
Each unit shall have valves on the influent, effluent and backwash connections to allow any unit to operate and function as the lead or lag unit or stand-by as required.

2.3.2 Parallel Operation
Each of the parallel units shall have valves on the influent, effluent and backwash connections adequate to allow the unit to be taken out of service to backwash or change out the activated carbon in the unit without affecting the operation of the other units.

2.3.3 Parallel or Serial Operation
Units designated for use in either series or parallel operation shall have valves on the connections that allow switching between modes of operation without disconnecting any of the piping.

2.4 DIFFERENTIAL PRESSURE SENSOR
Differential pressure sensor shall be capable of measuring plus or minus 5 percent variation in the pressure drop across the media. Sensor shall be equipped with necessary wiring and controls for automatic backwashing or an alarm device to give notice when the pressure differential exceeds the set point.

2.5 INTERLOCKS AND ALARMS
Interlock system shall be provided to prevent backwashing of more than one unit at a time and to prevent backwashing when the waste backwash tank capacity is inadequate to contain an additional backwash.

2.6 PRESSURE GAUGES AND SAMPLING COCKS

2.6.1 Pressure Gauges
Pressure gauges connected to the influent and effluent to indicate the pressure loss through the adsorber and its pipe, valve, and fitting assembly shall be furnished for each adsorption unit. Gauges shall be precision type with bronze Bourdon tube and phenolic case and an accuracy of plus or minus 1/2 percent conforming to ASME B40.100.

2.6.2 Sampling Cocks and Valves
PVC, ground key, lever handle, faucet type sampling cocks or ball valves shall be provided upstream of the adsorbers and on the downstream side of each unit for sampling the influent and the effluent of each of the individual adsorbers.

2.7 VALVES
Design of the valve operators and mechanisms shall avoid initial surges and sudden inrushes of influent or backwash by gradually allowing flows to increase as ports are opened. A dial pointer shall indicate each step of the operation.

2.7.1 Butterfly Valves
Butterfly valves 3 through 72 inches shall conform to AWWA C504.

2.7.2 Gate Valves
Gate valves less than 3 inches in diameter shall be bronze with screwed ends, conforming to MSS SP-70 and valves 3 inches or larger shall conform to AWWA C509. Valves shall open counter clockwise, and the operating wheel shall have an arrow, cast in the metal, indicating the direction of opening.

2.7.3 Package-Type Valve Nest

Package-type valve nest shall consist of a pilot valve connected with fittings as may be required to each one of a nest of valves hydraulically or pneumatically operated. Nest of valves shall have connections to raw water inlet, treated water outlet, backwash inlet and outlet, and activated carbon refill inlet and outlet.

2.7.4 Ball Valves

Full port stainless steel ball valves shall be provided on carbon fill and discharge lines.

2.8 ISOLATION JOINTS

2.8.1 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.8.2 Isolation Joints

Isolation joints shall be installed between nonthreaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a sandwich-type flange isolation gasket of the dielectric type, isolation washers, and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.8.2.1 Sleeve-type Couplings

Sleeve-type couplings shall be used for joining plain end pipe sections. The two couplings shall consist of one steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

2.8.2.2 Split-sleeve Type Couplings

Split-sleeve type couplings may be used in aboveground installations when approved in special situations and shall consist of gaskets and a housing in two or more sections with the necessary bolts and nuts.

2.9 PIPE AND FITTINGS

Pipe hangers and supports shall be in accordance with Section 15400 PROCESS PIPING. Pipe, valves and fittings for liquids shall be in accordance with Section 15400 PROCESS PIPING. Pipe, valves and fittings for compressed air shall be in accordance with Section 15400 PROCESS PIPING.

2.10 BOLTS, NUTS, AND FASTENERS

Bolts, anchor bolts, nuts, washers, plates, bolt sleeves, and all other types of supports necessary for the installation of the equipment shall be furnished with the equipment and shall be galvanized unless otherwise indicated. Where indicated, specified, or required, anchor bolts shall be provided with square plates at least 4 by 4 by 3/8 inch thick or shall have square heads and washers and be set in the concrete forms with suitable sleeves. Expansion bolts shall have malleable-iron and lead composition elements. Unless otherwise specified, stud, tap, and machine bolts shall be of refined bar iron. All threads shall conform to ASME B1.1. Bolts, anchor bolts, nuts, and washers specified to be galvanized, shall be zinc coated, after being threaded, by the hot-dip process in conformity with ASTM A 123/A 123M or ASTM A 153/A 153M. Bolts, anchor bolts, nuts, and washers indicated to be stainless steel shall be Type 316 stainless steel.

2.11 ELECTRICAL WORK

Hazard classifications indicated on the drawings shall be implemented in accordance with NFPA 70. Electrical work shall be in accordance with SECTION16050N BASIC ELECTRICAL MATERIALS AND METHODS.

2.11.1 Motors

Electrical motor-driven equipment shall be provided complete with starters and alternating current motors conforming to NEMA MG 1. Fractional horsepower electric motors shall be single-phase 115-volt, single-phase, 60 cycle. Integral horsepower electric motors shall be three-phase, 60 cycle. Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for the motor specified. Each motor shall be designed for operation in a 104 degree F ambient temperature.

2.11.2 Controls and Panels

Manual or automatic controls and protective or signal devices required for the operation specified, and any control wiring required for controls and devices shall be provided. Motor controls shall conform to NEMA ICS 1. Enclosures for power and control panels shall conform to NEMA ICS 6.

2.12 SPECIAL TOOLS

For each type of equipment furnished special tools necessary for adjustment, operation, maintenance, and disassembly shall be provided; a lever type grease gun or other lubricating device for each type of grease required; and one or more steel cases mounted on the wall complete with flat key locks, two keys, and clips or hooks to hold each tool in a convenient location. Tools shall be high-grade, smooth, forged, alloy, tool steel.

2.13 STORAGE TANKS

Each tank shall be fabricated from steel conforming to ASTM A 666 not less than 3/16 inch thick, lined with enamel, or of fiber glass filament-wound reinforced plastic construction, conforming to ASTM D 3299.

2.14 FACTORY TESTS

The adsorption system equipment shall be assembled in the shop to the maximum practical extent. A factory pressure test shall be made at 125 percent of the rated pressure of the equipment. Fiberglass tanks shall be examined in accordance with ASTM E 1067. Test reports shall be furnished to the Contracting Officer prior to shipment of the equipment.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION
Each adsorber shell or tank shall be anchored to a footing isolated from the floor slab or mounted on a skid base. Anchor brackets, anchor rods or straps shall be provided to hold the shell to anchors in the footing. Skids shall be fabricated from [steel channels and shall be designed to support the equipment and to distribute the weight in transit and in service filled with water without point loading on the tank or concrete slab.

3.2 PIPE, VALVES, FITTINGS AND APPURTENANCES
Installation of piping including cleaning, cutting, threading and jointing, shall be in accordance with Section 15400 PROCESS PIPING. Differing metals shall be provided with isolation devices.

3.2.1 Strainers
Strainer heads and strainers shall be protected while concrete fill provided for support of the header-lateral-distributor head is being placed.

3.3 ELECTRICAL WORK
Electrical work shall be as specified in Section 16050N BASIC ELECTRICAL MATERIALS AND METHODS.

3.4 TRANSFER

3.4.1 Onsite
Spent media shall be unloaded from and new media loaded in permanently mounted adsorbers.

3.4.2 Offsite Reactivation of Modular Units
Modular units shall be removed from service, disconnected from the permanent piping, drained of free water and returned to the supplier for reactivation.

3.5 TOOLS
Tools shall be delivered at the same time as the equipment and handed over on completion of the work.

3.6 PAINTING/CORROSION PREVENTION
All ferrous surfaces shall be coated or painted.

3.6.1 Exterior Surfaces
Factory primed surfaces shall be solvent-cleaned before painting. Surfaces that have not been factory primed shall be prepared and primed in accordance with the paint manufacturer's recommendations. Color shall be as indicated on the paint schedule or as otherwise approved.

3.6.2 Interior Surfaces
Tank interior surfaces shall be coated with the coating conforming to Section 3.2, 3.3, 3.4, 3.5, 3.6, or 3.7 of AWWA D102. System of three coats, 3.9 - 5.9 mils dry film thickness (DFT) per coat, for total of 11.7 - 17.7 mils minimum DFT.

3.6.3 Touch-Up Painting
Factory painted items shall be touched up as needed. Factory painted items requiring touching up in the field shall be thoroughly cleaned of all foreign material, primed and top-coated with the manufacturer's standard factory finish.

3.6.4 Field Painting
Equipment which did not receive a factory finish shall be painted.

3.6.5 Corrosion Resistant Metals
Painting of corrosion resistant materials such as copper, brass, bronze, copper-nickel, and stainless steel is not required unless otherwise specified.

3.7 MANUFACTURER'S SERVICES

3.7.1 Manufacturer's Representative
Services shall be provided by a representative of the manufacturer who is experienced in the installation, adjustment, and operation of the equipment specified. The representative shall supervise the installing, adjusting, and testing of equipment.

3.7.2 Field Training
The Contractor shall conduct a training course for designated operating, maintenance and support staff members. The training period, for a total of 16 hours of normal working time, shall start after the system is functionally completed but prior to final acceptance tests. Field training shall cover each item contained in the operating and
maintenance data.

3.8 TESTS
All products shall be carefully inspected for defects in workmanship and material; debris and foreign matter shall be cleaned out of valve openings and seats; all operating mechanisms shall be operated to check their proper functioning; and all nuts and bolts shall be checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced.

3.8.1 Hydrostatic Tests
After installation, all tanks shall be tested for water tightness. Testing plugs or caps, all necessary pressure pumps, pipe connections, gauges, other equipment, and all labor required shall be included. Test pressures shall be as indicated in the schedule. Piping systems shall be isolated from the tanks for pressure testing at the specified test pressures.

3.8.2 Performance Tests
After installation of the activated carbon adsorption system, operating tests shall be carried out to assure that the system operates properly. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests repeated. Eachadsorption unit shall be put through a complete cycle of operation at a constant flow rate for the capacity test. A complete log of each test run shall be made, giving the following data: date, time of readings and sampling, total backwash, and total water treated. Total organic carbon removed shall be determined by analyses of the influent at such intervals as will give a representative organic carbon content. When the required quantity of water has been run through the adsorber, samples shall be taken of the effluent for analysis. Results of the tests shall be used in determining the capacity and performance of the adsorption unit.

3.8.3 Liquid Sampling and Analyses
Influent and effluent samples shall be collected, marked, preserved and analyzed in accordance with the requirements of Section 01450 CHEMICAL DATA QUALITY CONTROL.

3.8.4 Activated Carbon Sampling and Analyses
Sampling and analyses of the activated carbon media shall be performed in accordance with requirements for spent carbon transport and requirements of AWWA B605 and of the

reactivation facility

3.8.5 Discharge

During the capacity test, treated water shall stored as necessary to maintain the required flow rate.

3.8.6 Utilities

The obtaining of water, electric power and other utility items as well as the disposal of water drainage are the responsibility of the Contractor.

3.9 POSTING FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams showing the complete layout of the system shall be posted where directed. Condensed operating instructions shall be posted beside the diagrams.

END OF SECTION

SECTION 11226

VAPOR PHASE ACTIVATED CARBON ADSORPTION UNITS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
ASHRAE Fundamentals Handbook (2001) Fundamentals Handbook

ASME INTERNATIONAL (ASME)
ASME B40.100 (2000) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)
ASTM D 2652 (1994; R 1999) Activated Carbon
ASTM D 2854 (1996; R 2000) Apparent Density of Activated Carbon
ASTM D 2862 (1997; R 2004) Particle Size Distribution of Granular Activated Carbon
ASTM D 2866 (1994; R 2004) Total Ash Content of Activated Carbon
ASTM D 2867 (2004) Moisture in Activated Carbon
ASTM D 3802 (1979; R 1999) Ball-Pan Hardness of Activated Carbon
ASTM D 4607 (1994; R 1999) Determination of Iodine Number of Activated Carbon
ASTM D 5228 (1992; R 2000) Determination of the Butane Working Capacity of Activated Carbon

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)
SMACNA HVACTAB (2002, 3rd Ed) HVAC Systems - Testing, Adjusting and Balancing

1.2 SUBMITTALS

Government approval is required for submittals having a "G" designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Vapor Phase Activated Carbon Adsorption Units; G
Drawings showing complete equipment layout, piping, wiring and schematic diagrams, manufacturer's description and technical literature, performance charts, catalog cuts and installation instructions and any other details required to show equipment relationships, clearances for maintenance and operation and to demonstrate that the system has been coordinated and will properly function as a unit. Process flow diagrams and instrumentation diagrams showing all major pieces of process equipment with controls. Details on the carbon adsorber construction materials and structural and supporting design calculations.

SD-03 Product Data
Emissions
Reports for emissions permit compliance.

Vapor Phase Activated Carbon Adsorption Units; G
Instrumentation and controls; capacities and pressure drop; make and model; complete list of equipment and materials, including manufacturer's descriptive and technical literature; spare parts data; performance charts and curves; catalog cuts; and installation instructions. Design calculations or computer modeling results for vapor phase carbon adsorption system indicating removals of each of the organic compounds listed. Demonstration of, or design calculations for, the total head loss through the carbon unit. Isotherm and design calculations or manufacturer's computer models shall be provided to estimate the mass of carbon required and the breakthrough curves. Calculations showing how the vapor phase carbon adsorption system functions with the entire air/gas system including carbon vessel, instrumentation and controls, dimensions, capacities, make and model, materials of construction, coating systems, pressure drop through each component of the system, including line sizing, valving, pressure and temperature gauges. Structural calculations for fabrication and erection drawings if requested (not needed for drum/canister applications). A complete list of parts, supplies, special tools, instruments and accessories and special lifting and handling devices required for periodic maintenance, repair, adjustment and calibration and recommended spare parts for each different item of material and equipment specified, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after one and three years of service.

Vapor Phase Activated Carbon; G
Type of activated carbon, with isotherms for the selected carbon, with each of the volatile organic compounds listed in the effluent requirements for the anticipated temperature range at 50 percent relative humidity. Design calculations or vendor computer models shall be used to estimate the mass of carbon required and the breakthrough curves for the listed organic compounds in the carbon bed.

Posted Framed Instructions; G
Framed and other instructions, containing wiring and control diagrams and condensed operating instructions.

SD-06 Test Reports
Field Quality Control
Reports on tests performed to show compliance with instructions.
Test reports shall include all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria. Each test report shall indicate the final position of all controls. Performance test data shall be reflected in the operating instructions.

SD-07 Certificates
Vapor Phase Activated Carbon
Manufacturer's certificates attesting that the activated carbon furnished meets the specified requirements. Copies of certificate from system supplier showing that the equipment has been tested and has passed all quality control criteria. Certification of the activated carbon supplier or regeneration facility.

Vapor Phase Activated Carbon Adsorption Units
Verification from a Registered Professional Engineer, licensed to practice mechanical or structural engineering, as appropriate, in the State in which the system is to be installed/fabricated stating that: 1) The fabrication drawings and pressure calculations for the vessels were done for the site conditions in accordance with the appropriate codes and

standards. 2) The erection drawings for the shells and tank foundations and supports were done for the site conditions in accordance with the appropriate codes and standards.

SD-10 Operation and Maintenance Data
Operating and Maintenance Manuals; G
Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include layout, wiring, and control diagrams of the system as installed. The manufacturer's name, model number, service manual, parts list, brief description of all equipment and their basic operation features, and operating instructions for each piece of equipment and bulletins, cut sheets and descriptive data. Six complete copies of maintenance instructions listing routine preventative maintenance procedures, possible breakdowns and repairs, and trouble shooting guides list showing lubricants for each item of mechanical equipment, approximate quantities needed per year and recommended lubrication intervals.

1.3 SYSTEM DESCRIPTION

The vapor phase activated carbon adsorption system shall be a complete once-through forced flow system. The system shall be capable of reducing the levels of the listed organic contaminants to the values shown in paragraph Performance Requirements. The unit shall be filled with granular activated carbon for removal of organic contaminants from soil vapor extraction. Equipment shall include, but shall not be limited to, vessels containing activated carbon, supporting equipment and accessories. Terminology is in conformance with ASTM D 2652. The system shall be complete with 2 carbon vessels in series, activated carbon, blowers, instruments, controls, valves, piping, pre-heater/cooler and other specified appurtenances. The piping shall be arranged as shown on the drawings to allow either of the 2 units to serve as the primary unit and shall also allow any unit to operate alone while the other units are being emptied and refilled with fresh carbon.

1.3.1 Design Requirements

The following requirements shall be met:

a) Minimum equipment design life: 5 years.

b) Vessel type: replacement.

c) Adsorption system design requirements:

    1) Maximum vertical projection: 11 ft.

    2) Maximum ground surface coverage per vessel: 8.5 by 8.5 ft.

d) Seismic zone: 4

e) Wind speed (maximum): 100 mph.

f) Ambient air temperature:

    1) Maximum: 100 degrees F.

    2) Minimum: 32 degrees F.

1.4 QUALIFICATIONS

1.4.1 Contractor

The Contractor shall have a minimum of 2 years experience in the construction, startup and operation of industrial air pollution control devices 2 vapor phase carbon adsorption units in the past 5 years.

1.4.2 Single Source Supplier

The Contractor shall assign to a single supplier full responsibility for furnishing of the activated carbon system. The designated single supplier, however, need not manufacture the system but shall coordinate the selection, assembly, installation, and testing of the entire adsorption system, including preheater, the blower and ductwork specified in other Sections. The supplier shall have been in the business of manufacturing, fabricating or installing these systems for a minimum of 2 years.

1.4.3 Carbon Vessel Fabricator

The Contractor shall have a Registered Professional Engineer, licensed to practice mechanical or structural engineering, as appropriate, in the State in which the system is to be installed verify that: 1) The fabrication drawings and pressure calculations for the vessels and appurtenances were done for the site conditions in accordance with the appropriate codes and standards. 2) The erection drawings for the shells and tank foundations and supports were done for the site conditions in accordance with the appropriate codes and standards.

1.5 GENERAL REQUIREMENTS

1.5.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Materials and equipment shall be supported by a service organization that is located within reasonable vicinity of the site.

1.5.2 Nameplates

Major equipment items such as adsorption vessels, blowers and motors shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

1.5.3 Verification of Dimensions

The Contractor shall, after becoming familiar with the details of the work, verify all dimensions in the field, and shall advise the EPA of any discrepancies before performing the work.

1.5.4 Operation

The system shall be designed to operate continuously, 24 hours per day, 7 days per week.

1.6 DELIVERY, STORAGE AND HANDLING

Parts shall be preassembled to the largest extent possible, compatible with transportation limitations and equipment protection considerations. Field assembly, if any, shall require merely bolting together of match-marked components. Equipment shall be crated and delivered to protect against damage during shipping. Flange faces shall be protected from damage. All openings shall be covered to prevent entrance of dirt, water and debris. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed and until the units and equipment are ready for operation. Finished iron or steel surfaces shall be properly protected to prevent rust and corrosion. All equipment delivered and placed in storage shall be stored with protection from the weather (humidity and temperature), dirt and dust, and other contaminants.

1.7 SPARE PARTS

Within 30 days of approval, the Contractor shall furnish a spare parts list for each different item of material and equipment specified with the shop drawings submitted. The list shall include parts, supplies, prices and sources schedule. The Contractor shall furnish those spare parts and special tools which are recommended by the manufacturer. The Contractor shall also provide 12 months supply of any expendable items and frequently replaced parts, except for carbon, as identified by the manufacturer.

1.8 DESIGN CALCULATIONS

Before initiation of construction the Contractor shall supply a copy of all the design calculations to the Project Engineer or Construction Manager.

PART 2 PRODUCTS

2.1 VAPOR PHASE ACTIVATED CARBON

Material shall conform to the following:

a) The initial charge of carbon shall be virgin carbon. Subsequent charges may be regenerated carbon.

b) The carbon adsorption system shall be capable of reducing emissions for individual compounds to below the limits specified in SYSTEM DESCRIPTION.

c) Approximate average volatile organic composition of the vapor stream shall be based on estimated influent component levels as specified in SYSTEM DESCRIPTION.

d) Minimum butane working capacity of new activated carbon of 23.5 percent by weight shall be as determined by ASTM D 5228.

e) Minimum iodine number of virgin or reactivated carbon of 1000 shall be as determined by ASTM D 4607.

f) Maximum moisture content of 2 percent by weight shall be as determined by ASTM D 2867.

g) Maximum total ash content of 10 percent by weight shall be as determined by ASTM D 2866.

h) Minimum hardness number of 90 necessary for the required life in vapor phase applications shall be as determined by ASTM D 3802.

i) Activated carbon particle size shall be uniform for consistent pressure drop characteristics. Maximum particle size shall be 0.2 inch diameter as determined by ASTM D 2862.

j) The granular activated carbon shall be of the type that can be accepted for offsite regeneration of the spent activated carbon by an approved carbon regeneration facility.

k) Minimum apparent density of 0.45 g/cc shall be as determined by ASTM D 2854.

l) Material shall be free from impurities that affect the serviceability and appearance of the finished product.

2.2 VAPOR PHASE ACTIVATED CARBON ADSORPTION UNITS

2.2.1 Setup and Flow Capacity

The carbon vessel(s) will be setup in a down-flow system configuration. The flow capacity of the carbon vessel(s) will be at least 3000 cfm. Other specifications of the adsorption vessel(s) will meet the operation and efficiency requirements of the remediation system and be in conformance with existing treatment system design.

2.2.2 Vapor Distribution/Collection Systems

Vapor distribution/collection systems shall provide effective distribution across the bed throughout the stated capacity range. A system shall be provided to minimize short circuiting or channeling of contaminated air/gas through the carbon vessel. The system shall be designed to evenly distribute the controlled contaminated air/gas flow across the cross section. Design of the inlet and outlet shall be adequate to prevent local pressurization in excess of the vessel rating or design.

2.2.3 Shell Design

2.2.3.1 Corrosion Prevention

Corrosion resistant steel, fiberglass, or other plastic shall be used for shell construction or a steel shell with a corrosion resistant coating. The lining system shall have a corrosion resistant coating. Paint kits shall be furnished for use after assembly and finishing.

2.2.3.2 Manways

Manways on each adsorber unit shall meet requirements, for access and removal/replacement of carbon.

2.2.3.3 Insulation

2.2.3.4 Vessel

The following requirements shall be met:

a) Minimum Number of Vessels: 2

b) Minimum Adsorber Diameter: 5 ft.

c) Material of Construction: carbon steel

d) Maximum Allowable Working Pressure: 15 psig.

e) Minimum Carbon Quantity per Vessel: 4000 lbs.

f) Minimum Carbon Bed Depth: 36 inches.

g) Flow Direction: downflow

h) Inlet Distributor: Integral

Each unit shall be skid-mounted. Skids shall be designed to support the equipment and to distribute the weight in transit and in service without loading on the tank or concrete slab and pre-piped internally. Each vessel shall be secured to a structural steel frame suitable for shipment or transport with a forklift or crane and set on a level area for operation. Exterior structural steel surfaces shall be coated with a suitable primer and top coat to resist corrosion due to water spray. Each unit shall have a minimum of one ground connection. Each unit shall be provided with an inlet air/gas distributor, if required. Sampling ports shall be provided on the inlet and outlet pipes to each vessel to allow independent sampling and measurement of breakthrough for each unit.

2.2.3.5 Seismic Requirements
Adsorption units shall be supported and braced to resist seismic loads as specified under SECTION 13080 - SEISMIC ROTECTION FOR MISCELLANEOUS EQUIPMENT.

2.2.4 Description
Calculations, layouts and drawings of the carbon adsorption system shall be provided to clearly show the basis for the design.

2.3 ACCESSORIES

2.3.1 Blowers
The blowers shall conform to SECTION 11215 - FANS/BLOWERS/PUMPS.

2.3.2 Preconditioning Equipment for Inlet Air/Gas Stream
An air warmer (heating coil) shall lower the relative humidity of the influent to 40 percent. Materials of construction and controls and cutoffs shall be provided. The heating element shall be directly heated. The vapor stream leaving a forced draft blower that precedes the carbon vessel shall pass through a heat exchanger that cools the air/gas stream. The heat exchanger shall be of the type and size as shown on the schedule on the drawings. The heat exchanger shall lower the temperature enough to raise the relative humidity to no more than 50 percent.

2.3.3. Sampling Valves
Sampling valves shall be provided at the inlet and outlet piping of each carbon unit.

2.4 VAPOR PHASE ACTIVATED CARBON INSTRUMENTATION AND CONTROLS

2.4.1 Sensors and Transmitters
Sensors and transmitters shall have a range selected for the application, using the smallest range available from the controls manufacturer that will meet all expected sensed conditions in the sequence of control. Sensors and transmitters shall consist of the following:

2.4.1.1 Relative Humidity Sensors
Relative humidity sensing element shall have a relative humidity sending range from 0 to 100 percent (condensing). The sensor shall be capable of sensing a condensing air stream (100 percent RH) without affecting the sensors calibration or harming the sensor. Sensing elements shall have an accuracy of plus or minus 5 percent of full scale within the range of 20 to 80 percent relative humidity. All sensors shall be mounted in locations that are accessible for calibration and shall be fitted for ease of calibration and re-calibration.

2.4.1.2 Airflow Measuring
The velocity sensing elements shall be of the RTD or thermistor type, with linearizing means. The sensing elements shall be distributed across the pipe in the quantity and pattern set forth for measurements and instructions in ASHRAE Fundamentals Handbook and SMACNA HVACTAB for traversing of ducted airflows. The resistance to airflow through the airflow measurement station shall not exceed 0.08 inch water gauge at an airflow of 2,000 fpm. Station construction shall be suitable for operation at airflows of up to 5,000 fpm over a temperature range of 40 to 140 degrees F, and accuracy shall be plus or minus 3 percent over a range of 125 to 2,500 fpm scaled to air volume.

2.4.1.3 Pressure Gauges
Pressure gauges shall conform to ASME B40.100.

2.4.1.4 Thermometers
Thermometers shall be dial type, 3-1/2 inch diameter, chromium plated case; remote or direct-type bulb as required; plus or minus 1 degree F accuracy; white face with black digits graduated in 2 degree F increments. Thermometer wells of the separable socket type shall be provided for each thermometer with direct-type bulb.

2.4.2 Controllers
Controllers shall have set point, action, proportional band, authority throttling range, ratio, and remote set point adjustment as required to meet requirements of the sequence of control. Controllers shall be mounted on a unit control panel located near the carbon vessels.

2.4.2.1 Relative Humidity Controllers
Humidity controllers shall be space-type and shall take full control action for a relative humidity change of plus or minus 5 percent of the setting of the controller. Set point adjustment range shall be approximately 20 percent to 80 percent relative humidity. Controllers shall have adjustable throttling ranges. Controllers to be mounted in the interior of piping shall be of the insertion type, fitted with air shields where so recommended by the manufacturer.

2.4.2.2 Alarms
Alarm annunciation shall be by visual indication. Alarm signals shall be locked in and require manual reset. An auto dialer shall be furnished and/or alarms shall be telemetered to the master control panel in the control room.

2.4.2.3 Relative Humidity Alarms
Relative humidity alarms shall be installed immediately upstream from the carbon vessels to alert the operator of relative humidity exceeding 50 percent.

2.4.2.4 Pressure Alarms
Pressure indicators shall be installed on each side of the carbon vessels to alert the operator of excessive pressure drop

2.4.2.5 Temperature Alarms
Temperature alarms shall be provided on excursions (drop or rise) of 18 degrees F outside the control range in the duct leaving the carbon vessel.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Equipment shall be installed as shown and in accordance with written instructions of the manufacturer. Each vessel shall be anchored to a footing isolated from the floor slab or mounted on a skid base. Anchor brackets, anchor rods or straps shall be provided to hold the shell to anchors in the footing. Reinforced concrete foundations for each carbon unit shall be designed to support the unit and shall be in accordance with SECTION 03300 - CAST-IN-PLACE STRUCTURAL CONCRETE.

3.2 FIELD QUALITY CONTROL

3.2.1 Equipment Tests

After installation of the carbon adsorption system is complete, operating tests shall be carried out to ensure that the unit installed operates properly. All products shall be carefully inspected for defects in workmanship and material; debris and foreign matter shall be cleaned out of all equipment; all operating mechanisms shall be tested to check their proper functioning; and all nuts and bolts shall be checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced. Tests shall assure that there is no vibration, or noise from any parts. If deficiencies are revealed during tests, such deficiencies shall be corrected and the tests shall be reconducted at the Contractor's expense.

3.2.2 Performance Tests

After installation of the activated carbon adsorption system, operating tests shall be carried out to ensure that the system operates properly. This shall include the adsorption units, all accessories and instruments and controls. If any deficiencies are revealed during any tests, such deficiencies shall be corrected and the tests repeated. A complete log of each test run shall be made, giving the following data: date, time of readings and sampling. Total chemicals removed shall be determined by analyses of the inlet and outlet for the chemical requirements listed in paragraph Performance Requirements. Samples shall be taken of the emissions for analysis according to the prepared sampling schedule, in accordance with SECTION 01320 - PROJECT SCHEDULE. Results of the tests shall be used in determining the capacity and performance of the adsorption unit. Sampling and analyses shall be performed in accordance with SECTION 01450 - CHEMICAL DATA QUALITY CONTROL.

3.2.3 Spent Activated Carbon Sampling and Analyses

Sampling and analyses of the spent activated carbon media shall be performed in accordance with requirements for spent carbon transport and requirements of the regeneration facility and SECTION 01450 - CHEMICAL DATA QUALITY CONTROL.

3.2.4 Carbon Testing

The carbon to be used during the performance testing shall be tested by the Contractor to ensure it meets the requirements of SECTION 01450 - CHEMICAL DATA QUALITY CONTROL and paragraph VAPOR PHASE ACTIVATED CARBON.

3.2.5 Breakthrough Monitoring

Monitoring the emissions for the chemicals in paragraph Chemical Requirements shall be done once every 7 days or according to the monitoring schedule prepared by the Project Engineer. The volume of air/gas that was treated, from the time that the vessel was placed in the upstream position until breakthrough was consistently determined, shall be recorded as the breakthrough volume. Breakthrough volume is the volume of air/gas that was treated before the concentration of any one of the chemicals in paragraph Chemical Requirements was exceeded.

The criteria for determining when to replace granular activated carbon may be modified as more data are generated.

3.2.6 Noncompliance with Performance Requirements

Removals shall meet or exceed those specified in the performance requirements of this specification. If at any time during the first 12 months of operation the results of the organic analyses of the air/gas emissions are not in compliance with paragraph Chemical Requirements, except for periods when the carbon is saturated, flow through the unit shall be stopped and the system shall be said to be inoperable. If at any time the operation of the system does not meet the flow rate requirements, instrumentation or control requirements set forth in this contract, flow through the system shall be stopped. The Contractor shall immediately proceed to repair or modify the system for compliance with the contract documents. Repairs or modifications shall be made entirely at the Contractor's expense. The Contractor shall notify the Project Engineer one day before the system is to be restarted and retested.

3.4 MANUFACTURER'S FIELD SERVICE

3.4.1 Manufacturer's Representative

Services of the manufacturer's representative, who is experienced in the installation, adjustment and operation of the equipment specified, shall be provided as needed and arranged for by the Project Engineer.

3.4.2 Field Training

The Contractor shall conduct a training course of operating staff as designated by the Project Engineer. The training period shall start after the system is functionally complete but prior to final acceptance tests. The field instructions shall cover the topics included in the Operating and Maintenance Manuals. The Contractor shall also provide additional training, if required or arranged for by the Project Engineer, following completion of the operating period for the follow-in Contractor.

3.5 POSTED FRAMED INSTRUCTIONS

Installation instructions, sequences, and precautions, including tolerances for level, horizontal, and vertical alignment shall be posted as specified. Grouting requirements, including grout spaces and materials; wiring and control diagrams; system layouts and isometrics; instructions and other sheets; operating instructions explaining preventive maintenance procedures and checks to assure the system is operating normally and safely shall be submitted for approval prior to posting. Methods of checking the system for normal safe operation; procedures for operating the system; and procedures for safely starting and stopping the system shall be prepared in typed form, framed and posted beside the diagrams. Instructions shall be written for any required sampling, carbon transfer and shipping of activated carbon to regeneration or disposal facility. Catalog cuts are not acceptable.

END OF SECTION

SECTION 11378

FLAMELESS THERMAL OXIDIZER SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN GAS ASSOCIATION (AGA)
AGA B109.1 (2000) Diaphragm-Type Gas Displacement Meters (Under 500 cubic ft./hour Capacity)
AGA B109.2 (2000) Diaphragm-Type Gas Displacement Meters (500 cubic ft./hour Capacity and Over)
AGA B109.3 (2000) Rotary-Type Gas Displacement Meters
AGA Report No 3 (2000) Orifice Metering of Natural Gas; PART 2: Specification and Installation Requirements

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
ANSI Z21.15 (1997; A 2001) Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves

AMERICAN PETROLEUM INSTITUTE (API)
API Spec 6D (2002) Specification for Pipeline Valves

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
ASCE 25 (1999) Earthquake-Activated Automatic Gas Shutoff Devices

AMERICAN WATER WORKS ASSOCIATION(AWWA)
AWWA EWW (1998) Standard Methods for the Examination of Water and Wastewater

AMERICAN WELDING SOCIETY (AWS)
AWS B2.1 (2000) Welding Procedure and Performance Qualification
AWS D1.1/D1.1M (2004) Structural Welding Code – Steel

ASME INTERNATIONAL (ASME)
ASME B1.1 (2001; R 2003) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B16.33 (2002) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig, Sizes NPS 1/2 - NPS 2
ASME B40.100 (2000) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX (2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME PTC 19.3 (1974; R 2004) Temperature Measurement

ASTM INTERNATIONAL (ASTM)
ASTM A 123/A 123M (2002) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M (2004) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

FM GLOBAL (FM)
FM P7825 (2003) Approval Guide

ISA - THE INSTRUMENTATION, SYSTEMS AND AUTOMATION SOCIETY (ISA)
ISA MC96.1 (1982) Temperature Measurement Thermocouples

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
MSS SP-25 (1998) Standard Marking System for Valves, Fittings, Flanges and Unions

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA ICS 1 (2000) Industrial Control and Systems: General Requirements
NEMA ICS 6 (1993; R 2001) Industrial Control and Systems: Enclosures
NEMA MG 1 (2003) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 211 (2003) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 30 (2003) Flammable and Combustible Liquids Code
NFPA 31 (2001) Installation of Oil Burning Equipment
NFPA 54 (2002) National Fuel Gas Code
NFPA 58 (2004) Liquefied Petroleum Gas Code
NFPA 70 (2005) National Electrical Code
NFPA 82 (2004) Incinerators and Waste and Linen Handling Systems and Equipment

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)
NIST SP 250 (1998) Calibration Services Users Guide

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
29 CFR 1910 Occupational Safety and Health Standards
40 CFR 60 Standards of Performance for New Stationary Sources

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Detail Drawings; G
Detail drawings containing process and instrumentation diagrams (P&IDs), complete flow diagrams, piping, wiring, schematic, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show capacities and pressure drop; heat and material balances; make and model; complete list of equipment and materials. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for installation, maintenance and operation.

SD-03 Product Data
Emissions Reports for permit compliance
Temperature Sensors, Transmitters and Controllers; G
Detailed manufacturer's data on the overall controls, sensors, process controllers, control operators, ladder diagrams, timers, sequence of controls, valves, alarms, signals, interlocks and

cut off systems. Data describing in detail the equipment used to monitor emissions, including the sampling probe, filters, off-gas transport tubing, sampling pump, moisture removal system, analyzer calibration systems, and data recorder.

Field Training
Training course must cover all operational parameters and take place immediately following installation.

SD-06 Test Reports
Factory Tests; G
Printout of factory test results.

Field Quality Control/Tests; G
Test reports, in booklet form, showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates
Motors
Manufacturer's certificates attesting that the motors meet the NFPA 70 requirements for the hazardous area classification.

Manufacturer's Field Representative
Names and qualifications of each manufacturer's field representative and training engineer with written certification from the manufacturer that each representative and trainer is technically qualified.

SD-10 Operation and Maintenance (O&M) Data
Flameless Thermal Oxidizer O&M Plan
Three complete copies of detailed operating instructions with step-by-step procedures and sequences for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and the operating features of each element. The instructions shall include as-built drawings of the piping layout, equipment layout, and simplified wiring and control diagrams of the system as installed. Automatic controls, functional logic, control loops, set points and alarm signals shall be described. Flow diagrams shall be included in the instructions. Three complete copies of maintenance instructions listing maintenance procedures, possible breakdowns and repairs, and trouble shooting guides.

1.3 SYSTEM DESCRIPTION

The remediation system incorporates a flameless thermal oxidizer (FTO) designed for the destruction of Volatile Organic Compounds (VOCs), including chlorinated solvents TCE, PCE, DCE, VC, BTEX, and all other organic compounds. The FTO is a complete and operational FTO system and includes supporting equipment and accessories. Technical specifications including water, gas, and electrical requirements of the FTO unit are summarized below:

Air/Fume Specifications at System Inlet:

Process Vent (flow): 1400 acfm, 70°F to 180°F; air and water vapor; 1200 scfm dry.

Max Inlet Flow to Oxidizer: 1500 scfm, air and water vapor

Process Blower Suction: -3 inches w.c.

Inlet Temperature: 65° F to 180°F from discharge of liquid ring blowers

Moisture: 80% R.H. max.

Filtration: Oil-mist eliminator, 99% on 0.1 mm particle

VOC Destruction Removal Efficiency: 99.99% or 1 ppmv max, whichever is least restrictive.

Exhaust/Exit Temperature: 165°F - 175°F saturated; vented to scrubber

Scrubber System Expected Acid Removal: 99+% or 10 ppmv max

Operation Duty Cycle: Intermittent or continuous

Installation: Outdoor, NEMA 3R, 32°F to 100°F Ambient Temperature; Approximately 100 ASL

Water Requirements:

Quench Chamber: 100 gpm, filtered, recirculated water, 10 - 20 gpm make-up water (softened)

Scrubber System: 30 gpm filtered, recirculated water, 5 - 8 gpm wastewater discharge (< 6% T.D.S.)

Water Quality Specifications: <500 mg/l Total Dissolved Solids, Filtered and Free of Total Suspended Solids; 3 ppm Calcium, pH = 6.0 – 8.5

Fuel Supply: natural gas, 4,500,000 btu/hr, 2.0 to 5.0 psig;

Electrical Requirements:

Power: 240/480 VAC, 3f, 60 Hz, 26 kW (5 hp process/dilution air fan, 20 hp scrubber draft fan, 10 hp recirculation pump

Control: 115 VAC, 1f, 60 Hz, estimated at 15 amps

1.3.1 Design Requirements

Vertical and lateral supports for the stack shall be in accordance with NFPA 82 and NFPA 211, as applicable, for the wind forces indicated. The FTO system shall be designed for the following parameters:

Altitude: 140.5 ft. above mean sea level (MSL).

Stack discharge: 35 ft above existing grade at the site (175.5 ft. MSL).

Minimum operating period: 1 year.

Oxidizer system dimensions: 8 ft x 30 ft x 8 ft (excluding stack and scrubber)

Maximum vertical projection (excluding stack): ~25 ft; Must be capable of retrofit with granular activated carbon (GAC) post-treatment unit

Approximate Weight: 12,000 lbs (dry)

Soil bearing capacity: 1000 psf.

Seismic zone: 4

Wind speed (maximum): 100 mph.

1.3.2 Performance Requirements
Minimum retention time in the combustion chamber shall be 0.5 seconds at 1700 degrees F minimum at maximum flow.

Flow rates shall be based on measurement at standard temperature and pressure (STP). Inlet temperature shall vary between 65 and 180 degrees F. Materials of construction shall be compatible with the ambient and operating temperatures and long term exposure to untreated and treated gas constituents.

1.3.3 System Effluent
The FTO efficiency shall be capable of oxidation of 99.90% of the organic components of gaseous, solid and aerosol type emissions, as follows:

Compound	Possible Influent Concentration (ppmv)	Flameless Thermal Oxidizer - Effluent	
		ppmv in effluent	Removal Efficiency
Acetone	1.5	0.002	99.90%
Benzene	1.4	0.001	99.90%
Carbon Disulfide	72.2	0.072	99.90%
1,1-Dichloroethane	4.2	0.004	99.90%
1,1-Dichloroethene	255.4	0.255	99.90%
cis-1,2-Dichloroethene	3116.1	3.116	99.90%
trans-1,2-Dichloroethene	364.3	0.364	99.90%
1,4-Dioxane	75.0	0.075	99.90%
Ethylbenzene	7.1	0.007	99.90%
Hexachloro-1,3-butadiene	43.5	0.044	99.90%
MTBE	2.9	0.003	99.90%
Tetrachloroethene	62.0	0.062	99.90%

Compound	Possible Influent Concentration (ppmv)	Flameless Thermal Oxidizer - Effluent	
		ppmv in effluent	Removal Efficiency
Toluene	33.8	0.034	99.90%
1,1,1-Trichloroethane	3.0	0.003	99.90%
Trichloroethene	7129.4	7.129	99.90%
1,2,4-Trimethylbenzene	0.7	0.001	99.90%
Vinyl Chloride	2176.2	2.176	99.90%
p/m-Xylenes	9.2	0.009	99.90%
o-Xylene	3.0	0.003	99.90%

The FTO shall be capable of being retrofitted with a by-pass valve within the stack so that exhaust will be passed through a polishing step consisting of granular activated carbon in treatment vessels. Following carbon polish, treated vapor will be discharged to the atmosphere.

1.4 QUALIFICATIONS

1.4.1 Contractor
Contractor shall have had a minimum of 5 years of experience in the construction of industrial air pollution control systems, sanitary wastewater sludge digestion gas systems, landfill off-gas or vapor extraction off-gas handling systems.

1.4.2 Single Source Supplier
The Contractor shall assign to a single supplier full responsibility for the furnishing of the FTO system. The designated single supplier, however, need not manufacture the system but shall coordinate the selection, assembly, installation, and testing of the entire specified system.

1.4.3 Manufacturer's Field Representative
Services of a manufacturer's field representative, who is experienced in the installation, adjustment, and operation of the equipment furnished, and who has complete knowledge of the proper operation and maintenance of the system, shall be provided.

1.4.4 Welders
Welders shall have passed qualification tests using procedures covered in AWS B2.1 or ASME BPVC SEC IX and have the appropriate certification. The Contractor shall require any welder to retake the test when, in the opinion of the QC Engineer, the work of the welder creates reasonable doubt as to proficiency.

1.5 PARTNERING OR PRE-INSTALLATION CONFERENCE
A pre-installation conference may be requested by the Project Engineer. The Contractor shall ensure that involved subcontractors, suppliers, and manufacturers are represented. The date and time of the conference shall be furnished to the Project Engineer for approval.

1.6 REGULATORY REQUIREMENTS
The Contractor shall abide by regulatory, state and local oversight agency requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

Equipment delivered and placed in storage shall be protected from the weather, excessive humidity, excessive temperature variation, and dirt, dust, or other contaminants. Catalyst material shall be protected in accordance with the manufacturer's recommendations.

1.8 GENERAL REQUIREMENTS

Equipment and appurtenances shall be as specified and as shown on the detail drawings, and shall be suitable for the service intended. Materials and equipment shall be new and unused, except for testing equipment. Components that serve the same function and are the same size shall be identical products of the same manufacturer.

1.8.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Project Engineer, reasonably convenient to the site.

1.8.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Each piece of equipment shall bear the approval designation and the markings required for that designation. Valves shall be marked in accordance with MSS SP-25 and shall bear a securely attached tag with the manufacturer's name, catalog number and valve identification permanently displayed.

1.8.3 Safety Requirements

Belts, chains, couplings, and other moving parts shall be completely enclosed by guards, to prevent accidental personal injury, in accordance with 29 CFR 1910, Subpart O, Machinery and Machine Guarding. Guards shall be removable and arranged to allow access to the equipment for maintenance. Thermal insulation shall enclose high temperature components to prevent ignition of combustible materials and to preclude personnel contact.

1.8.4 Verification of Dimensions

After becoming familiar with all details of the work, the Contractor shall verify all dimensions in the field, and shall advise the Project Engineer of any discrepancy before performing the work.

1.10 SEQUENCING AND SCHEDULING

Installation of the FTO shall be complete and the system operational according to the treatment system installation and implementation schedule agreed upon by RPM, Project Engineer, and Contractor.

Point source release of untreated off-gas shall be avoided to the maximum extent consistent with completion of the contract. Sampling and analyses to demonstrate system performance and emission compliance shall be performed in accordance with SECTION 01450 - CHEMICAL DATA QUALITY CONTROL.

1.11 AUXILIARY EQUIPMENT AND SPARE PARTS

Concurrent with delivery and installation of the specified equipment, auxiliary equipment and spare parts shall be furnished. The Contractor shall furnish the following:

Spare parts for each different item of material and equipment specified, including replacement parts and other items duplicated or replaced during the operating period.

For each type of grease, one lever type grease gun or other lubricating device.

One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment.

PART 2 PRODUCTS

2.1 EQUIPMENT OPTIONS

The system will be rejected upon failure to achieve both the minimum temperature and the minimum retention time specified in paragraph Performance Requirements.

2.2 FLAMELESS THERMAL OXIDIZER

The FTO shall be composed of a horizontal enclosed combustion chamber that maintains a constant temperature by controlling fuel and combustion air.

2.3 HEAT RECOVERY SYSTEM

If heat recovery systems are used, exhaust flow through media chambers shall recycle a minimum of 50 percent of the heat input at maximum operating conditions (maximum flow and temperature).

2.4 INLET PROTECTION

The inlet conditions detailed in paragraph 1.3 - System Description shall be maintained during FTO operation in order to protect the equipment.

2.5 PYROCORE® RADIANT BURNER

The PyroCore® unit, Model PCI-30-36, is a three segment burner with insulated mounting flanges. The unit has a maximum energy rating of 4.5 MMbtu/hour. A view port is provided on the unit. The PyroCore® burner shall be compatible with the specified fuel. The burner shall be of adequate capacity to maintain the required combustion temperature at the maximum flow with no fuel value in the off-gas.

2.5.1 Pilot

Automatic gas shutoff system conforming to ASCE 25 shall be provided on the pilot supply. The pilot assembly shall be removable and shall be provided with pressure indicator, pressure regulator, solenoid valve, manual shutoff valve and pilot gas pressure manometer port. Pilot inlet nozzle shall be 150# ANSI, stainless steel, flanged.

2.5.2 Igniter

The PyroCore shall utilize a spark-ignited gas pilot.

2.5.3 Insulation

The burner assembly shall be adequately insulated to minimize the radiant heat felt by maintenance personnel working on or around the FTO during operation.

2.6 EXHAUST TREATMENT

The FTO shall be equipped with an acid gas scrubber system capable of removing 99 percent (minimum) of acid gas formed.

2.7 STACK

2.7.1 Minimum Elevation

The stack elevation shall be not less than stated in paragraph Design Requirements.

2.7.2 Lining

Stack shall be lined with ceramic and/or castable refractory.

2.7.3 Lightning Protection

An engineered lightning protection system with grounding shall be provided in accordance with specification SECTION 13100A - LIGHTENING PROTECTION.

2.7.4 Lugs

Lifting lugs shall be provided at the top of the stack for ease of installation; each lug shall be capable of supporting the entire weight of the stack.

2.7.5 Ladder

An aluminum or galvanized steel fixed ladder shall be mounted to allow access to emissions monitoring equipment. The ladder furnished with the system shall have side rails. Individual rung ladders are not acceptable. Ladder shall conform to 29 CFR 1910, Part 27 Fixed Ladders, except as specified herein.

2.8 PROVISIONS FOR OBSERVATION AND SAMPLING

2.8.1 Inlet Sample Port

Inlet sample port with cap or valve shall be located upstream of all contributing flows.

2.8.2 Outlet Sample Port

Outlet sample port with cap or valve shall be located upstream of the dilution air inlet and two stack diameters from the top of stack or as recommended by the manufacturer.

2.8.3 Sampling Equipment

The Contractor shall provide an access port on the FTO stack for effluent sample collection.

2.9 CONTROLS

Set points, signals and control functions and dampers shall be linked by a central programmable logic controller (PLC) located in the control panel. Burner control diagnostics shall be included. For parameters specified to be continuously recorded, digital data shall be recorded at intervals not exceeding one minute. Sensors shall be calibrated with standards traceable to NIST and in conformance with NIST SP 250.

2.9.1 Timers

Automatic timers shall provide independent adjustment of the start and duration of each step in the control sequence.

2.9.2 Temperature Sensors, Transmitters and Controllers

2.9.2.1 Thermocouples

Thermocouples shall conform to ISA MC96.1, Type K, suitable for continuous operation and control at temperatures up to 260 degrees F above the temperature specified in the performance requirements and accurate to 0.75 percent of the maximum temperature. Each thermocouple used for control shall be provided with high and low set points and an adjustable time delay before initiation of each control action. A thermocouple located in or immediately downstream of the combustion chamber shall control burner operation and a chart recorder shall record combustion chamber temperatures.

2.9.2.2 Thermometers
Thermometers shall conform to ASME PTC 19.3, with wells and temperature range suitable for the use encountered.

2.9.2.3 Combustion Chamber Temperature Controller
The combustion temperature control shall record the combustion chamber temperature and maintain the temperature between the adjustable high temperature and low temperature set points.

a) The system shall shut down and not attempt to restart if the temperature exceeds the allowable combustion chamber temperature range. A high temperature shutdown shall activate the high temperature alarm.

b) During operation, the system shall shut down and not attempt to restart if the temperature falls below the allowable combustion chamber temperature range. During the ignition cycle, if the temperature does not reach or exceed the low temperature shutdown setting, the system shall shut down and not attempt to restart. A low temperature shutdown during operation or during the ignition cycle shall activate the low temperature alarm.

2.9.2.4 Primary Combustion Air Control
Fully adjustable air dampers on each burner shall be furnished with remote operation by external lever control, sized to provide a minimum of 100 percent of theoretical stoichiometric air as primary air. Dampers shall allow the operator to adjust the primary air/fuel ratio while burner is in operation.

2.10 FLOW METERS, TRANSMITTERS AND FLOW CONTROLLER
The flow control system shall include an automatically actuated main fuel valve with fail-closed feature and limit switches for position indication. The flow rate metering system shall include recording, totaling and alarm capabilities.

2.10.1 Off-Gas Flow Meter
Flow metering for the off-gas shall conform to AGA Report No 3.

2.10.2 Supplemental Fuel Flow Meter
Gas meters shall conform to AGA B109 standards.

2.11 PRESSURE MEASUREMENT AND CONTROL
Sufficient pressure sensors and gauges shall be provided by the manufacturer to accurately and safely monitor FTO operation in accordance with the O&M Plan.

2.11.1 Draft Gauges
Draft gauges shall be Type I, Class 1 or 2, as applicable, conforming to ASME B40.100 with a diaphragm or bellows actuating system and a circular scale. The gauges shall have a zero adjustment screw. Suitable shutoff cocks shall be provided.

2.11.2 Pressure Gauges
Pressure gauges shall conform to ASME B40.100 and be of pressure detecting Class, single Bourdon tube style, and suitable for detecting air pressure.

2.11.3 Pressure Switches
Pressure switches shall be provided to activate the blowers.

2.11.4 Pressure Release
A pressure release valve shall be located on the off-gas line upstream of the oxidizer.

2.12 EXPLOSIMETER
A combustible gas analyzer, with a minimum of four in-line sensors, calibrated to methane shall be located in the control panel.

2.12.1 Lower Explosive Limit (LEL)
The lower explosive limit of the fuel and of the off-gas shall be continuously indicated. The lower explosive limit of the off-gas shall be continuously recorded.

2.12.2 Upper Explosive Limit (UEL)
The upper explosive limit of the combustion air and of the off-gas shall be continuously indicated.

2.13 OXYGEN METERING AND MAKE-UP AIR CONTROL

2.13.1 Oxygen Meter
The upper oxygen level of the combustion air and of the off-gas shall be continuously indicated.

2.14 OPERATING INDICATORS AND ALARMS
Simulated running lights to indicate normal operating conditions and alarms shall be displayed at the control panel.

2.14.1 Visible Alarms
Each visible alarm shall be indicated at the control panel and by a red light at the device.

2.14.2 Audible Alarms
Each audible alarm shall be located at the device.

2.14.3 Remote Alarms
Remote alarms shall activate the programmable auto dialer. A prerecorded message shall provide specific information to the operator about the alarm condition. At contract close out, the dialer shall be reprogrammed to the number indicated by the RPM.

2.15 ELECTRICAL WORK
All electrical equipment, wiring and controls shall comply with SECTION 16402N - INTERIOR DISTRIBUTION SYSTEM and with NFPA 70, with proper consideration given to environmental considerations such as moisture, dirt, corrosive agents and proper NFPA 70 hazardous area classification. Lightning and surge protection shall be provided.

2.15.1 Motors
Electric motor driven equipment shall be provided complete with starters and alternating current motors conforming to NEMA MG 1. Fractional horsepower motors shall be 115-volt, single-

phase, 60 cycle. Integral horsepower motors shall be three-phase, 60 cycle. Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for the motor specified. Each motor shall be designed for operation in ambient temperatures up to 104 degrees F.

2.15.2 Control Panels

A complete control panel with options for various control schemes and control wiring shall be included. Manual or automatic controls, protective or signal devices and control wiring for the controls and devices required for the operation specified shall be provided. Motor controls shall conform to NEMA ICS 1. Enclosures for power and control panels shall conform to NEMA ICS 6. Panels located outdoors shall be NEMA 4 or 4X and shall be weatherproof.

2.15.3 Resistance Heaters

Electric resistance pre-heaters and dryers shall be used where indicated on the drawings.

2.16 VALVES

Design of valve operators and mechanisms shall avoid initial surges and sudden inrushes by gradually allowing flows to increase.

2.16.1 Butterfly Valves

Butterfly valve shall be cast iron body with resilient seat, 316 stainless steel disc and shaft and actuator. Valve shall have fail-safe closing in ease of a power failure. Valve shall have location limit switch for use in the control system.

2.16.2 Other Valves

Other valves shall conform to API Spec 6D, ANSI Z21.15 or ASME B16.33 as appropriate for the type.

2.17 JOINTS

2.17.1 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.17.2 Isolation Joints

Isolation joints shall be installed between non-threaded ferrous and nonferrous metallic pipe, fittings and valves. Isolation joints shall consist of a dielectric sandwich type flange isolation gasket with isolation washers and isolation sleeves for flange bolts. Isolation gaskets shall be full faced with outside diameter equal to the flange outside diameter. Bolt isolation sleeves shall be full length. Units shall be of a shape to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.17.2.1 Sleeve Type Couplings

Sleeve type couplings shall be used for joining plain end pipe sections. Each coupling shall consist of a steel middle ring, two steel followers, two gaskets, and the necessary steel bolts and nuts to compress the gaskets.

2.17.2.2 Split Sleeve Couplings
Split sleeve type couplings may be used in aboveground installations, when approved in special situations, and shall consist of gaskets and housing in two or more sections with the necessary bolts and nuts.

2.17.3 Bolts, Nuts, and Fasteners
Bolts, anchor bolts, nuts, washers, plates, bolt sleeves, and all other types of supports necessary for the installation of the equipment shall be furnished with the equipment and shall be galvanized unless otherwise indicated. Anchor bolts shall be provided with square plates at least 4 by 4 by 3/8 inch or shall have square heads and washers and be set in the concrete forms with suitable sleeves. Expansion bolts shall have malleable-iron and lead composition elements. Unless otherwise specified, stud, tap, and machine bolts shall be of refined bar iron. All threads shall conform to ASME B1.1. Bolts, anchor bolts, nuts, and washers specified to be galvanized, shall be zinc coated, after being threaded, by the hot-dip process in conformance with ASTM A 123 or ASTM A 153. Bolts, anchor bolts, nuts, and washers indicated to be stainless steel shall be Type 316 stainless steel.

2.18 FACTORY TESTS
The FTO system equipment shall be skid mounted and assembled in the shop, to the maximum practical extent, in the configuration outlined in the detail drawings and specifications. The system will be tested at the factory prior to shipping to verify its functionality and operability.

PART 3 EXECUTION

3.1 EXAMINATION
All equipment and products shall be inspected for defects in workmanship and material. Debris and foreign matter shall be cleaned out of valve openings and seats. Each operating mechanism shall be operated to check proper functioning. Each nut shall be checked for tightness. Valves and other equipment that do not operate easily or are otherwise defective shall be repaired or replaced.

3.2 CONCRETE FOUNDATION
The FTO will be installed in the treatment compound. The compound will consist of a pre-engineered building on a concrete foundation consisting of a 10-inch thick reinforced concrete slab with a secondary containment berm and sump. Typical Sections of the compound foundation are indicated on Drawing C-13.

3.3 ERECTION

3.3.1 Welding
Welding procedures shall be as specified in AWS D1.1/D1.1M.

3.3.2 Painting/Corrosion Prevention
All ferrous surfaces shall be coated or painted.

3.3.2.1 Factory Primed Surfaces
Factory primed surfaces shall be solvent-cleaned before painting.

3.3.2.2 Touch-Up Painting
Factory painted items shall be touched up as needed. Factory painted items requiring touching up in the field shall be thoroughly cleaned of foreign material, primed and top coated with the factory finish.

3.3.3 Corrosion Resistant Metals
Painting of corrosion resistant materials such as copper, brass, bronze, copper-nickel, and stainless steel is not required unless otherwise specified.

3.4 INSTALLATION

3.4.1 Insulation
Equipment and piping shall be insulated in accordance with ASTM standards.

3.4.2 Utilities
Fuel and utilities shall be provided at locations shown on the drawings. The Contractor shall verify availability and locations of utilities and shall compensate the utility company for connection and usage. Fuel, water, sewer, power and any other utility bills shall be paid on receipt.

3.4.2.1 Electricity
The power company is Southern California Edison; 24-hour customer service telephone number 1-800-990-7788.

3.4.2.2 Water
The City of Maywood is located in the Division III service area of the Central Basin Municipal Water District. Contact the *Public Utilities Service Commission: Electric-Gas-Water-Telephone* at (213) 897-2975 for water service information or support.

3.4.2.3 Natural Gas
The natural gas company is Sempra Energy and Affiliates; telephone number (213) 614-9857.

3.4.3 Fuel System
Fuel system installation and testing shall comply with the applicable requirements of NFPA 30 and NFPA 31, NFPA 54 or NFPA 58, as appropriate to the type of fuel.

3.5 FIELD QUALITY CONTROL/TESTS

3.5.1 Pressure and Leakage Test
After installation, all piping, equipment, joints and connections shall be tested for gas tightness. Connections and piping shall be tested by subjecting the complete system to pneumatic pressure of not less than 15 psi or the pressure indicated in the schedule for 6 hours. During the test, the system shall be disconnected from the source of pressure and, with corrections made for barometric and temperature changes, the pressure shall remain constant for the test period, as indicated by a test gauge. Joints shall be tested using a soapy water solution to detect leaks.

3.5.2 Operational/Performance Tests
After installation and pressure testing, the entire off-gas system shall be subjected to a performance test to demonstrate satisfactory functional efficiency. Results of the tests shall be used in determining the capacity and performance of the oxidation unit. Any deficiencies revealed during the tests shall be corrected and the tests repeated.

3.5.2.1 Constant Flow Tests
Each unit shall be operated at a constant flow rate of approximately 1500 cubic meters per second cubic feet per second (actual) for the capacity test. Samples shall be taken as directed by the Project Engineer of the influent and effluent at appropriate intervals for analysis.

3.5.3 Sampling and Analyses
Samples of influent vapors and the off-gas shall be collected and analyzed for the parameters listed in accordance with the Sampling and Analysis Plan developed to conform to SECTION 01450 - CHEMICAL DATA QUALITY CONTROL.

3.5.4 Test Logs
A complete log of each test shall be made, giving the following data: date, time of each reading and each sampling event, fuel use, and total off-gas treated.

3.6 MANUFACTURER'S FIELD SERVICE

3.6.1 Representative's Services
Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installation, adjustment, calibration, commissioning, start-up and operational/performance testing of the equipment.

3.6.2 Field Training
Initial system setup and startup operations provided by the manufacturer with the installation of the system are not formally considered training. Following functionally complete installation of the system, a formal training course for field personnel, if required, will be set up at the discretion of the Project Engineer. Field training shall cover each item contained in the operating and maintenance manuals, as well as demonstrations of routine maintenance operations.

3.7 POSTING FRAMED INSTRUCTIONS
Wiring and control diagrams and typed condensed operating instructions framed under glass or in laminated plastic shall be posted where directed. Diagrams shall show the complete layout, wiring and control of the entire system. Condensed operating instructions shall explain preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system. The diagrams and instructions shall be posted before acceptance testing of the system.

3.8 MAINTENANCE
The Contractor shall manage, operate, maintain, and monitor the off-gas control system after construction, startup and performance testing are complete. An operator shall be on site several hours a week or as deemed necessary by the Project Engineer to operate, maintain, and calibrate the equipment and instruments, and to collect samples for analyses. A qualified person shall be on call to respond to emergencies and alarm conditions at the off-gas system within two hours of alarm conditions. Compliance and monitoring records and reports shall be prepared and maintained for the RPM and regulatory agencies. The operator shall maintain a log of the actions taken.

END OF SECTION

SECTION 11393

FILTRATION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN WATER WORKS ASSOCIATION (AWWA)
AWWA B100 (2001) Filtering Material
AWWA C110 (1998) Ductile-Iron and Gray-Iron Fittings, 3-48 inches for Water
AWWA C111 (2000) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115 (1999) Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151 (2002) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA D100 (1996) Welded Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS)
AWS D1.1/D1.1M (2004) Structural Welding Code – Steel

ASME INTERNATIONAL (ASME)
ASME B16.1 (1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3 (1998) Malleable Iron Threaded Fittings
ASME B16.5 (2003) Pipe Flanges and Flanged Fittings
ASME B40.100 (2000) Pressure Gauges and Gauge Attachments
ASME BPVC SEC VIII D1 (2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

ASTM INTERNATIONAL (ASTM)
ASTM A 126 (2004) Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 153 (2004) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167 (2004) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 193 (2004c) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 194 (2004a) Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service or Both
ASTM A 216 (2004) Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service

ASTM A 276 (2004) Stainless Steel Bars and Shapes
ASTM A 283 (2003) Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 307 (2004) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 312 (2004b) Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A 36 (2004) Carbon Structural Steel
ASTM A 420 (2004) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Low-Temperature Service
ASTM A 53 (2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 707 (2002) Forged Carbon and Alloy Steel Flanges for Low-Temperature Service

ASTM C 127 (2004) Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128 (2004) Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 136 (2004) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 582 (2002) Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment
ASTM D 1330 (1985; R 2000) Rubber Sheet Gaskets
ASTM D 1784 (2003) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785 (2004a) Poly(Vinyl Chloride)(PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241 (2004b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2564 (2004) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 3139 (1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3299 (2000) Filament-Wound Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
ASTM D 3308 (2001) PTFE Resin Skived Tape
ASTM D 4097 (2001) Contact-Molded Glass-Fiber-Reinforced Thermoset Resin Corrosion-Resistant Tanks
ASTM F 477 (2002e1) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ISA - THE INSTRUMENTATION, SYSTEMS AND AUTOMATION SOCIETY (ISA)
ISA S5.1 (1984; R 1992) Instrumentation Symbols and Identification

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)
MSS SP-58 (2002) Pipe Hangers and Supports -Materials, Design and Manufacture
MSS SP-67 (2002) Butterfly Valves
MSS SP-69 (2002) Pipe Hangers and Supports -Selection and Application
MSS SP-70 (1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71 (1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-78 (1998) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-85 (2002) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA ICS 1 (2000) Industrial Control and Systems: General Requirements
NEMA MG 1 (2003) Motors and Generators

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)
SSPC PS 13.01(1982; R 2000) Epoxy-Polyamide Painting System
SSPC SP 6(2000) Commercial Blast Cleaning

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Shop Drawings; G

Shop drawings consisting of a complete list of equipment and materials, including manufacturer's descriptive and technical literature; performance charts and curves; catalog cuts; and installation instructions. Shop drawings shall also contain complete wiring and schematic diagrams; equipment layout and anchorage; and any other details required to demonstrate that the system has been coordinated and will properly function as a unit.

SD-03 Product Data
Posting Framed Instructions
Proposed diagrams and instruction shall be submitted prior to posting.

Qualifications
Qualifications of the installer, and the manufacturer's and media supplier's representatives.

Media
Characteristics of each filter media material.

Materials and Equipment
Catalog cuts and other pertinent information on filters, pumps, tanks, mixers, piping, and flow elements.

Control System
Detailed description of the proposed control system.

Spare Parts
After approval of the shop drawings, and not later then 10 days prior to the start of operation, spare parts data for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-06 Test Reports
Acceptance Testing
Test reports in booklet form showing field tests performed to adjust each component and to prove compliance with the specified performance criteria. Each test report shall indicate the final position of controls.

Factory Tests
Test reports in booklet form showing results of factory tests performed.

SD-07 Certificates
Materials and Equipment
Manufacturer's certificates attesting that the equipment meets the specified material and performance requirements.

SD-10 Operation and Maintenance Data
Field Training Operating and Maintenance Instructions
Six complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of equipment and their basic operating features. Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, and trouble shooting guides. The instructions shall include simplified diagrams for the system as installed. The manual shall require valves be numbered and tagged and shall provide a schematic indicating the number of

each valve. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the facility, name of the Contractor, and contract number.

1.3 SYSTEM DESCRIPTION

Treatment system design includes extracted vapor and groundwater filtration systems. Vapor filtration includes inlet vacuum filters and oil-mist exhaust filters. Extracted groundwater will be filtered via a series of bag or cartridge filtration units.

The filtration system shall be designed, constructed, and installed to comply with the following design conditions. The Contractor shall supply auxiliary systems and equipment required to maintain complete and workable filter systems including, but not limited to, required piping between units, auxiliary equipment for plumbing and power, and controls and interfaces between auxiliary equipment and the filter. Chemical additives will not be allowed to enhance the filtration system. The installation shall be constructed indoors.

1.3.1 Influent Vapor and Groundwater Filtration Characteristics

The inlet vapor and oil mist filters will conform to specifications for use with the vacuum blower units, as provided by the blower manufacturer.

1.3.1.1 Inlet Vapor Filtration

Number of Filters: 2 (in parallel)
Capacity: 2000 ACFM
Mesh Size: 5 Microns
Flow Conditions: Continuous
Maximum working temperature and pressure shall be consistent with system.

1.3.1.2 Oil Mist Exhaust (Vapor System)

Number of Filters: 2 (in parallel)
Capacity: 1100 ACFM
Mesh Size: 5 Microns
Flow Conditions: Continuous
Maximum working temperature and pressure shall be consistent with system.

1.3.1.3 Water Filtration

Number of Filters: 10 (5x2 parallel)
Capacity: 30 GPM
Mesh Size: 1-10 Microns
Flow Conditions: Continuous
Max Working Pressure: 150 psi
Maximum Working Temperature: 450 degrees F

<u>Design Influent:</u>
Total Dissolved Solids (TDS): 640 mg/L
Alkalinity: 510 mg $CaCO_3$/L
Calcium Concentration: 240 mg/L
Hardness: 335 mg/L

1.4 QUALIFICATIONS

1.4.1 Installer
The installer shall have a minimum of 2 years experience in the installation of a minimum of 10 similar filtration systems and shall show evidence of satisfactory operation for each installation.

1.4.2 Manufacturer's Representative
A representative of the filtration system manufacturer, who is familiar with the design and experienced in the installation, adjustment, and operation of the equipment specified shall be present at the jobsite during installation of the filtration system.

1.4.3 Media Supplier Representative
A representative of the media supplier who is experienced in the installation of the specified filtration media shall be present at the jobsite during media installation.

1.5 DELIVERY, STORAGE AND HANDLING
Equipment delivered and placed in storage shall be protected from the weather, excessive humidity, excessive temperature variation, and dirt, dust, or other contaminants.

1.6 FIELD MEASUREMENTS
The Contractor shall verify all dimensions in the field and shall advise the Project Engineer, QC Engineer, or Construction Manager of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products
Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Project Engineer, reasonably convenient to the site.

2.1.2 Nameplates
Each major item of equipment shall identify manufacturer's name, address, type of style, model or serial number, and catalog number on a plate secured to the item of equipment. The nameplate will also indicate safe working temperature and pressure limits, where applicable.

2.1.3 Protection of Moving Parts
Belts, chains, couplings, and other moving parts shall be completely enclosed by guards to prevent accidental personal injury. Guards shall be removable or arranged to allow access to the equipment for maintenance. If equipment is housed in a lockable housing, this shall be sufficient protection and no additional guards are necessary.

2.1.4 Special Tools
One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided.

2.1.5 Steel Plates, Shapes and Bars
ASTM A 36.

2.1.6 Pipe and Fittings

Pipe and fittings shall conform to the standards specified below.

2.1.6.1 Steel Pipe

ASTM A 53

a) Flanged Joints: ASTM A 707
b) Welded Joints: AWS D1.1
c) Bolts: ASTM A 307, Grade B.
d) Fittings: ASTM A 420

2.1.6.2 Ductile Iron Pipe

AWWA C115.

a) Flanged Pipe: AWWA C115 with ASME B16.1, Class 125 flanges.
b) Rubber-Gasket Joints: AWWA C111.
c) Fittings: AWWA C110.
d) Push-on Joints: AWWA C151.
e) Bolts and Nuts: ASTM A 307, Grade B.

2.1.6.3 Stainless Steel Pipe

ASTM A 312, Schedule 40, Type 316 or Type 304.

a) Flanged Pipe: ASME B16.5, Class 150.
b) Rubber-Gasket Joints: ASTM D 1330.
c) Fittings: ASME B16.3.
d) Bolts: ASTM A 193, Class 1, Grade B8.
e) Nuts: ASTM A 194, Grade 8.

2.1.6.4 Polyvinyl Chloride (PVC) Pipe

PVC pipe and fittings less the 4 inch diameter shall be in accordance with ASTM D 1785 or ASTM D 2241. PVC pipe and fittings 4 inch in diameter or larger shall be in accordance with ASTM D 2241 and shall have push-on joints.

a) Push-on Joints: ASTM D 3139 or ASTM F 477.
b) Solvent Cement: ASTM D 2564.

2.1.7 Pipe Hangers and Supports

MSS SP-58 and MSS SP-69.

2.1.8 Valves

2.1.8.1 Steel Valves
ASTM A 216/A 216M, Grade WCB.

2.1.8.2 Cast Iron Valves ASTM A 126, Class B

a) Globe and Angle Valves: MSS SP-85.

b) Gate Valves: MSS SP-70.

c) Plug Valves: MSS SP-78.

d) Butterfly Valves: MSS SP-67.

e) Ball Valves: MSS SP-72.

f) Check Valves: MSS SP-71.

2.1.8.3 PVC Valves
ASTM D 1784, Class 12454-B (formerly designated Type I, Grade 1).

2.1.9 Other Materials

2.1.9.1 Polypropylene Support Material
ASTM C 1147.

2.1.9.2 Joint Compound
Joint compound for threaded joints shall be a stiff mixture of graphite and oil, inert filler and oil, or a graphite compound.

2.1.9.3 Joint Tape
Joint tape for threaded joints shall comply with ASTM D 3308.

2.2 GENERAL REQUIREMENTS

2.2.1 Electrical Work
Electrical motor-driven equipment specified shall be provided complete with motors and controls. Electrical work shall be as specified in Section 16402 - INTERIOR DISTRIBUTION SYSTEM. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices, shall be provided.

2.2.2 Electrical Power Control

2.2.2.1 General Requirements
A manual or automatic complete electrical power, control, and instrumentation system as specified or recommended by the equipment manufacturer for the safe operation and supervision of the filter units and related equipment shall be provided, except those items specified to be furnished under other sections. Schematics and interconnection wiring diagrams for power, control, and instrumentation circuits shall be provided to equipment specified. Terminal blocks (plus 25 percent spare terminals) shall be provided in panels to terminate field and interconnection wiring.

2.2.2.2 Control System
Control power transformers, relays, adjustable timers, auxiliary contacts, switches, or additional equipment as required shall be provided to interconnect the filter equipment to a remote plant monitoring system, and control circuits as shown on schematic or instrument control system drawings. Conduit wiring between control panels and control devices shall be furnished as part of this specification.

2.2.3 Bolts, Nuts, Anchors, and Washers
Bolts, nuts, anchors, and washers shall be steel, galvanized in accordance with ASTM A 153.

2.2.4 Valves
Transfer of water to and from the filtration unit shall be accomplished by ball valves. Design of the valve mechanisms shall be such that gradually increasing flows will be attained as ports are opened and initial surges and sudden inrushes of water are avoided. A dial pointer shall indicate each step of the operation.

2.2.5 Pumps
Pump shall be supplied where insufficient head is available to move the influent water. The pump shall comply with the requirements of SECTION 11215 - FANS/BLOWERS/PUMPS.

2.2.6 Air Compressors
Air compressors shall be supplied in accordance with design specifications.

2.2.7 Pressure Gauges
Gauge sizes and scale ranges shall be as shown or scheduled on the Contract Drawings. Gauges shall comply with ASME B40.100 Type 2A, as a minimum. Compound gauges shall be provided on the suction side of pumps and standard pressure gauge on the discharge side of pumps. Gauges shall have clear acrylic or shatterproof glass windows and shock-resistant cases. The design operations should be at the midpoint of the graduated scale. Major divisions shall be equally spaced and shall be in whole integers. Scale units shall be engraved on the scale face. Pointer travel shall not be less than 200 degrees nor more than 270 degrees arc. Gauge accuracy shall be plus or minus 0.5 percent of span. Each gauge, except those for hydraulic systems, shall have a process shutoff valve.

2.2.8 Gauge Panel
Process gauge on the inlet vapor filters and the oil mist filters shall contain sensor switches that shall be wired to a control panel which sounds an alarm when the differential pressure exceeds 90% of maximum differential pressure specified by the manufacturer. The differential pressure on water filtration filters shall be read manually.

2.2.9 Tank Requirements

2.2.9.1 General
Tanks specified shall be provided in accordance with the following general requirements, unless otherwise indicated. Each tank shall include flanged fittings for inlet, outlet, overflow and drain. The size, elevation and orientation shall be provided in accordance with construction drawings. Hold down lugs shall be provided to anchor the tank to the base.

2.2.9.2 Tank Construction Materials
The tank construction material shall be compatible with the material to be handled. Tanks constructed of polyethylene, polypropylene, and fiberglass reinforced plastic (FRP) shall

conform to applicable material and construction provisions of ASTM C 582, ASTM D 3299, and ASTM D 4097. Tanks constructed of steel shall conform with applicable material and construction provisions of AWWA D100. Carbon steel tanks shall be fabricated with ASTM A 283 carbon steel Grade C or D and protected with an appropriate interior coating system for the intended service. Stainless steel tanks shall be fabricated of Type 304 stainless steel conforming to ASTM A 167 with structural support conforming to ASTM A 276.

2.3 FLOWMETERS

Influent and effluent lines shall be equipped with sonic flowmeters or equivalent non-fouling meter.

2.4 CARTRIDGE FILTER (WATER)

2.4.1 Equipment Capacity

The Contractor shall supply filtration units for continuous, online operation.

2.4.2 Construction

Cartridge chamber and hardware shall be of 316 SS construction.

2.4.3 Cartridge Style

The cartridge style shall conform with filter housing unit specified in paragraph 2.9 - FILTER HOUSING.

2.4.4 Gasket or O-Ring Material

The gasket or O-ring material shall be buna-n or equivalent.

2.4.5 Pore Size/Rating

The filter pore size shall be 1-10 microns.

2.4.6 Filter Cartridge Dimensions

The cartridge diameter shall be 6 inches. Cartridge length shall be 20-inches.

2.4.7 Core Material

Cartridge core material shall be 316 stainless steel.

2.4.8 Shell O-Ring Material

The filter housing shell O-ring material shall be buna-n or equivalent.

2.5 BAG FILTER (WATER)

2.5.1 Equipment Capacity

The Contractor shall supply filtration units for continuous, online operation.

2.5.2 Filter Material

The filter material shall be of polypropylene construction.

2.5.3 Gasket Material

A single gasket cover seal for each bag element shall be provided. The material of construction shall be buna-n or equivalent.

2.5.4 Pore Size/Rating
The bag pore size shall vary depending on influent quality but will generally range from 1-10 microns.

2.5.5 Bag Filter Surface Area
The bag surface area shall be 4.4 square feet (sq. feet).

2.5.6 Bag Support
Support material shall be 316 stainless steel.

2.6 FILTER HOUSING

2.6.1 Material of Construction
Vessel housing shall be Over-The-Top design and conform to ASME housing specifications. The housing head, shell, and associated internal and external connections and internal and external hardware shall be constructed of 316 stainless steel or other material specified by the manufacturer. The housing shall be prefabricated and delivered to the site in such a condition that the unit can be fastened in the location designated on the design drawings. The filter housing shall have the following dimensions and inlet, outlet, and system control connections:

Diameter: 7”
Overall Height: 16”; 33” (extended length model)
Inlet/Outlet: 2” Flanges, raised face
Downstream Drain: ¾” NPT
Vent: ¼” NPT
Gauge: ¼” NPT
Maximum Differential Pressure: 100 psi (housing only)

2.6.2 Shell O-Ring Material
The filter housing shell O-ring material shall be buna-n or equivalent.

PART 3 EXECUTION

3.1 GENERAL
Metal surfaces, except aluminum, bronze, brass, galvanized steel, and stainless steel shall be painted. Surface preparation and painting shall be performed in the shop or in the field as indicated. Manufactured items, such as motors and switchboards, shall be finished with the manufacturer's standard finish.

3.2 PAINTING

3.2.1 Preparation and Application
Ferrous metal surfaces shall be prepared in accordance with SSPC SP 6 and painted with two coats of epoxy paint in accordance with SSPC PS 13.01.

3.2.2 Testing
Coating shall be examined for flaws and tested for thickness. Thickness of coatings shall be measured wet and dry using a commercial film thickness gauge. The Contracting Officer shall be notified in advance of any painting. Additional coats shall not be applied until the previous coat has been approved. Repair or additional coats shall be accomplished at no additional cost to the government.

3.2.3 Coating Repair

If welding is required after application of the coating or if the coating is damaged in any way, repair shall consist of preparing the affected area in compliance with SSPC SP 6 and reapplying the coating to that area. If holidays are detected or film thickness is insufficient, the surface shall be prepared and additional coats applied in the affected area in compliance with the manufacturer's instructions.

3.3 VALVE AND PIPE INSTALLATION

3.3.1 Valves

Valves shall be installed as nearly as possible in the position shown. Valves shall be erected and supported in their respective position free from distortion and strain on appurtenances during handling and installation. Material shall be inspected for defects in workmanship and material. Debris and foreign material shall be cleaned out of valve openings and seats; operating mechanisms shall be operated to check their proper functioning, and nuts and bolts checked for tightness. Valves and other equipment which do not operate easily or are otherwise defective shall be repaired or replaced.

3.3.2 Piping

Piping shall be installed to accurate lines and grades. Where temporary supports are used they shall be sufficiently rigid to prevent shifting or distortion of the pipe. Provision shall be made for expansion where necessary. Piping shall pitch toward low points, and provision shall be made for draining these low points. A sufficient number of unions or flanges shall be used to allow for the dismantling of all water pipe, valves, and equipments. Installation of piping including cleaning, cutting, threading and jointing, shall be in accordance with manufacturer requirements and specifications noted in this Section.

3.4 FILTER MEDIA INSTALLATION

Media shall be installed under the supervision of the filter equipment supplier. Before installing the filter media, the Contractor shall check all piping connections and ensure filter components are in good condition and proper position.

3.4.1 Media Layers

Each layer of media shall be completed before the next layer above is started. Each layer of media shall be deposited so as not to disturb the level surface of the layer below. Any media which is made dirty before or after placement shall be removed and replaced.

3.4.2 Cleaning of Media

The filter media shall be backwashed, scraped, and skimmed in accordance with AWWA B100 to remove excess fine material upon completion of placement of each layer. The number of washes, the wash rate and duration of wash required to achieve the specified gradation for each layer shall be in accordance with the recommendations of the filter media supplier.

3.5 IDENTIFICATION SYSTEMS

3.5.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures.

3.6 VENT LINE INSTALLATION

The vent line shall be installed according to the manufacturer's standard design and placement. The vent line shall be located in position to reduce system operating pressure prior to replacement of filter elements.

3.7 POSTING FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted where directed. Condensed operating instructions, prepared in typed form, shall be framed as specified above and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system.

3.8 FIELD TESTS AND INSPECTIONS

Following completion of installation of the treatment systems and after the Contractor and manufacturer's representative agree the system is ready for operation, the system shall be operated over an initial operating period not to exceed 2 days. The Contractor shall demonstrate proper operation of the equipment, including, but not limited to, the ability of the system to produce the minimum specified effluent requirements detailed in Paragraph Design Criteria or Cartridge and Bag Design Criteria (as applicable), proper operation of the media cleaning equipment, and the control system ability to provide the correct operational logic to optimize the filtration process.

3.8.1 Acceptance Testing

Acceptance testing shall commence not sooner then 1 day and not later than 10 days following approval of the initial operation. The acceptance tests shall demonstrate the ability of the filtration system to meet the effluent specified requirements when operating at the design flow rate and to demonstrate the control system ability to provide the correct operational logic to optimize the filtration process. The tests shall be conducted over 5 days of continuous operation. Two effluent samples shall be collected during each day. Samples shall be taken not less than 6 hours nor more than 10 hours apart. The samples shall be analyzed for turbidity and total suspended solids. For the filtration system to qualify for process acceptance, the average value of each of the filtered water effluent parameters monitored during the continuous testing shall not exceed the values of the specified parameters. In the event that the specified filtered water quality requirements are not met during the period that acceptance testing is conducted, the defective equipment or operation shall be modified or replaced and the testing repeated. The schedule for retesting is subject to approval by the Project Engineer.

3.9 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Field training shall cover all of the items contained in the Operating and Maintenance Instructions. The instructions shall include, but shall not be limited to, the following:

a) System layout showing piping, valves and controls and installation requirements.

b) Approved wiring, logic, and control diagrams prepared in accordance with ISA S5.1 including a drawing index, legend and symbols list, and abbreviations and identifiers.

c) A control sequence describing startup, operation, and shutdown; including the functional and operational description of the control system covering the procedures for programming, operation, startup, shut-down, and calibration.

d) Operating and maintenance instructions for each piece of equipment, including checkout, troubleshooting, and servicing.

e) Manufacturer's bulletins, cut sheets and descriptive data, parts list, and recommended spare parts.

END OF SECTION

SECTION 13080

SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASME INTERNATIONAL (ASME)
ASME B18.2.1 (1996) Square and Hex Bolts and Screws, Inch Series
ASME B18.2.2 (1987; R 1999) Square and Hex Nuts

ASTM INTERNATIONAL (ASTM)
ASTM A 153/A 153M (2003) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307 (2002) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325 (2002) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M (2003) Structural Bolts, Steel, Heat Treated, 830 Mpa Minimum Tensile Strength (Metric)
ASTM A 36/A 36M (2003a) Carbon Structural Steel
ASTM A 500 (2003) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 53/A 53M (2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563 (2000) Carbon and Alloy Steel Nuts
ASTM A 563M (2001) Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M (2003a) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 603 (1998; R 2003) Zinc-Coated Steel Structural Wire Rope
ASTM A 653/A 653M (2003) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 488 (1996; R 2003) Strength of Anchors in Concrete and Masonry Elements

UNDERWRITERS LABORATORIES (UL)
UL 1570(1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures

U.S. ARMY CORPS OF ENGINEERS (USACE)
TI 809-04(1998) Seismic Design for Buildings

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Lighting Fixtures in Buildings;

Bracing; G

Resilient Vibration Isolation Devices; G

Equipment Requirements; G
Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. For equipment and systems in buildings that have a performance objective higher than life-safety, the drawings shall be stamped by the registered engineer who stamps the calculations required above.

SD-03 Product Data

Lighting Fixtures in Buildings; G

Bracing; G

Equipment Requirements; G
Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements
The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems, the electrical equipment and systems, and the miscellaneous equipment and systems listed below. Seismic protection requirements shall be in accordance with TI 809-04 and additional data furnished by the EPA, and shall be provided in addition to any other requirements called for in other sections of these specifications. The design for seismic protection shall be based on a Seismic Use Group I,II,IIIH, or IIIE building occupancy and on site 0.2 second spectra response acceleration of 150% g and 1.0 second spectra response acceleration of 60% g. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. The basic force formulas, for Ground Motions A and B in Chapter 3 of TI 809-04, use the design spectral response acceleration parameters for the performance objective of the building, not for equipment in the building; therefore, corresponding adjustments to the formulas shall be required.

1.3.2 Equipment and Systems
The bracing for equipment and systems shall be developed by the Contractor in accordance with the requirements of this specification.

1.4 EQUIPMENT REQUIREMENTS

1.4.1 Rigidly Mounted Equipment
The items of equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in TI 809-04, Chapter 10. For any rigid equipment which is rigidly attached on both sides of a building expansion joint, flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions, shall be provided.

1.4.2 Nonrigid or Flexibly-Mounted Equipment
The items of equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of 1.5 times the operating weight of the equipment at the vertical center of gravity of the equipment.

PART 2 PRODUCTS

2.1 BOLTS AND NUTS
Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A 307 for bolts and ASTM A 563 for nuts or ASTM A 325 for bolts and nuts. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153.

2.2 SWAY BRACING
Material used for members listed in this section, shall be structural steel conforming with the following:

a) Plates, rods, and rolled shapes, ASTM A 36, and ASTM A 572, Grade 503.

b) Wire rope, ASTM A 603.

c) Tubes, ASTM A 500, Grade B.

d) Pipes, ASTM A 53, Type E or S, Grade B.

e) Light gauge angles, less than 1/4 inch thickness, ASTM A 653.

PART 3 EXECUTION

3.1 BRACING
Bracing shall conform to the arrangements shown. Trapeze-type hanger shall be secured with not less than two 1/2 inch bolts. Conduit shall be braced as for an equivalent weight pipe in accordance with standards of seismic protection for mechanical equipment.

3.2 BUILDING DRIFT
Sway braces for a piping run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided.

3.3 ANCHOR BOLTS

3.3.1 Cast-In-Place
Floor or pad mounted equipment shall use cast-in-place anchor bolts, except as specified below. Two nuts shall be provided on each bolt. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

3.3.2 Expansion or Chemically Bonded Anchors

Expansion or chemically bonded anchors shall not be used unless test data in accordance with ASTM E 488 has been provided to verify the adequacy of the specific anchor and application. Expansion or chemically bonded anchors shall not be used to resist pull-out in overhead and wall installations if the adhesive is manufactured with temperature sensitive epoxies and the location is accessible to a building fire. Expansion and chemically bonded anchors shall be installed in accordance with the manufacturer's recommendations. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

3.3.2.1 General Testing

Expansion and chemically bonded anchors shall be tested in place after installation. The tests shall occur not more than 24 hours after installation of the anchor and shall be conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

3.3.2.2 Torque Wrench Testing

Torque wrench testing shall be done on not less than 50 percent of the total installed expansion anchors and at least one anchor anchor for every piece of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Torque wrenches shall be calibrated at the beginning of each day the torque tests are performed. Torque wrenches shall be recalibrated for each bolt diameter whenever tests are run on bolts of various diameters. The applied torque shall be between 20 and 100 percent of wrench capacity. The test torque shall be reached within one half turn of the nut, except for 3/8 inch sleeve anchors which shall reach their torque by one quarter turn of the nut. If any anchor fails the test, similar anchors not previously tested shall be tested until 5 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

3.3.2.3 Pullout Testing

Expansion and chemically bonded anchors shall be tested by applying a pullout load using a hydraulic ram attached to the anchor bolt. At least 5 percent of the anchors, but not less than 3 per day shall be tested. The load shall be applied to the anchor without removing the nut; when that is not possible, the nut shall be removed and a threaded coupler shall be installed of the same tightness as the original nut. The test setup shall be checked to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus shall be at least 1.5 times the embedment length away from the bolt being tested. Each tested anchor shall be loaded to 1 times the design tension value for the anchor. The anchor shall have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested shall be tested until 5 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified load; if the anchor still fails the test it shall be replaced.

3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS, except that an equipment weight equal to five times the actual equipment weight shall be used.

3.4.1 Resilient and Spring-Type Vibration Devices

Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.

3.4.2 Multidirectional Seismic Snubbers

Multidirectional seismic snubbers employing elastomeric pads shall be installed on floor or slab mounted equipment. These snubbers shall provide 0.25 inches free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

3.5 SWAY BRACES FOR PIPING

Transverse sway bracing for pipe shall be provided at recommended intervals. Bracing shall consist of at least one vertical angle 2 x 2 inches x 16 gauge and one diagonal angle of the same size.

3.5.1 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided in accordance recommendations.

3.5.2 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

3.5.3 Maximum Length for Anchor Braces

Type	Size (Inches)	Maximum Length* (Feet/Inches)
Angles	1-1/2 x 1-1/2 x 1/4 2 x 2 x 1/4 2-1/2 x 1-1/2 x 1/4 3 x 2-1/2 x 1/4 3 x 3 x 1/4	4-10 6-6 8-0 8-10 9-10
Rods	3/4 7/8	3-1 3-8
Flat Bars	1-1/2 x 1/4 2 x 1/4 2 x 3/8	1-2 1-2 1-9
Pipes (40S)	1 1-1/4 1-1/2 2	7-0 9-0 10-4 13-1

3.5.4 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 1/2 inch diameter.

3.6 EQUIPMENT SWAY BRACING

3.6.1 Suspended Equipment and Light Fixtures

Equipment sway bracing shall be provided for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged and secured at both ends with not less than 1/2 inch bolts. Sufficient braces shall be provided for equipment to resist a horizontal force as specified in Chapter 10 of TI 809-04 without exceeding safe working stress of bracing components. The Contractor shall provide, for approval, specific force calcualtions in accordance with Chapter 10 of TI 809-04 for the equipment in the project. Details of equipment bracing shall be submitted for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.6.2 Floor or Pad Mounted Equipment

3.6.2.1 Shear Resistance

Floor mounted equipment shall be bolted to the floor. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

3.6.2.2 Overturning Resistance

The ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads shall be used to determine if overturning forces need to be considered in the sizing of anchor bolts. Calculations shall be provided to verify the adequacy of the anchor bolts for combined shear and overturning.

END OF SECTION

SECTION 13100A

LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
ANSI C135.30 (1988) Zinc-Coated Ferrous Ground Rods for Overhead or Underground Line Construction

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 70 (2002) National Electrical Code
NFPA 780 (2000) Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)
UL 467 (1993; Rev thru Feb 2001) Grounding and Bonding Equipment
UL 96 (1994; Rev thru Jan 2000) Lightning Protection Components
UL 96A (2001) Installation Requirements for Lightning Protection Systems
UL Elec Const Dir (2003) Electrical Construction Equipment Directory

1.2 GENERAL REQUIREMENTS

1.2.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Project Engineer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Project Engineer.

1.2.2 System Requirements

The system furnished under this specification shall consist of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and shall be the manufacturer's latest UL approved design. The lightning protection system shall conform to NFPA 70 and NFPA 780, UL 96 and UL 96A, except where requirements in excess thereof are specified herein.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General Requirements

No combination of materials shall be used that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist which would cause corrosion of conductors, conductors with protective coatings or oversize conductors shall be used. Where a mechanical hazard is involved, the conductor size shall be increased to compensate for the hazard or the conductors shall be protected by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

2.1.2 Main and Secondary Conductors

Conductors shall be in accordance with NFPA 780 and UL 96 for Class I, Class II, or Class II modified materials as applicable.

2.1.2.1 Copper

Copper conductors shall be used to connect each building column to the ground ring. The size of any wire in the cable shall be not less than No. 15 AWG, and the cable shall not be smaller than No. 1/0 AWG.

2.1.2.2 Aluminum

Aluminum shall not contact the earth nor shall it be used in any other manner that will contribute to rapid deterioration of the metal. Appropriate precautions shall be observed at connections with dissimilar metals. Aluminum conductors for bonding and interconnecting metallic bodies to the main cable shall be at least equivalent to strength and cross-sectional area of a No. 4 AWG aluminum wire. A strip width that is at least twice that of the diameter of the perforations shall be used. Aluminum strip for connecting exposed water pipes shall be not less than No. 12 AWG in thickness and at least 1-1/2 inches wide.

2.1.3 Ground Ring

The ground ring shall consist of a bare copper cable not less than 4/0 AWG.

2.1.4 Connectors

Connections made to the ground ring and all other connections, bonds, and splices shall be done by exothermic welds or by high compression fittings. The exothermic welds and high compression fittings shall be listed for the purpose. The high compression fittings shall be the type which require a hydraulically operated mechanism to apply a minimum of 10,000 psi.

2.1.5 Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, chimney bands, clips, and fasteners shall conform to UL 96, classes as applicable.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

3.1.1 General Requirements

The lightning protection system shall consist of down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground. All conductors on the structures shall be exposed except where conductors are in protective sleeves exposed on the outside walls. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts.

3.1.1.1 Down Conductors

Down conductors shall be electrically continuous from each building column to grounding ring.

3.1.1.2 Interconnection of Metallic Parts

Metal doors, windows, and gutters shall be connected directly to the grounds or down conductors using not smaller than No. 6 copper conductor, or equivalent. Conductors placed where there is probability of unusual wear, mechanical injury, or corrosion shall be of greater electrical capacity than would normally be used, or shall be protected. The ground connection to metal doors and windows shall be by means of mechanical ties under pressure, or equivalent.

3.1.1.3 Ground Connections

Ground connections comprising continuations of down conductors from the structure to the grounding ring shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. There shall be a ground connection for each down conductor. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

3.1.1.4 Grounding Ring

A grounding ring shall be provided and located not less than 3 feet nor more than 8 feet from the structures foundation. The complete installation shall have a total resistance to ground of not more than 25 ohms. The system shall be tested not less than 24 hours after rainfall. When the resistance of the complete installation exceeds 25 ohms, the EPA shall be notified immediately. The ground ring shall be of No. 4/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 30 inches deep at a distance not less than 3 feet nor more than 8 feet from the nearest point of the structure. All connections between ground connectors and grounds shall be electrically continuous. Where so indicated on the drawings, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radially from the building. The lower ends of the down conductors or their equivalent in the form of metal strips or wires are then buried in the trenches.

3.1.2 Steel Frame Building

The steel framework shall be made electrically continuous. Electrical continuity may be provided by bolting, riveting, or welding steel frame, unless a specific method is noted on the drawings. Where a grounded metal pipe water system enters the building, the structural steel framework and the water system shall be connected at the point of entrance by a ground connector. Connections to pipes shall be by means of ground clamps with lugs. Connections to structural framework shall be by means of nut and bolt or welding. All connections between columns and ground connections shall be made at the bottom of the steel columns. Ground connections to grounding electrons or counterpoise shall be run from not less than one-half of all the columns distributed equally around the perimeter of the structure at intervals averaging not more than 60 feet.

3.2 FENCES

Except as indicated below, metal fences that are electrically continuous with metal posts extending at least 2 feet into the ground require no additional grounding. Other fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods every 1,000 to 1,500 feet of length when fences are located in isolated places, and every 500 to 750 feet when in proximity 100 feet or less to public roads, highways, and buildings. The connection to ground shall be made from the post where it is of metal and is electrically continuous with the fencing. All metal fences shall be grounded at or near points crossed by overhead lines in excess of 600 volts and at distances not exceeding 150 feet on each side of line crossings.

3.3 INSPECTION

The lightning protection system will be inspected by the Project Engineer or other qualified person to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Construction Manager or Project Engineer.

END OF SECTION

SECTION 13120

PREENGINEERED STEEL BUILDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)
AA 30 (1986) Aluminum Structures, Construction Manual Series Section 1
AA 45 (2003) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)
AAMA 101 (2005) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
AISC FCD (1995a) Quality Certification Program Description
AISC Pub No. S303 (2000) Code of Standard Practice for Steel Buildings and Bridges
AISC S329 (20045) Allowable Stress Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts
AISC S335 (1989) Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
ASCE 7 (2005) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)
AWS D1.1/D1.1M (2006) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)
ASTM A 252 (1998; R 2002) Welded and Seamless Steel Pipe Piles
ASTM A 36/A 36M (2005) Carbon Structural Steel
ASTM A 463/A 463M (2005) Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 500 (2003a) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501 (2001) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 529/A 529M (2005) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 53/A 53M (2004a) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 570/A 570M (1998) Steel, Sheet and Strip, Carbon, Hot-Rolled
ASTM A 572/A 572M (2004) High-Strength Low-Alloy Columbium-Vanadium Structural Steel ASTM A 588/A 588M (2005) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 606 (2004) Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 607 (1998) Steel, Sheet and Strip, High-Strength, Low-Alloy, Columbium or Vanadium, or Both, Hot-Rolled andCold-Rolled
ASTM A 618 (2004) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing

ASTM A 653/A 653M(2004a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 755/A 755M (2004a) Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
ASTM A 792/A 792M (2003) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM B 209 (2004) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M (2004) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221 (2005) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M (2005) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 241/B 241M (2002) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
ASTM B 308/B 308M (2002) Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B 429 (2002) Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C 1289 (2005) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 236 (1989; R 1993e1) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM C 518 (2004) Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 553 (2002) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 578 (2005) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 612 (2004) Mineral Fiber Block and Board Thermal Insulation
ASTM C 991 (2003) Flexible Glass Fiber Insulation for Metal Buildings
ASTM D 1308 (2002e1) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 1654 (1992; R 2000) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 2244 (2002e1) Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D 2247 (2002) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 2794 (1993; R 2004) Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
ASTM D 3359 (2002) Measuring Adhesion by Tape Test
ASTM D 3841 (1997; R 2001) Glass-Fiber-Reinforced Polyester Plastic Panels
ASTM D 4214 (1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4397 (2002) Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 522 (1993a; R 2001) Mandrel Bend Test of Attached Organic Coatings
ASTM D 523 (1989; R 1999) Specular Gloss
ASTM D 5894 (1996) Cyclic Salt Fog/UV Exposure of Painted Metal, (Alternating Exposures in a Fog/Dry Cabinet and a UV/Condensation Cabinet)
ASTM D 610 (2001) Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D 714 (2002) Evaluating Degree of Blistering of Paints
ASTM D 828 (1997; R 2002) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
ASTM D 968 (1993; R 2001) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM E 84 (2005) Surface Burning Characteristics of Building Materials
ASTM E 96 (2005) Water Vapor Transmission of Materials

ASTM G 23 (1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)
BHMA A156.1 (2000) Butts and Hinges
BHMA A156.2 (2003) Bored and Preassembled Locks and Latches
BHMA A156.3 (2001) Exit Devices
BHMA A156.4 (2000) Door Controls - Closers

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)
CMAA 70 (2004) EnviroTop Running and Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes, No. 70

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)
MBMA MBSM (2002) Metal Building Systems Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)
SMACNA Arch. Manual (2003e6) Architectural Sheet Metal Manual

STEEL DECK INSTITUTE (SDI)
SDI DDM02 (1991) Diaphragm Design Manual

STEEL DOOR INSTITUTE (SDI)
SDI A250.8 (2003) Standard Steel Doors and Frames

STEEL WINDOW INSTITUTE (SWI)
SWI SGSW (2002) Architect's Guide to Steel Windows

UNDERWRITERS LABORATORIES (UL)
UL 580 (1994; Rev thru Feb 1998) Tests for Uplift Resistance of Roof Assemblies

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 – SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Preengineered Building; G
Template for anchorage
Submit as necessary to erect the building and install components.

SD-03 Product Data
Preengineered metal building materials
Submit sufficient data indicating conformance to specified requirements on materials provided under this section.

Instruction Manuals
Erection
Qualifications

SD-04 Samples
Factory color finish
Accessories
Roofing and Siding
Fasteners
Insulation
Gaskets and Insulating Compounds
Sealants
Skylights
Wall Liners

SD-05 Design Data
Building; G
Foundation loads; G
Anchor bolts; G

SD-06 Test Reports
Factory Color Finish
Insulation

SD-07 Certificates
Preengineered metal building materials
Submit certificates attesting that materials comply with this specification.

SD-10 Operation and Maintenance Data
Preengineered Building, data package 1; G

1.3 SYSTEM DESCRIPTION

1.3.1 Design Requirements

1.3.1.1 Design Analysis

The design analysis shall be the design of a licensed Professional Engineer experienced in design of this work and shall include complete calculations for the building, its components, and the foundations. Foundations shown on the drawings are based on loads derived from a representative set of similar building types. The Contractor shall obtain the services of a licensed Professional Engineer to verify that the foundations shown are adequate for the building supplied using the criteria in paragraph Foundations. Formulas and references shall be identified. Assumptions and conclusions shall be explained, and cross-referencing shall be clear. Wind forces on various parts of the structure, both positive and negative pressure, shall be calculated with the controlling pressure summarized. Lateral forces due to seismic loading shall be calculated and tabulated for the various parts and portions of the building. Computer programmed designs shall be accompanied by stress values and a letter of certification, signed by a licensed Professional Engineer, stating the design criteria and procedures used and attesting to the adequacy and accuracy of the design. A narrative of the computer program delineating the basic methodology shall be included. Computer program output shall be annotated and supplemented with sketches to verify the input and output. Critical load conditions used in the final sizing of the members shall be emphasized. The design analysis shall include the name and office phone number of the designer, who shall function as a point of contact to answer questions during the detail drawing review.

1.3.1.2 Dimensions
Building dimensions shall be as standard with manufacturer, not less than those indicated, but exceeding the indicated dimensions only by the amount of the closest standard size thereto. Eave height shall be measured from the top of finished floor to intersection of insides of roof and sidewall sheets. The clear height between finished floor and bottom of roof steel shall be as indicated.

1.3.1.3 Framing
Provide building with vertical walls and gable roof. Building shall be single-span structures with one of the following framing systems: self-framing, column with single-span or continuous trusses, continuous beam frames, column with rigid frame, or rigid frame type, similar to AISC S335, Type I construction. End walls shall be of rigid frame. Roof slope shall be 3 to 12. Design framed openings structurally.

1.3.1.4 Foundation Requirements
Design foundations for allowable soil bearing pressure and a minimum bottom of footing depth as indicated. The foundation loads are supplied by the building manufacturer. The building foundation will consist of a 10-inch thick reinforced concrete slab with a secondary containment berm and sump. Typical Sections of the compound foundation are indicated on Drawing C-13.

1.3.2 Performance Requirements
MBMA MBSM, for loading combinations and definitions with the exceptions of wind load and special collateral loads. Design for each material shall be as specified by the Design Authority as listed in MBMA MBSM.

1.3.2.1 Dead Loads
The dead load shall consist of the weight of all permanent construction such as roof, framing, covering members and all other materials of the building system.

1.3.2.2 Roof Live Loads

a. Uniform Loads: Uniform roof live loads, including maintenance traffic and construction loads, shall be determined and applied in accordance with ASCE 7.

b. Concentrated Loads: In addition to ASCE 7 roof live loads, a minimum design concentrated load of 300 pounds shall be used to simulate a construction load on roof panels. The concentrated load shall be applied at the panel midspan and shall be resisted by a single standing seam metal roof panel, or a 24 inches wide corrugated metal panel, assumed to be acting as a beam. The undeformed shape of the panel shall be used to determine the section properties.

1.3.2.3 Wind Loads
Compute and apply wind pressures, ASCE 7. Basic wind speed and multiplying factors are as indicated. The ground wind speed shall be 90 mph.

1.3.2.4 Impact Loads
Impact loads due to monorails of 1000 lb magnitude shall be applied as indicated in MBMA MBSM.

1.3.2.5 Seismic Loads
As required for ground motion acceleration indicated. According to the International Building Code, Figure 1615(3), Maximum Considered Earthquake Ground Motion will have a 0.2 second spectra response acceleration of 150% g and from Figure 1615(4), will have a 1.0 second spectra response acceleration of 60% g.

1.3.2.6 Collateral Loads
Collateral load of 10 pounds per square foot shall be applied to the entire structure to account for the weight of additional permanent materials other than the building system, such as mechanical systems, electrical systems, etc. This allowance does not include the weight of hung equipment weighing 50 pounds or more. Equipment loads of 50 pounds or more shall be shown on the shop (detail) drawings and the structure frame, purlins, girts shall be strengthened as required. The Contractor is responsible for providing the building manufacturer the magnitude and approximate location of all concentrated loads greater than 50 pounds before design of the building commences.

1.3.2.7 Deflection

a. Structural Members: The maximum deflection of main framing members shall not exceed 1/240th of their respective spans. The maximum deflection due to live load in roof panels and purlins shall not exceed 1/180th of their respective spans.

b. Roof Panels: UL 580, Class 90. The design analysis shall establish that the roof when deflected under dead plus live or snow loads, will not result in a negative gradient. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect. In addition, the roof decking shall be designed for a 300-pound concentrated load at midspan on a 24 inch wide section of deck. Panels thinner than 0.03 inches are not permitted for diaphragms used to resist seismic loads.

c. Wall Panels: The maximum deflection due to wind on wall panels and girts shall be limited to 1/120th of their respective spans except that when interior finishes are used the maximum allowable deflection shall be limited to 1/180th of their respective spans.

d. Openings: Limit deflections of steel framing above and along the side of rolling door openings to a maximum of 1/2 the allowable movement in the telescoping top roller of the doors to ensure proper operation. Frame all equipment openings over 12 by 12 inches.

1.3.2.8 Provisions for Gutters and Downspouts
Gutters and downspouts shall be designed according to the requirements of SMACNA Arch. Manual for storms which should be exceeded only once in 5 years and with adequate provisions for thermal expansion and contraction. Supports for gutters and downspouts shall be designed for the anticipated loads. Roof drainage system to withstand rainfall intensity of 3 inches per hour, with 5 minute duration.

1.3.2.9 Provisions for Louvers
Louvers shall be fixed-blade type designed for a minimum net open area of 1 square foot, to be rainproof, and to resist vibration when air is passed at the rate of 100 cubic feet per minute.

1.3.2.10 Ventilators

Continuous Ventilators: Continuous roof ventilators shall be ridge mounted gravity type, without dampers, designed for a minimum capacity of 100 cubic feet of air per minute for each 10 foot section based on a wind velocity of 5 miles per hour and an exterior-interior temperature differential of 10 degrees F and without screens in place.

1.3.2.11 Drift Provisions

Lateral deflections, or drift, at the roof level of a structure in relation to the floor or slab on grade, caused by deflection of horizontal force resisting elements, shall be less than 1 inch.

1.3.2.12 Monorail

The monorail loads shall be obtained from the monorail manufacturer and shall be applied per MBMA MBSM for the design of monorail supports. Monorail loads, including lateral support, to be provided by the building structure.

1.2.2.13 Grounding and Lightning Protection

Grounding and lightning protection shall be provided as specified in Section 13100A LIGHTNING PROTECTION SYSTEM.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Qualifications of the manufacturer, the manufacturer's Representative when one is used, and qualifications and experience of the building erector. A brief list of locations where buildings of similar design have been used shall be included with the detail drawings and shall also include information regarding date of completion, name and address of owner, and how the structure is used.

1.4.1.1 Manufacturer

The manufacturer shall have AISC FCD, category MB certification.

1.4.1.2 Installer

Erector shall have specialized experience in the erection of metal building systems for a period of at least 3 years.

1.4.1.3 Manufacturer's Representative

A representative designated by the building manufacturer, who is familiar with the design of the building supplied and experienced in the erection of metal buildings similar in size to the one required under this contract, shall be present at the job site during construction, from the start of the structural framing erection until completion of the installation of the exterior covering, to assure that the building is erected properly.

1.4.2 Regulatory Requirements

1.4.2.1 Drawings: Preengineered Building

Submit complete design drawings for the preengineered building. Submit drawings for the foundations and anchorage.

1.4.2.2 Design Data Building
Submit design calculations for the entire preengineered building and foundations, prepared and stamped by a professional engineer. Also submit for components requested, and stamp with the seal of a professional engineer. Include sizes and location of anchor bolts.

1.4.3 Coordination Meeting
A coordination meeting shall be held within 45 days after contract award for mutual understanding of the metal building system contract requirements. This meeting shall take place at the building site and shall include representatives from the Contractor, the roofing/metal building system manufacturer, the roofing/metal building supplier, the erector, the designer, and the Contracting Officer. All items required by paragraph SUBMITTALS shall be discussed, including applicable standard manufacturer shop drawings, and the approval process. The Contractor shall coordinate time and arrangements for the meeting.

1.4.4 Instructions

1.4.4.1 Instruction Manuals
Manufacturer's literature for individual building component systems.

1.4.4.2 Erection
Manufacturer's erection instruction and erection drawings describing the preparation requirements, assembly sequence, temporary bracing, shoring, and related information necessary for erection of the metal building including its structural framework and components.

1.4.5 Samples

1.4.5.1 Factory color Finish
Submit one sample of each color indicated for verification that the color matches the colors indicated. Where colors are not indicated, submit not less than four different samples of manufacturer's standard colors for selection by the Project Engineer.

1.4.5.2 Accessories
One sample of each type of flashing, trim, closure, cap and similar items. Size shall be sufficient to show construction and configuration.

1.4.5.3 Roofing and Siding
One piece of each type and finish (exterior and interior) to be used, 9 inches long, full width. The sample for factory color finished covering shall be accompanied by certified laboratory test reports showing that the sheets to be furnished are produced under a continuing quality control program and that a representative sample consisting of not less than 5 pieces has been tested and has met the quality standards specified for factory color finish.

1.4.5.4 Fasteners
Two samples of each type to be used, with statement regarding intended use. If so requested, random samples of bolts, nuts, and washers as delivered to the job site shall be taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

1.4.5.5 Gaskets and Insulating Compounds
Two samples of each type to be used and descriptive data.

1.4.5.6 Sealant
One sample, approximately 1 pound, and descriptive data.

1.4.5.7 Wall Liners
One piece, 9 inches long, full width.

1.5 DELIVERY, STORAGE, AND HANDLING
Deliver, store, and handle manufactured items so that materials remain dry and undamaged. Do not store in contact with materials that might cause staining.

1.6 WARRANTIES

1.6.1 Warranty
The Metal Building System, composed of framing and structural members, roofing and siding, gutters and downspouts, accessories, fasteners, trim, and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer) shall be warranted as described below against material and workmanship deficiencies, system deterioration caused by exposure to the elements and service design loads, leaks and wind uplift damage. Any emergency temporary repairs conducted by the owner shall not negate the warranties.

1.6.2 Prime Contractor's Weathertightness Warranty
The Metal Building System shall be warranted by the Contractor on a no penal sum basis for a period of five years against materials and workmanship deficiencies; system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks, and wind uplift damage. The Metal Building System covered under this warranty shall include but is not limited to the following: framing and structural members, roofing and siding panels and seams, interior or exterior gutters and downspouts, accessories, fasteners, trim, flashings and miscellaneous building closure items such as doors and windows (when furnished by the manufacturer), connectors, components, and fasteners, and other system components and assemblies installed to provide a weathertight system; and items specified in other sections of these specifications that become part of the metal building system. All material and workmanship deficiencies, system deterioration caused by exposure to the elements and/or inadequate resistance to specified service design loads, water leaks and wind uplift damage shall be repaired as approved by the Contracting Officer. See the attached Contractor's written warranty for issue resolution of warrantable defects. This warranty shall warrant and cover the entire cost of repair or replacement, including all material, labor, and related markups. The Contractor shall supplement this warranty with written warranties from the installer and/or system manufacturer, which shall be submitted along with Contractor's warranty. However, the Contractor is ultimately responsible for this warranty. The Contractor's written warranty shall be as outlined in attached WARRANTY FOR METAL BUILDING SYSTEMS, and start upon final acceptance of the facility. The Contractor shall provide a separate bond in an amount equal to the installed total metal building system cost in favor of the owner (Government) covering the Contractor's warranty responsibilities effective throughout the five year Contractor's warranty period for the entire metal building system as outlined above.

1.6.3 Manufacturer's Material and/or System Weathertightness Warranties
The Contractor shall furnish, in writing, the following manufacturer's material warranties to the Contracting Officer which cover all Metal Building System components:

a. A manufacturer's 20 year material warranty warranting that the specified aluminum, zinc-coated steel, aluminum-zinc alloy coated steel or aluminum-coated steel will not rupture, structurally fail, fracture, deteriorate, or become perforated under normal design atmospheric conditions and service design loads. Liability under this warranty shall be limited exclusively to the cost of either repairing or replacing nonconforming, ruptured, perforated, or structurally failed securement system including fasteners and coil material.

b. A manufacturer's 20 year exterior material finish warranty on the factory colored finish warranting that the finish, under normal atmospheric conditions at the site, will not crack, peel, or delaminate; chalk in excess of a numerical rating of eight, as determined by ASTM D 4214 test procedures; or change colors in excess of five CIE or Hunter Lab color difference (delta E) units in accordance with ASTM D 2244. Liability under this warranty is exclusively limited to replacing the defective coated material.

PART 2 PRODUCTS

2.1 WALL AND ROOF MATERIALS

MBMA MBSM except as specified otherwise herein. Design roof and wall panels, accessories, and flashings to be completely weathertight and free of abrasions, loose fasteners, and deformations. Each piece or part of the assembly shall be clearly and legibly marked to correspond with the drawings.

2.1.1 Minimum Thickness

As required to conform to design requirements but not less than the following:

Items	Minimum Thickness (Uncoated)
Steel Structural Members Other Than Roof and Wall Panels	18 Manufacturer's Standard (MFG STD) gage, 0.0478 inch
Roof and Wall Panels Steel	26 MFG STD gage, 0.0179 inch
Gable and Eave Trim, Fascia Closure Strips, Rake Flashings, Copings, and Liner Panels Steel	26 MFG STD gage
Eave Gutters and Downspouts Steel	26 MFG STD gage
Roof Ventilators Steel	26 MFG STD gage
Louvers Steel	18 MFG STD gage, 0.0478 inch
Girders and Columns	3/16 inch
Purlins and Girts	14 Manufacturer’s Standard gage (MFG STD)
Bracing	3/16 inch thick steel memebers
Column Base Plates	5/8 inch thick
Column Anchor Bolts	5/8 inch diameter

2.1.2 Panels

a. Fabricated of zinc-coated steel.

b. Preformed.

c. If designed as diaphragm, roof decks shall be designed in accordance with SDI DDM02.

Depth of the panels shall be as required for loads and deflection limitations. Panels over 30 feet in length shall be designed for thermal expansion and contraction.

2.1.2.1 Zinc-Coated Steel Sheet
ASTM A 755/A 755M, Coating Class Z 350 G-90 or ASTM A 653/A 653M, SQ, Grade 33, Coating Class Z 350 G-90.

2.1.3 Wall Liners
Wall liners shall be 0.018 inch thick minimum for steel with the same composition specified for panels, and formed or patterned to prevent waviness and distortion, and shall extend from floor to the required height above the floor. Matching metal trim shall be provided at base of wall liner, at top of wall liner, around openings in walls and over interior and exterior corners. Wall liners shall have the same factory color finish as specified for the interior face of the wall panels.

2.2 FRAMING AND STRUCTURAL MEMBERS

2.2.1 Steel
ASTM A 36/A 36M, ASTM A 529/A 529M, ASTM A 572/A 572M, or ASTM A 588/A 588M.

2.2.2 Uncoated Steel
ASTM A 570/A 570M, ASTM A 606, or ASTM A 607.

2.2.3 Galvanized Steel
ASTM A 653/A 653M, G 90 coating designation, 0.045 inch minimum thickness.

2.2.4 Structural Tube
ASTM A 500 or ASTM B 221M ASTM B 221.

2.3 ACCESSORIES

2.3.1 Caps, Strips, and Plates
Form ridge caps, eave and edge strips, fascia strips, miscellaneous flashings, and miscellaneous sheet metal accessories from the same material and gage as the roof panels. Wall plates, base angles or base channels, and other miscellaneous framing members may be standard structural steel shapes.

2.3.2 Closure Strips
Provide closure strips of closed-cell or solid-cell synthetic rubber or neoprene, or polyvinyl chloride premolded to match configuration of the covering. Closure strips shall not absorb or retain water.

2.3.3 Sealant

Provide elastomeric type sealant containing no oil or asphalt. Exposed sealant shall cure to a rubberlike consistency. Concealed sealant may be the nonhardening type.

2.3.4 Gaskets and Insulating Compounds

Provide nonabsorptive gaskets and insulating compounds suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.3.5 Fasteners

Provide fasteners for steel wall and roof panels of zinc-coated steel, aluminum, corrosion resisting steel, or nylon capped steel, type and size specified below or as otherwise approved for the applicable requirements. Fasteners for structural connections shall provide both tensile and shear strength of not less than 750 pounds per fastener. Fasteners for accessories shall be the manufacturer's standard. Exposed roof fasteners shall be gasketed or have gasketed washers on the exterior side of the covering to waterproof the fastener penetration. Washer material shall be compatible with the covering; have a minimum diameter of 3/8 inch for structural connections; and gasketed portion of fasteners or washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick. When wall covering is factory color finished, exposed wall fasteners shall be color finished or provided with plastic color caps to match the covering.

2.3.5.1 Screws

Provide self-tapping screws not less than No. 14 diameter and not less than No. 12 diameter if self-drilling/self-tapping type.

2.3.5.2 End-Welded Studs

Provide automatic shouldered type studs with a shank diameter of not less than 3/16 inch and cap or nut for holding covering against the shoulder.

2.3.5.3 Explosive Actuated Fasteners

Fasteners for use with explosive actuated tools shall have a shank diameter of not less than 0.145 inch with a shank length of not less than 1/2 inch for fastening panels to steel and not less than one inch for fastening panels to concrete.

2.3.5.4 Blind Rivets

Provide aluminum rivets with 3/16 inch nominal diameter shank or stainless steel rivets with 1/8 inch nominal diameter shank. Rivets shall be threaded stem type if used for other than the fastening of trim. Provide hollow stem rivets with closed ends.

2.3.5.5 Bolts

Provide bolts not less than 1/4 inch diameter, shouldered or plain shank as required, with proper nuts.

2.3.6 Gutters

Provide complete with mitered corners, end pieces, and special pieces that may be required. Expansion-type slip joints shall be provided at the center of the runs and at intervals of not more than 40 feet for steel. Provide water tight seal at all other joints. Provide gutters below the slope line of the roof, to allow snow and ice to slide clear. Provide hangers and fastenings from a metal compatible with the gutters. Space hangers not more than 36 inches apart.

2.3.7 Downspouts
Provide cross sectional area not less than the size of gutter indicated and complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths; end joints shall telescope not less than 1/2 inch, and longitudinal joints shall be locked. Provide gutter outlets with stainless steel wire ball strainers of a standard type. Position downspouts not less than 1/2 inch away from walls and fasten to the walls at top, bottom, and at not to exceed 5 foot centers intermediately between with manufacturer's standard type leader straps, or concealed type fasteners. Form straps and fasteners from a metal compatible with the downspouts.

2.3.8 Continuous (Ridge) Roof Ventilators
Provide ventilators fabricated of zinc-coated steel the same finish specified in paragraph entitled "Finish," color as indicated, complete with braces, and bird screening. Provide ventilators in sections 8 or 10 feet long, braced at midlength. Join sections together with splice plates of the same material as the sections. Provide end closures for each section.

2.3.9 Doors and Windows
Provide framing members and flashings as necessary fro installation of the doors and windows.

2.3.9.1 Swinging Personnel Doors and Frames
SDI A250.8, Grade II, Model 1, 2, 3, or 4, design as indicated, zinc-coated and shop primed, exterior mounting. Hardware shall conform to BHMA A156.1, BHMA A156.2, BHMA A156.3, and BHMA A156.4.

2.3.9.2 Overhead Doors Rolling Doors
Overhead rolling doors shall conform to the requirements of SECTION 08330A – OVERHEAD ROLLING DOORS.

2.3.10 Insulation
Insulation material and installation shall conform to EPA and building standards.

2.3.11 Sealant
Sealant shall be an elastomeric type containing no oil or asphalt. Exposed sealant shall be colored to match the applicable building color and shall cure to a rubber like consistency.

2.3.12 Gaskets and Insulating Compounds
Gaskets and insulating compounds shall be nonabsorptive and suitable for insulating contact points of incompatible materials. Insulating compounds shall be nonrunning after drying.

2.4 FINISH

2.4.1 Shop Painting
Ferrous metal work, except factory-finished work, zinc-coated work, and work specified to be painted shall be (1) cleaned of dirt, rust, scale, loose particles, grease, oil, and other deleterious substances; (2) phosphate treated; and (3) then be given one coat of an approved rust-inhibiting primer paint of the type standard with the metal building manufacturer.

2.4.2 Factory Color Finish
Provide exterior and interior exposed surfaces of metal roof and wall panels, roof ventilators, louvers, gutters, downspouts, and metal accessories with a Plastisol (PVC); a two-coat system consisting of a polyvinyl-chloride resin dispersed in a plsticizer top-coat over a corrosion-resistant primer. Plastisol is a high-performance, thick coating designed for highly aggressive

and corrosive environments with excellent resistance to common acids, alkalis, and inorganic compounds.

Provide standard dry film thickness of 1.0 mil for exterior coating exclusive of primer. Interior color finish shall consist of the same coating and dry film thickness as the exterior. Provide interior and exterior color finish meeting the test requirements specified below. Tests shall have been performed on the same factory finish and thickness provided. Interior color of metal wall, roof, and liner panels, columns, beams, purlins, and girts shall be manufactures standard white. Exterior color of metal wall panels shall be manufactures standard tan. Exterior color of metal roof panels, gable, eave trim, fascia closure, gutters, and downspouts shall be manufacturers standard white. Exterior color of metal wall panels and trim shall be manufactures standard tan.

2.4.3 Testing of Factory Color Finishes

2.4.3.1 Salt Spray Test

A sample of the sheets shall withstand a cyclic corrosion test for a minimum of 2016 hours in accordance with ASTM D 5894, including the scribe requirement in the test. Immediately upon removal of the panel from the test, the coating shall receive a rating of not less than 10, no blistering, as determined by ASTM D 714; 10, no rusting, as determined by ASTM D 610 and a rating of 6, over 1/16 to 1/8 inch failure at scribe, as determined by ASTM D 1654.

2.4.3.2 Accelerated Weathering Test

ASTM G 23, Method 2, Type D apparatus minimum 2000 hours or Type EH apparatus minimum 500 hours, no checking, blistering or loss of adhesion; color change less than 5 NBS units by ASTM D 2244 and chalking less than No. 8 rating by ASTM D 4214.

2.4.3.3 Flexibility

ASTM D 522, Method A, 1/8 inch diameter, 180 degree bend, no evidence of fracturing to the naked eye.

2.4.3.4 Adhesion

ASTM D 3359, Method B, for laboratory test and film thickness less than 5 mil and Method A for site tests. There shall be no film removed by tape applied to 11 parallel cuts spaced 1/8 inch apart plus 11 similar cuts at right angles.

2.4.3.5 Impact

ASTM D 2794, no loss of adhesion after direct and reverse impact equal to 1.5 times metal thickness in mils, expressed in inch-pounds.

2.4.3.6 Humidity Resistance

ASTM D 2247, 1000 hours, no signs of blistering, cracking, creepage or corrosion on score panel.

2.4.3.7 Abrasion

ASTM D 968, Method A, falling sand shall not expose substrate when tested in quantities 13.2-15.9 gallons of sand per mil of thickness.

2.4.3.8 Formability Test

When subjected to testing in accordance with ASTM D 522 Method B, 1/8 inch diameter mandrel, the coating film shall show no evidence of cracking to the naked eye.

2.4.3.9 Pollution Resistance
Coating shall show no visual effects when covered spot tested in a 10 percent hydrochloric acid solution for 24 hours in accordance with ASTM D 1308.

PART 3 EXECUTION

3.1 INSPECTION
Check concrete dimensions, anchor bolt size and placement, and slab elevation with the metal building manufacturer's templates and drawings before setting any steel.

3.2 ERECTION
Erect in accordance with the manufacturer's approved erection instructions and diagrams. Correct defects and errors in the fabrication of building components in a manner approved by the Contracting Officer. If defects or errors in fabrication of components cannot be corrected, remove and provide nondefective components. When installing wall and roof systems, install closure strips, flashing, sealing material, and other accessories in accordance with building manufacturer's instructions to provide a weathertight system, free of abrasions, loose fasteners, and deformations. After erection is complete, repair and coat abraded and damaged, primed or factory-finished surfaces to match adjacent surfaces.

3.2.1 Dissimilar Materials
Prevent direct contact between aluminum surfaces, and ferrous or other incompatible metals, by one of the following methods:

a. Paint the incompatible metal with a coating of manufacturer's standard heavy-bodied paint.

b. Paint the incompatible metal with a prime coat of corrosion inhibitive primer followed by one or two coats of aluminum metal-and-masonry paint, or other suitable protective coating, excluding products containing lead and chromium pigmentation.

c. Provide an approved nonabsorptive gasket.

d. Apply an approved calking between the aluminum and the incompatible metal.

If drainage from incompatible metal passes over aluminum, paint the incompatible metal by method (a) or (b). Paint aluminum surfaces in contact with concrete or masonry materials by method (a). Paint green or wet wood, or wood treated with incompatible wood preservatives, by method (a) or use two coats of aluminum paint.

3.2.2 Rigid Frames, Bases, and Sill Members
Brace frames as necessary to ensure safety. Set accurately, using a nonshrink grout to obtain uniform bearing on the concrete and to maintain a level base line elevation. Separate leveling plates under column base plates shall not be used. Members shall be accurately spaced to assure proper fitting of panels. As erection progresses, the work shall be securely fastened to resist the dead load and wind and erection stresses. Clean surfaces to receive the mortar and thoroughly moisten immediately before placement of mortar. Water cure exposed surfaces of mortar with wet burlap for 7 days.

3.2.2.1 Field Welding
Steel, AWS D1.1/D1.1M.

3.2.2.2 Field Bolting
AISC S329. Improper or mislocated bolt holes in structural members or other misfits caused by improper fabrication or erection, shall be repaired in accordance with AISC Pub No. S303. Anchor bolts shall be accurately set by template while the concrete is in a plastic state.

3.2.3 Wall Construction
Apply panels in full wall heights from base to eave with no horizontal joints except at the junctions of door frames, window frames, louver panels, and similar locations. Lay side laps away from the prevailing winds. Seal side and end laps with the joint sealing material recommended by the manufacturer. Flash or seal walls at the base, at the top, door frames, framed louvers, and other similar openings. Flashing will not be required where approved "self-flashing" panels are used. Minimum end laps for all types of panels shall be 2 1/2 inches. Minimum side laps for all types of panels shall be one corrugation, one configuration, or an interlocking joint. Install liner panels to height indicated.

3.2.4 Roof Construction
Apply the roofing panels in [full lengths from ridge to eaves with no transverse joints except at the junction of ventilators, curbs, chimneys, equipment protections, and similar openings. Lay side laps away from the prevailing wind, and seal side and end laps with joint sealing material. Flash and seal the roof at the ridge, at eaves and rakes, at projections through the roof, and elsewhere as necessary. Minimum side lap shall be one corrugation, configuration, or interlocking rib.

3.2.5 Installation of Gutters and Downspouts
Gutters and downspouts shall be rigidly attached to the building. Spacing of cleats for gutters shall be 16 inches maximum. Spacing of brackets and spacers for gutters shall be 36 inches maximum. Supports for downspouts shall be spaced at 5 foot centers maximum.

3.2.6 Louvers and Ventilators
Louvers and ventilators shall be rigidly attached to the supporting construction to assure a weather tight installation.

3.2.7 Doors and Windows
Doors and windows, including frames and hardware, shall be securely anchored to the supporting construction, shall be installed plumb and true, and shall be adjusted as necessary to provide proper operation. Joints at doors and windows shall be sealed according to manufacturer's recommendations to provide weathertight construction.

3.2.8 Minimum Fastener Spacing
Space fasteners according to manufacturer's instructions, but not to exceed:

a. 8 inches o.c. at end laps of covering,

b. 12 inches o.c. at connection of covering to intermediate supports,

c. 12 inches o.c. side laps of roof coverings, 18 inches o.c. at side laps of wall.

3.3 FIELD PAINTING

Immediately upon detection, abraded or corroded spots on shop-painted surfaces shall be wire brushed and touched up with the same color and material used for the shop coat.

3.4 FIELD QUALITY CONTROL

At the discretion of the Contracting Officer, sample panels may be taken at random from each delivery or from stockpiles on the site at any time during the construction period, and tests may be made to check the conformance of the materials to the requirements specified in paragraph entitled "Factory Color Finish." Failure of the sample sheets to pass the required tests shall be cause for rejection of all sheets represented by the samples and replacement of the entire shipment.

3.5 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452 SPECIAL INSPECTION FOR SEISMIC RESISTING SYSTEMS.

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
PREENGINEERED METAL BUILDINGS

FACILITY
DESCRIPTION:____

BUILDING
NUMBER:____

CORPS OF ENGINEERS CONTRACT
NUMBER:____

CONTRACTOR

CONTRACTOR:____

ADDRESS:____

POINT OF
CONTACT:____

TELEPHONE
NUMBER:____

OWNER

OWNER:____

ADDRESS:____

POINT OF
CONTACT:____

TELEPHONE
NUMBER:____

CONSTRUCTION AGENT

CONSTRUCTION
AGENT:____

ADDRESS:____

POINT OF
CONTACT:____

TELEPHONE
NUMBER:____

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
PREENGINEERED METAL BUILDINGS
(continued)

THE METAL BUILDING SYSTEM INSTALLED ON THE ABOVE NAMED BUILDING IS WARRANTED BY [_____] FOR A PERIOD OF FIVE (5) YEARS AGAINST WORKMANSHIP AND MATERIAL DEFICIENCIES, WIND DAMAGE AND STRUCTURAL FAILURE WITHIN PROJECT SPECIFIED DESIGN LOADS, AND LEAKAGE. THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO, THE FOLLOWING: FRAMING AND STRUCTURAL MEMBERS, ROOFING AND SIDING PANELS AND SEAMS, INTERIOR OR EXTERIOR GUTTERS AND DOWNSPOUTS, ACCESSORIES, TRIM, FLASHINGS AND MISCELLANEOUS BUILDING CLOSURE ITEMS SUCH AS DOORS AND WINDOWS (WHEN FURNISHED BY THE MANUFACTURER), CONNECTORS, COMPONENTS, AND FASTENERS, AND OTHER SYSTEM COMPONENTS AND ASSEMBLIES INSTALLED TO PROVIDE A WEATHERTIGHT SYSTEM; AND ITEMS SPECIFIED IN OTHER SECTIONS OF THESE SPECIFICATIONS THAT BECOME PART OF THE METAL BUILDING SYSTEM. ALL MATERIAL AND WORKMANSHIP DEFICIENCIES, SYSTEM DETERIORATION CAUSED BY EXPOSURE TO THE ELEMENTS AND/OR INADEQUATE RESISTANCE TO SPECIFIED SERVICE DESIGN LOADS, WATER LEAKS AND WIND UPLIFT DAMAGE SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER

ALL MATERIAL DEFICIENCIES, WIND DAMAGE, STRUCTURAL FAILURE AND LEAKAGE ASSOCIATED WITH THE METAL BUILDING SYSTEM COVERED UNDER THIS WARRANTY SHALL BE REPAIRED AS APPROVED BY THE CONTRACTING OFFICER. THIS WARRANTY SHALL COVER THE ENTIRE COST OF REPAIR OR REPLACEMENT, INCLUDING ALL MATERIAL, LABOR, AND RELATED MARKUPS. THE ABOVE REFERENCED WARRANTY COMMENCED ON THE DATE OF FINAL ACCEPTANCE ON [_____] AND WILL REMAIN IN EFFECT FOR STATED DURATION FROM THIS DATE.

SIGNED, DATED, AND NOTARIZED (BY COMPANY PRESIDENT)

____

(Company President) (Date)

CONTRACTOR'S FIVE (5) YEAR NO PENAL SUM WARRANTY
FOR
PREENGINEERED METAL BUILDINGS
(continued)

THE CONTRACTOR SHALL SUPPLEMENT THIS WARRANTY WITH WRITTEN WARRANTIES FROM THE MANUFACTURER AND/OR INSTALLER OF THE METAL BUILDING SYSTEM, WHICH SHALL BE SUBMITTED ALONG WITH THE CONTRACTOR'S WARRANTY. HOWEVER, THE CONTRACTOR WILL BE ULTIMATELY RESPONSIBLE FOR THIS WARRANTY AS OUTLINED IN THE SPECIFICATIONS AND AS INDICATED IN THIS WARRANTY.

EXCLUSIONS FROM COVERAGE

1. NATURAL DISASTERS, ACTS OF GOD (LIGHTNING, FIRE, EXPLOSIONS, SUSTAINED WIND FORCES IN EXCESS OF THE DESIGN CRITERIA, EARTHQUAKES, AND HAIL).

2. ACTS OF NEGLIGENCE OR ABUSE OR MISUSE BY GOVERNMENT OR OTHER PERSONNEL, INCLUDING ACCIDENTS, VANDALISM, CIVIL DISOBEDIENCE, WAR, OR DAMAGE CAUSED BY FALLING OBJECTS.

3. DAMAGE BY STRUCTURAL FAILURE, SETTLEMENT, MOVEMENT, DISTORTION, WARPAGE, OR DISPLACEMENT OF THE BUILDING STRUCTURE OR ALTERATIONS MADE TO THE BUILDING.

4. CORROSION CAUSED BY EXPOSURE TO CORROSIVE CHEMICALS, ASH OR FUMES GENERATED OR RELEASED INSIDE OR OUTSIDE THE BUILDING FROM CHEMICAL PLANTS, FOUNDRIES, PLATING WORKS, KILNS, FERTILIZER FACTORIES, PAPER PLANTS, AND THE LIKE.

5. FAILURE OF ANY PART OF THE BUILDING SYSTEM DUE TO ACTIONS BY THE OWNER WHICH INHIBIT FREE DRAINAGE FROM THE ROOF, AND GUTTERS AND DOWNSPOUTS; OR CONDITIONS WHICH CREATE PONDING WATER ON THE ROOF OR AGAINST THE BUILDING SIDING.

6. THIS WARRANTY APPLIES TO THE METAL BUILDING SYSTEM. IT DOES NOT INCLUDE ANY CONSEQUENTIAL DAMAGE TO THE BUILDING INTERIOR OR CONTENTS WHICH IS COVERED BY THE WARRANTY OF CONSTRUCTION CLAUSE INCLUDED IN THIS CONTRACT.

7. THIS WARRANTY CANNOT BE TRANSFERRED TO ANOTHER OWNER WITHOUT WRITTEN CONSENT OF THE CONTRACTOR AND THIS WARRANTY AND THE CONTRACT PROVISIONS WILL TAKE PRECEDENCE OVER ANY CONFLICTS WITH STATE STATUTES. REPORTS OF LEAKS AND BUILDING SYSTEM DEFICIENCIES SHALL BE RESPONDED TO WITHIN 48 HOURS OF RECEIPT OF NOTICE BY TELEPHONE OR IN WRITING FROM EITHER THE OWNER, OR CONTRACTING OFFICER. EMERGENCY REPAIRS, TO PREVENT FURTHER ROOF LEAKS, SHALL BE INITIATED IMMEDIATELY; A WRITTEN PLAN SHALL BE SUBMITTED FOR APPROVAL TO REPAIR OR REPLACE THIS SSSR SYSTEM WITHIN SEVEN CALENDAR DAYS. ACTUAL WORK FOR PERMANENT REPAIRS OR REPLACEMENT SHALL BE STARTED WITHIN 30 DAYS AFTER RECEIPT OF NOTICE, AND COMPLETED WITHIN A

REASONABLE TIME FRAME. IF THE CONTRACTOR FAILS TO ADEQUATELY RESPOND TO THE WARRANTY PROVISIONS, AS STATED IN THE CONTRACT AND AS CONTAINED HEREIN, THE CONTRACTING OFFICER MAY HAVE THE METAL BUILDING SYSTEM REPLACED OR REPAIRED BY OTHERS AND CHARGE THE COST TO THE CONTRACTOR. IN THE EVENT THE CONTRACTOR DISPUTES THE EXISTENCE OF A WARRANTABLE DEFECT, THE CONTRACTOR MAY CHALLENGE THE OWNER'S DEMAND FOR REPAIRS AND/OR REPLACEMENT DIRECTED BY THE OWNER OR CONTRACTING OFFICER EITHER BY REQUESTING A CONTRACTING OFFICER'S DECISION, UNDER THE CONTRACT DISPUTES ACT, OR BY REQUESTING THAT AN ARBITRATOR RESOLVE THE ISSUE. THE REQUEST FOR AN ARBITRATOR MUST BE MADE WITHIN 48 HOURS OF BEING NOTIFIED OF THE DISPUTED DEFECTS. UPON BEING INVOKED THE PARTIES SHALL, WITHIN 10 DAYS JOINTLY REQUEST A LIST OF FIVE (5) ARBITRATORS FROM THE FEDERAL MEDIATION AND CONCILIATION SERVICE. THE PARTIES SHALL CONFER WITHIN 10 DAYS AFTER RECEIPT OF THE LIST TO SEEK AGREEMENT ON AN ARBITRATOR. IF THE PARTIES CANNOT AGREE ON AN ARBITRATOR, THE CONTRACTING OFFICER AND THE PRESIDENT OF THE CONTRACTOR'S COMPANY WILL STRIKE ONE (1) NAME FROM THE LIST ALTERNATIVELY UNTIL ONE NAME REMAINS. THE REMAINING PERSON SHALL BE THE DULY SELECTED ARBITRATOR. THE COSTS OF THE ARBITRATION, INCLUDING THE ARBITRATOR'S FEE AND EXPENSES, COURT REPORTER, COURTROOM OR SITE SELECTED ETC., SHALL BE BORNE EQUALLY BETWEEN THE PARTIES. EITHER PARTY DESIRING A COPY OF THE TRANSCRIPT SHALL PAY FOR THE TRANSCRIPT. A HEARING WILL BE HELD AS SOON AS THE PARTIES CAN MUTUALLY AGREE. A WRITTEN ARBITRATOR'S DECISION WILL BE REQUESTED NOT LATER THAN 30 DAYS FOLLOWING THE HEARING. THE DECISION OF THE ARBITRATOR WILL NOT BE BINDING; HOWEVER, IT WILL BE ADMISSIBLE IN ANY SUBSEQUENT APPEAL UNDER THE CONTRACT DISPUTES ACT. A FRAMED COPY OF THIS WARRANTY SHALL BE POSTED IN THE MECHANICAL ROOM OR OTHER APPROVED LOCATION DURING THE ENTIRE WARRANTY PERIOD.

END OF SECTION

SECTION 13405

PROCESS LOGIC CONTROL
(TO INCLUDE DESIGN/BUILD CRITERIA BASED ON USEPA AND USACE REQUIREMENTS)

PART 1 GENERAL

1.01 SCOPE

A. This specification identifies the minimum requirements for the following: design, fabrication, programming, inspection, documentation, functional testing, identification, shipment, and start-up of a control and shutdown system (Control System) for the Pemaco Treatment System. Also, this specification identifies required system instrumentation and control. It is the intent of this specification to provide a fully operational and ready-to-use system. In addition, this specification outlines design, fabrication, and field wiring required for the motor control center (MCC).

B. Entities identified in this specification are defined as follows:

Purchaser:	T N & Associates, Inc. (TN&A), United States Environmental Protection Agency Region IX (USEPA), and United States Army Corps of Engineers (USACE)
Vendor:	Supplier of the Control System and Instrumentation

C. The Vendor shall provide all materials, labor, fabrication and testing of the Control System. The Vendor is responsible for the functional operation of panel wiring from the panel terminal blocks to the programmable logic controller (PLC) modules, MCC, and panel instruments. Follow the manufacture's written requirements and recommendations for mounting and space allocation, wiring and grounding of the MCC, PLC and panel instruments.

D. The Control System shall be designed in accordance with the requirements of this specification, and the attached design drawings. These drawings are for conceptual use only and are not equipment specific. No change orders will be accepted unless a specific change of scope is requested in writing by the Purchaser, fully approved and executed.

E. This specification describes the requirements for providing the MCC and PLC including but not limited to all associated racks, power supplies and I/O modules and performing the PLC ladder logic programming necessary to provide a complete and operating system.

F. This specification describes the requirements for providing the instrumentation and equipment necessary to provide a complete and operating system. Follow the manufacturer's written requirements and recommendations for installation.

G. The Vendor shall provide overall system integration of Purchaser provided equipment and Vendor provided equipment and instrumentation with the Control System. At a minimum, the Vendor shall integrate inputs and outputs from one flameless thermal oxidizer and scrubber (FTO), one vapor conditioning package (one air cooler, one moisture separator, one air warmer, and 1 blower), three blowers (including blower included in vapor conditioning package), six pumps, one air compressor, one heat exchanger, and one MCC. The Vendor shall be responsible for design, coordination, and specification of control wiring and communications between the Control System and the local panels. The Vendor shall provide all required signal isolation as required.

1.02 ALTERNATES

Alternate designs will be considered, provided they meet the intent of this specification and result in performance that is equivalent to and otherwise in accordance with this specification. All proposed alternates or deviations from this specification shall be described by the Vendor separately and may not be substituted until mutually agreed upon in writing by the Purchaser and the Vendor.

1.03 REFERENCES

The enclosures, wiring, and component parts of this system shall conform to the latest revision of the following codes and regulations.

A. National Electric Code (NEC), ANSI/NFPA 70

B. National Electric Safety Code (NESC), ANSI C2

C. American National Standards Institute (ANSI)

D. National Electrical Manufacturing Association (NEMA)

E. Electronics Industry Association / Telecommunications Industry Association (EIA/TIA)

F. ANSI/NEMA ICS 1 General Standards for Industrial Control and Systems.

G. NEMA 250 Enclosures for Electrical Equipment (1,000 Volts Maximum)

H. ISA RP60.8 Recommended Practice Electrical Guide for Control Centers

I. ANSI X3.64 Additional Controls for Use with American National Standard Code for Information Interchange (ASCII).

J. All applicable federal, state, and local codes

1.04 SUBMITTALS

A. General

1. Review of submittals by the Purchaser shall not relieve the Vendor of the responsibility to meet all requirements of this specification.

2. The design drawings included with the Invitation to Bid may include certain hold areas (including the FTO and vapor conditioning package) awaiting additional design data or

information or may contain certain conflicts. The hold areas and conflicts are considered to be non-critical with respect to your ability to prepare an accurate bid.

3. Hold areas and conflicts will be resolved and appropriate revisions will be included with revised "Approved for Construction" issue of design drawings. Revisions will be specifically identified.

4. Revised "Approved for Construction" issue design drawings may not be completed until after bid award. If completed after bid award, a Change Order may be issued to either increase or decrease the scope of work based on the revisions.

5. The design drawings included with this Invitation to Bid are "B" size and are considered to be adequate to prepare an accurate bid. Access to "D" size design drawings will be available on request. Requests should be arranged with Mr. John Wingate, TN&A Ventura Office (805) 585-6389.

6. All post-award drawing submittals shall include three sets of standard “B” size 11-inch x 17-inch and one electronic copy submitted on AutoCAD 2004 or later on cd.

7. All post-award submittals will be reviewed by the Purchaser and returned to the Vendor within 4 working days of receipt unless otherwise agreed to by the Purchaser and Vendor.

8. All post-award submittals shall be revised and resubmitted by the Vendor until identified as "APPROVED" by the Purchaser.

9. Submittals identified in this specification represent minimum or special requirements identified by the Purchaser. The Vendor shall be responsible for identification and preparation of all other design work and submittals to meet the requirements of this specification.

10. Post-award drawings shall include parts lists referencing the components identified on the drawings.

B. Pre-Award Submittals

Three copies of the following information shall be included with the Vendor quotation for the Control System:

1. Brief written description of proposed Control System

2. Brief description of proposed instrumentation and data sheets

3. Preliminary or conceptual design drawings and data for the proposed Control System including:

    a. Control System schematic indicating the basic interconnections between the major components or panels

    b. Interior and exterior layout drawings and descriptions for the Control Panel

c. A detailed materials list for all major components

d. Vendor data and/or data sheets for major components materials supplied by the Vendor

e. Specifications regarding the overall Control System scan rate and minimum communications rate for the proposed Control System

f. Specifications for the electronic equipment including the mean time between failures for primary components

4. Brief description of proposed functional testing procedures

5. Representative examples of display screen graphics

6. Proposed schedule for design, fabrication, testing, and delivery of the Control System and instrumentation

7. Brief description of design capabilities and fabrication facilities

8. Résumés of key personnel

9. References for a minimum of three control systems of similar point count or complexity designed and fabricated by the Vendor and currently in service

10. Statement of warranty

11. Written alternates in accordance with the requirements of Paragraph 1.02

12. Written exceptions, if any. Exceptions should be carefully considered and held to a minimum

C. Bid Presentation

1. Prior to award, a short list of prospective bidders may be required to present their bid to representatives of the Purchaser.

2. The bid presentation should include key members of the project team and describe the capabilities of the bidder and the overall project approach.

D. Post-Award Submittals

Three copies of the following information shall be submitted for Purchaser review and approval:

1. Within 3 working days of contract award the Vendor shall provide and present a detailed project schedule for the design, fabrication, testing, and delivery of the Control System at a project kick-off meeting. The detailed project schedule will include the following:

a. Design coordination meetings
b. Design
c. Programming
d. Design drawing preparation and submittal
e. Construction drawing preparation and submittal
f. Material and component procurement
g. Fabrication
h. Testing
i. Delivery and Installation

2. Within 3 weeks of contract award the Vendor shall provide design drawings including the following:

   a. Control system schematic indicating basic interconnections between the Control System and the local control panels provided by the Purchaser.

   b. Interior and exterior panel layout diagrams and descriptions for the Control Panel including at a minimum: mechanical layout detailing the external dimensions of enclosure and location of components; interior layout detailing layout of terminal blocks, wireways, I/O racks, processors, disconnect switches, and fuse blocks.

   c. Point-to-point wiring diagrams for the Control Panel including field wiring to instrumentation and external power. The wiring diagrams shall include individual wire and terminal block numbers and relay contact cross-reference designations.

   d. A detailed bill of materials for all components and materials with reference to applicable drawings.

   e. Vendor data and/or data sheets for major components.

   f. A preliminary detailed functional test procedure.

   g. A list of recommended spare components with prices.

3. The following information shall be delivered 1 week prior to the functional test of the Control System:

   a. Three copies of the final functional test procedure and documentation forms

   b. Two copies of a draft operating and maintenance manual (Operating Manual) shall be submitted to the Purchaser. The Operating Manuals shall be compiled in separate nominal 8-1/2 by 11-inch, 3-ring binders. The Operating Manuals shall include the following information at a minimum:

      i. Description of the Control System

      ii. Description of all control programs, algorithms, mathematical equations, variables, set points, time periods, messages, passwords, and other information necessary to load alter, test, and execute the Control System

iii. Instructions on modifying control algorithms or parameters, verifying errors, point status, changing passwords, and initiating or disabling control programs

iv. Complete point identification, including terminal number, symbol, engineering units, and control program reference number

v. Field information, including location, device, and device type and function, electrical parameters and installation drawing number

vi. Location and identification of Control System hardware

vii. Instructions on the proper assembly, installation, and maintenance of the Control System

viii. Start-up instructions

ix. Shutdown and safety procedures

x. Maintenance and troubleshooting guidelines

xi. Drawings, materials lists, vendor literature, and other information provided with previous submittals

xii. Any limitations or warnings on the installation, operation, or maintenance of the Control System.

4. The following information shall be delivered 2 weeks prior to the delivery of the Control System to the site:

   a. One copy of all working programs on cd and a printed program listing.

   b. The Vendor shall submit documented Ladder Logic Diagrams (LLD) for this application prior to installation and start-up of the Control Panel.

5. The following information shall be delivered no later than 2 weeks after final acceptance of the Control System:

   a. The as-built drawings for the Control System

   b. Ten copies of any revisions to the Operating Manual.

E. Record Submittals

1. After the Vendor has successfully commissioned the PLC System, the PLC programming software will be transferred to Purchaser for ownership. In addition, a “hard copy” of the documented LLD and electronic file copy on cd will be submitted to Purchaser as a record copy.

2. Clearly documented LLD will be prepared for the Control System. Every element will have a tag number and/or descriptor. Rung comments shall be used to describe logic for control of specific equipment.

3. A complete commented LLD Report will be provided by the Vendor, at the completion of commissioning to include:

   a. Program Listing,
   b. Cross Reference,
   c. Processor Configuration, and
   d. Data Tables.

4. The Vendor shall submit all manuals, maintenance instructions, and spare parts data for installed equipment and instrumentation.

5. The Vendor shall submit 2 weeks prior to shipment to the site three copies and one reproducible set of the Control System operations and maintenance manual that will include:

   a. All control system drawings,
   b. LLD report,
   c. Start-up instructions,
   d. Shutdown and safety procedures, and
   e. Maintenance and troubleshooting guidelines.

1.05 TREATMENT SYSTEM PROCESS DESCRIPTION

See Exhibit 1

PART 2 PRODUCTS

2. 01 GENERAL

A. All products provided by the Vendor for the Control System and MCC shall be new, and UL-listed. Materials that are not covered by UL testing standards shall be tested and approved by an independent testing laboratory or a governmental agency, which shall be acceptable to the Purchaser.

B. The Vendor shall provide an Allen Bradley PLC or Purchaser-approved equal complete with all PLC hardware and software necessary for installing, maintaining, and programming LLD in Allen Bradley SLC 500-based system or Purchaser-approved equal.

C. The Vendor shall provide the HMI computer and HMI software.

D. All software shall be commercially available and not proprietary. No custom software or drivers will be acceptable.

E. The Vendor shall provide all identified instrumentation and control.

F. Grounding in Vendor-supplied equipment shall be provided by the Vendor. External grounding requirements for the Control System and MCC shall be identified and transmitted on the drawings by the Vendor to the Purchaser.

G. All analog I/O modules shall be individually and fully isolated to 1,000 volts. Output modules shall not have a common power supply.

H. All Control System components shall be capable of operating at an ambient temperature of 0 to 60 degrees Centigrade (°C), with an ambient temperature rating for storage of -40 to +85 degrees °C.

I. All Control System components shall be capable of functioning continuously in a relative humidity range of 5 percent to 95 percent with no condensation.

2. 02 PANEL COMPONENTS

A. Enclosures

1. Panel enclosures shall be manufactured by Hoffman or Purchaser-approved equal and provided as specified on the contract drawings.

2. Control panel shall be painted manufacturers standard.

3. Control panel shall be enclosed in a NEMA 12 enclosure. All products provided by the Vendor for the control panel shall be new, and UL-listed.

B. Panel Wiring

1. The Vendor shall provide all wiring from PLC inputs and outputs to terminal blocks for field wiring connection except as indicated below.

2. Power to each device shall be provided via DIN rail mounted circuit breaker Terminal Block. Provide internal panel wiring as follows:

3. Color codes internal panel wiring as follows:

a. 120 VAC Control Wiring:	Control = Red
b. 120 VAC Power Wiring:	Hot = Black Neutral = White Ground = Green
c. Analog Signal Wiring:	Blue
d. Communication	Wire direct to panel device
e. Fiber Optic cable	Orange

C. Wireway

1. The Vendor shall provide ventilated plastic wireways for separating and organizing the wiring. Size the wireways so that no more than 20 percent of the cross-sectional area is filled with conductors (NEC 362-19). Wireways shall be Panduit or Purchaser-approved equal.

2. Electric signals carried in one Wireway will be of similar types and voltage levels. Provide separate wireways for AC and DC wiring. Route internal wiring in separate wireway from space allowed for external field wiring. Provide each signal type with its own terminal strip.

D. Terminal Blocks

1. The Vendor shall provide DIN rail mounted terminal blocks for termination of internal and field wiring. Provide power to each device via DIN Rail mounted circuit breaker terminals. Terminate no more than two wires per side of each terminal. All Vendor wiring shall be limited to one side of the terminal strips. The other side of the terminal is reserved for field wiring connections. Terminal blocks shall be Allen-Bradley or Purchaser-approved equal.

E. Wire Marking

1. Permanently identify each wire at both ends with heat shrink tubing. Brady Hot-Stamped characters 3/32 x 3/32 inch or equal. Identify wiring according to wire identifiers provided on the elementary and loop diagrams. Wire from terminal block to terminal block without splicing. Wire each spare input or output channel from the module wiring arm to the panel field terminal block.

F. Power

1. Surge protection for incoming AC and a simulated sine wave output with ±5 percent regulation shall be provided for the control panel. Power Line Conditioners shall be supplied for the control panel to ensure "clean" power within the voltage ranges of ANSI C84.1.

2. 03 PLC PROCESSOR

The Vendor shall provide an Allen-Bradley SLC 500 series processor or Purchaser-approved equal, complete with chassis, power supplies, interconnecting cabling, and all necessary mounting hardware.

2. 04 PLC PROGRAMMING SOFTWARE

The Vendor shall provide the following programming software and appurtenances necessary to program the PLC. At a minimum one copy of Windows based RS 500 (most current Version) or Purchaser-approved equal.

2. 05 PLC INPUTS AND OUTPUTS

I/O modules shall be Allen-Bradley SLC 500 series or Purchaser-approved equal. The Vendor shall identify type and number of I/O modules based on Control System requirements and installed spare requirements.

2. 06 HMI INTERFACE COMPUTER

A. The computer shall at a minimum be a Dell Pentium 4 Processor at 3.2 gigahertz, 250 gigabyte (GB) hard drive, DVD ± RW with double layer write capabilities, 1 GB RAM, Windows™ XP or NT depending on HMI software selection, keyboard, and optical mouse with roller wheel. Computer shall have graphics card compatible with monitor. Computer shall be provided with sound card and speakers. The computer shall have a 56K Data Fax Modem and Cable/DSL wireless router. The computer shall be equipped with all necessary communication cards and cabling necessary to interface with the Control Panel.

B. Monitor shall be 19-inch E196 Analog Flat Panel Dell® Monitor or Purchaser-approved equal.

C. The computer shall be provided with a Hewlett-Packard color inkjet printer for alarm logging and output.

2. 07 HMI INTERFACE SOFTWARE

HMI software shall be Wonderware™ or Intellution™ or Purchaser-approved equal.

2. 08 AUTODIALER

The autodialer shall have the following features:

A. Power failure sensing in addition to four alarm conditions

B. Upon detection of alarm condition or power failure:

   1. Commences dialing first of eight user-selected phone numbers

   2. Delivers message describing alarm condition

   3. Continues calling phone numbers in succession until acknowledged.

C. Standard telephone lines communication

D. Ability to receive incoming phone calls

E. Minimum 1-hour of battery back-up

F. Nonvolatile read only memory (ROM) circuitry so that no memory loss shall occur when power (including battery power) is lost.

2. 09 END DEVICES

A. All end devices will be provided and installed by the Vendor.

B. Actual vendor data and completed instrument data sheets will be provided by the Vendor after contract award.

C. Interconnecting wiring between Control Panel and end devices will be provided by the Vendor.

2. 10 MOTOR CONTROL CENTER COMPONENTS

A. The Vendor shall provide an Allen-Bradley Centerline MCC or Purchaser-approved equal.

   1. The MCC shall be a NEMA 12 enclosure. All products provided by the Vendor for the MCC shall be new, and UL-listed.

   2. The MCC shall be complete with vertical sections, power busses, covers and panels, unit doors, wireways, ground bus, main disconnect, motor starters, thermal overloads, contactors, fuses, and terminal blocks.

   3. Unit doors shall be removable and include nameplates, red and green colored indictors, and disconnect handles.

B. The Vendor shall provide all necessary components control and power wiring between the MCC and the Control Panel.

C. The Vendor shall provide a variable frequency drive for Pump P-202.

D. The Vendor shall provide all necessary circuit breakers for system control.

2. 11 UNINTERRUPTIBLE POWER SUPPLY

The uninterruptible power supplies (UPS) shall be provided for the PLC processor, the HMI computer, and report printer. The UPS shall provide a minimum of 1 hour of emergency power for blackout, interruptions, and brownouts and also provide continuous protection from surges, spikes, and line noise of all types. When blackouts, brownouts, or power interruptions occur, the UPS shall instantly (within a maximum of 4 milliseconds transfer time for both over-voltage and under-voltage protection) switch to inverter operation and supply power to maintain systems operation.

Indicator lights (three-level LED display indicating AC normal, battery in use, and low battery cutoff) and audible alarms (two-level indicating battery in use and low battery warning) shall notify the user of inverter and battery status. The UPS shall feature EMI/RFI filtering, three-staged surge protection for incoming AC and a simulated sine wave output with ±5 percent regulation. Power Line Conditioners shall be supplied for the equipment to ensure "clean" power within the voltage ranges of ANSI C84.1.

PART 3 EXECUTION

3.01 GENERAL

A. The Control System shall provide system control for the proposed system as depicted on the design drawings. The design drawings are conceptual in nature and the Vendor shall be responsible for identifying additional equipment and programming not identified on the drawings and Contract Documents to result in functioning ready to use Control System.

B. The Control System shall include an auto dialer that will call-out to a programmable list of phone numbers based on alarm and/or shutdown conditions.

C. The Control System shall data log all analog and temperature channels. The data shall be stored in a manner to allow remote dial-up access to logged data and downloading. The Control System shall record channel values once a minute, and be capable of storing logged data for a minimum of 31 days. Logged data shall be in an ASCI format or in a format downloadable into Microsoft Excel.

D. The Control System shall be able to be accessed through the internet to allow remote inquiry of Control System.

E. The Vendor shall prewire all spare inputs and outputs from the PLC to the terminal block(s) in the Control Panel.

F. The Vendor shall install and pre-wire to the terminal block a minimum of 14 spare discreet inputs, 10 spare analog inputs, 10 discreet outputs, and 2 analog outputs. All spare I/O channels shall be wired to the terminal blocks.

G. The Vendor shall select and size all hardware to allow for future expansion by approximately 25 percent.

3.02 PROGRAM DEVELOPMENT

A. The Vendor shall be responsible for preparing all PLC configuration and ladder logic programming, installation, testing, debugging, and documentation for the Control System.

B. The narrative description for the Control System operation and interlocks is provided in Exhibit 1.

3.03 CONTROL SYSTEM CAPABILITIES

A. General

The minimum capabilities for the Control System shall be in accordance with the requirements of this specification and include normal start-up, normal operation, normal shutdown, and emergency shutdown of the treatment system. Descriptions of each of these capabilities are provided herein and specified on the applicable design drawings. The descriptions are for clarification only and not intended to describe all aspects of the Control System specified on the applicable design drawings.

B. Normal Start-Up Sequence

1. Normal start-up sequence applies to treatment system start-up after a normal shutdown, or a shutdown caused by an alarm condition after the alarm condition has been cleared. Normal operation assumes that all hand switches are in the auto position, and hand selector switches are in flow or level control position. Normal start-up shall be initiated by a "Vapor Treatment System Start" and a "Groundwater Treatment System Start" commands at the main operator interface at which time the following sequence shall be followed:

   The Control System shall survey all inputs for alarm conditions prior to actual start-up sequence. The inputs that result in equipment or treatment system shutdowns shall have timers to disable the shutdowns initially during start-up. The equipment and treatment system inputs shall become enabled as the timers time out. The timers shall be adjustable using the main operator interface from 0 to 240 minutes. Inputs that do not cause equipment or system shutdowns shall be active and displayed during start-up for operator information. Alarms shall clear as the process requirements are satisfied.

C. Normal Operation

1. Normal operation shall consist of operations after start-up under design load conditions. Set points adjustments for treatment system controllers and alarms shall be possible during normal operation. During normal operation, alarm points for switches shall be adjustable without a system shutdown; the PID loops shall be tunable.

2. Normal operation shall be as specified on the applicable design drawings and in accordance with the requirements of Exhibit 1.

D. Normal Shutdown

Normal shutdown shall consist of a shutdown resulting from a "Vapor Treatment System Start" and a "Groundwater Treatment System Start" commands executed from the HMI or interlock. A normal shutdown shall be an orderly shutdown of equipment.

E. Emergency Shutdown

Emergency shutdown shall consist of a shutdown resulting from an "Emergency System Stop" command executed from the HMI or from the control panel cabinet or the remotely located push button stations. The emergency stop is intended to immediately stop all rotating equipment and other electrical and mechanical components to protect operating personnel. An emergency shutdown procedure shall be defined during final design.

F. Interlocks

Interlocks have been provided to minimize the potential for discharge of untreated air and to prevent damage to treatment system equipment. Malfunctions or abnormal conditions that would damage equipment shall shut down the affected equipment. Malfunctions, abnormal conditions, or equipment shutdowns that prevent continued operation of the treatment system shall shut down the treatment system. Any malfunction or abnormal condition for the treatment system that requires operator attention to initiate corrective measures shall initiate an alarm.

G. Failure Modes

1. Power failure at the Control System shall result in an emergency shutdown. Upon restoring power, the Control System shall indicate power failure with an alarm. The Control System shall not restart until the alarm is acknowledged by an operator at the HMI.

2. All sensors that fail shall result in an alarm condition.

H. Alarm System

1. Time verification delays shall be used to ensure it is a true alarm.

2. All alarms shall be logged on the HMI computer hard drive.

3. All alarm messages shall have a time and date stamp.

4. Alarm messages shall be able to send to remote locations via the autodialer.

5. The Control System shall be able to send messages to different phone numbers based on type of message, time of day, or if the previous dialed number did not answer.

6. The autodialer shall be able to dial eight phone numbers and shall be able to rotate through numbers until contact is made or an alarm is acknowledged.

7. Alarms shall be displayed as they occur on the color-graphics display screen. Trouble alarms shall be represented by the "graphic target" flashing on and off (blinking). It shall be possible to determine the specific details of an alarm condition, including point name, alarm value, and current value using a mouse without leaving the color-graphics display screen.

8. The system shall include an alarm log that will store all acknowledged and unacknowledged alarms to the HMI hard drive with date and time stamp, name of point, and alarm condition.

9. A feature shall be provided to force operator acknowledgement of alarms prior to the system reset to resting state. The Control System shall log the name of the operator and time of alarm acknowledgement.

10. All current and historical alarm data from the HMI hard drive shall be available through an operator-selectable report that can be read on the color-graphics display screen or sent to a printer. Reports shall be definable as to specific date and time period.

11. All points, reports, parameters, control/monitoring strategies, and routines shall be definable by the operator through the operator's terminal. It shall be possible for the operator to modify the system functions independently after receiving the training from

the Vendor. Through the operator terminal, any trained operator with security access shall be able to:

a. Read the value of a measured variable (i.e., temperature, level)
b. Stop or start equipment
c. Monitor the status of equipment being controlled and/or monitored
d. Read the set point of a control/monitoring loop
e. Determine the control signal to an actuator and variable frequency drive
f. Set or change alarm limits
g. Determine the control/monitoring strategies that have been defined for a specific piece of equipment
h. Generate displays of control/monitoring strategies.

12. The Control System shall provide a qualified programmer with the ability to:

a. Star or stop the vapor and groundwater treatment systems
b. Add control/monitoring loops to the system
c. Add points and color graphics to the system
d. Create, modify, or delete control strategies
e. Assign sensors and/or actuators to a control/monitoring strategy
f. Tune control/monitoring loops by adjusting loop parameters
g. Enable or disable control/monitoring strategies
h. Generate hard-copy records of control/monitoring strategies on a printer
i. Select points to be alarmed and define the alarm state(s)
j. Select points to be trended over a period of time and initiate the recording of values
k. Add, Change, Modify, or Delete control strategies while "on-line."

I. Reports

1. The operator interface software shall be capable of producing reports with the following:

a. User-definable selection criteria
b. Generated periodically (period to be user-definable) or as requested
c. Generated and printed on the local terminal or the report printer.

2. Status reports shall contain current status of all controlled equipment and current values of all sensors.

3. Runtime reports shall contain the runtime of all equipment controlled and monitored.

4. Summary reports shall be able to contain any of the following information for any point in the Control System if requested by the operator:

a. Flow rates, temperatures, and pressures.
b. High, low, average, and calculated values.

5. History reports shall be selectable for any point in the Control System and for any time and/or date period. The system shall be able to use actual, average, or minimum and maximum values. Minimum display options shall be:

a. Color bar chart with auto-scaling and time and date stamps
b. Tabular report with time and date stamps per sample
c. Disk file Excel-compatible format.

6. Alarm and logging reports shall be available and definable by the user. Alarms shall cause a visual and audible notification to the user upon occurrence. Visual notification shall continue until acknowledged. Alarm and logging options shall be as follows:

   a. User-definable, low and high limits
   b. User adjustment directly from a graphics screen
   c. User-selectable event logging to hard drive, printer, or screen with time and date stamp:
      i. user log on/log off
      ii. alarms
      iii. manual controls
      iv. automatic controls
      v. communication failures
      vi. power failures and system reboots.
   d. Up to 31 days of data logs and 365 days per year history file
   e. Return from alarm tolerance setting.
   f. Data will be logged for all analog channels. The process value, time and date will be recorded at a frequency of once a minute.

3.04 DISPLAY SCREENS

A. The Vendor shall create a minimum of 16 detailed color graphics screens for the entire treatment system. The color graphics screens must be able to be modified by the Purchaser. The Purchaser must approve the color graphics screens submitted by the Vendor prior to their use. The color graphics screens shall be as follows:

1. Log On/Off

2. Operator Screens
   a. Vapor and Groundwater Treatment Systems Start/Stop screen with separate buttons for each system. The Vapor Treatment System will have a selector switch for either the FTO Vapor Treatment System of the Carbon Vapor Treatment System. The default system will be the FTO Vapor Treatment System.
   b. Overview screen, list type, with major operating parameters.
   c. Vapor Treatment train, P&ID type, with controller faceplates for each PID loop and HOAs for each pump, each blower, the FTO and the vapor conditioning package (air cooler and air warmer).
   d. Water Treatment train, P&ID type, with controller faceplates for each PID loop and HOAs for the air compressor and each pump.
   e. FTO Overview, P&ID type, with controller faceplates for each PID loop and HOAs for the FTO.
   f. Vapor Conditioning Package Overview, P&ID type, with controller faceplates for each PID loop and HOAs for each piece of equipment.
   g. Setup screen, text type, for establishment of alarm values, set points for control loops.
   h. Trending.

i. Alarm log. The Vendor shall prepare an alarm summary color graphics screen that will display current and acknowledged alarms. In addition, alarms that have been cleared and acknowledged during the past 24 hours shall be displayed.
j. Event log

3. Non-Operator Screens
   a. Overview screen, list type, with major operating parameters.
   b. Vapor Treatment train
   c. Water Treatment train
   d. FTO Overview and Vapor Conditioning Package Overview, P&ID type.
   e. Trending

B. The color graphics screens shall be dynamic, with a refresh rate of 60 times/second. The Vendor shall supply graphics sufficient to display all monitored points incorporated in the associated points lists.

C. Color graphics screens shall allow display of data as numerical, horizontal or vertical analog fill, or digital change-of-state. When monitored equipment goes into alarm, the data display shall flash on the screen to draw the operator's attention. Change-of-state signals shall cause the display to change color for that device. Status display colors shall be user-definable. Alarm conditions shall cause the displayed point to blink and generate an audible alarm buzzer.

D. It shall be possible to perform automatic and manual controls and monitoring directly from the color graphics screen using a mouse or track-ball. The operator shall be able to activate automatic controls from a graphics target, or manually adjust a digital or analog point by "clicking" on that particular object and selecting the desired control/monitoring option from a menu with "Help" text. The system shall require proper security level and shall prompt the user for verification prior to actuating control.

E. The color graphics screens shall provide change-of-state displays, graphics displays, information summaries, control system malfunction advisories, and operator input advisories. Furthermore, all software and program editing shall be capable of being performed either at the color graphics CRT or from a remote terminal (direct connect or via modem).

F. Operator communications with the system shall be performed at the main operator interface (or via remote terminal) and shall be in full English language. Complete access to controls, on-line monitoring, and all other operator interface functions shall be available remotely (via internet and/or hard-wire) assuming the operator has the proper password access code.

3.05 FIELD WIRING

The Vendor shall provide all field labor, tools, equipment, material, and transportation to install the Control System, install the instrumentation, and perform interconnecting wiring between the Control Panel and MCC.

3.06 COORDINATION

A. General Requirements

1. The Vendor shall coordinate with the Purchaser the following activities, at a minimum:

   a. Control and treatment system design, fabrication, and shop testing
   b. Control system installation
   c. Control system check-out
   d. Control and treatment system start-up
   e. Operator training

2. Coordination requirements identified in this specification shall not be construed to limit the amount of professional time or other resources provided by the Vendor to resolve deficiencies or other problems.

B. Design, Fabrication, and Shop Testing Coordination

1. During design, fabrication, and shop testing of the Control System, the Vendor shall coordinate activities and requirements with the Purchaser.

2. Design coordination shall include review of instrumentation and other interconnected devices selected by the Purchaser for compatibility with the design of the Control System.

3. Coordination shall include weekly design review meetings and periodic shop inspections by the Purchaser during fabrication and testing.

4. The agenda for the design meetings shall include the following:

   a. Status report, including progress made during the previous week
   b. Updated schedule
   c. Problems identified or resolved
   d. Progress expected to be made during the coming week

5. The meeting schedule and agenda may be modified by the Purchaser as required.

6. Fabrication coordination shall include inspection in accordance with the requirements of Paragraph 3.08.

7. Shop-testing coordination shall include completion of the Functional Test in accordance with the requirements of Paragraph 3.08.

C. Check-out Coordination

1. During check-out of the Control System, the Vendor shall work with the Purchaser to ensure that the Control System is ready for operation and installed in accordance with the Vendor's design requirements.

2. Check-out is expected to require full-time Vendor support for a minimum of 1 week.

3. Check-out is expected to include a detailed, point-by-point, inspection of the Control System to verify installation in accordance with the Vendor's design requirements. The inspection shall include field functional testing of each Control System function in accordance with the requirements of this specification and Paragraph 3.08.

D. Start-up Coordination

1. During start-up of the treatment system, the Vendor shall provide full-time assistance to verify Control System operation in accordance with the requirements of this specification and the final approved design.

2. Start-up is expected to require full-time Vendor support for a minimum period of 2 weeks. Additional part-time Vendor support to resolve Vendor deficiencies shall be provided as required at no additional cost to the Purchaser.

3. Start-up shall be deemed complete when the Control System demonstrates, to the satisfaction of the Purchaser, its ability to achieve normal start-up, operation, shutdown, and emergency shutdown of the treatment system on a routine basis. Control System functions shall be retested during start-up.

E. Operator Training Coordination

1. Coordination of operator training shall be in accordance with the requirements of Paragraph 3.10.

3.07 REPORTING

The Vendor shall prepare and submit a weekly status report to the Purchaser. The weekly status report shall briefly describe the status of work completed, problems encountered, proposed resolution of problems, and schedule updates.

3.08 INSPECTIONS AND TESTS

A. General

1. The inspections and tests identified in this specification represent minimum or special requirements identified by the Purchaser. The Vendor shall be required to identify and implement all other inspections and tests to meet the requirements of this specification.

2. The Vendor shall perform the following Observed inspections on the Control System:

   a. Installation inspection
   b. Control system check-out

3. The following witnessed tests shall be performed on the Control System:

   a. Functional Test
   b. Acceptance Test

4. After advance notification to the Vendor by the Purchaser, the Purchaser or Purchaser's representative shall have access to all Vendor and subvendor facilities where fabrication, testing, or inspection of the Control System is in progress.

5. The Vendor shall notify subvendors of the Purchaser's inspection and testing requirements.

6. The Vendor shall provide a minimum of 7 days advanced notice to the Purchaser before conducting any inspection or test that the Purchaser has specified to be witnessed or observed.

7. "Witnessed" means that a hold shall be applied to the production schedule and that the inspection and/or test shall be carried out with Purchaser and or the Purchaser's representative in attendance.

8. "Observed" means that the Purchaser shall be notified to the timing of the inspection and/or test. However, the inspection and/or test is performed as scheduled, and if the Purchaser and/or the Purchaser's representative is not present, the Vendor shall proceed to the next step.

9. Equipment and materials for the specified inspections and tests shall be provided by the Vendor.

10. The responsibility for inspection and testing rests with the Vendor; however, the Purchaser and/or the Purchaser's representative reserve the right to inspect the Control System at any time during fabrication to ensure that materials and workmanship are in accordance with the requirements of this specification.

11. The Purchaser's approval of any work and release of the Control System for shipment shall in no way relieve the Vendor of any responsibility for carrying out the requirements of this specification.

B. Inspections

1. The Purchaser may perform random inspections with advanced notice in accordance with the requirements of Paragraph 3.08 A.

2. The Purchaser may perform in-progress or final inspection of the Control System prior to the release of shipment.

3. Control System check-out shall be performed in accordance with the requirements of Paragraph 3.05 C and shall include the following:

   a. Voltage check of all circuits
   b. Phase sequence check
   c. Calibration of all safety equipment
   d. Verification of proper instrumentation and control signal generation, transmission, reception, and response
   e. Checking that identification of all enclosures, components, and wiring is completed in accordance with the requirements of Paragraph 3.08.

C. Functional Test

1. The Functional Test shall be conducted prior to shipment to the site to demonstrate that the Control System was fabricated and functions in accordance with the approved design.

2. The Functional Test shall be performed in accordance with a test procedure prepared by the Vendor after review and approval of the procedure by the Purchaser.

3. At a minimum, the Functional Test shall simulate normal start-up, normal operation, normal shutdown, and emergency shutdown.

4. During the Functional Test, inputs and outputs to the Control System will be simulated. The simulations will demonstrate the functionality of each loop. Each input and output loop shall be tested to verify operation.

5. The Vendor shall correct any fault, malfunction, or deficiency found during the Functional Test at the Vendor's expense. The particular function corrected shall be retested and witnessed by the Purchaser to verify that the control and shutdown system fault, malfunction, or deficiency has been corrected.

6. Testing will generally be limited to eight hours per day. The Purchaser’s representative will conduct a meeting each day to review the test results and upcoming test schedule. The Vendor will be allowed to correct deficiencies as the test progresses, as long as the corrective work does not delay the ongoing testing.

7. At the completion of the test, the Purchaser’s representative will review the list of deficiencies and determine if the system is acceptable for shipment or if major deficiencies must be corrected and re-tested prior to shipment. If the system test of a portion of the test fails, the Vendor will correct the deficiencies and pay any travel and living expenses incurred to complete the re-testing of the corrected equipment at the same rates as initially incurred.

D. Acceptance Tests

1. Acceptance testing is intended to demonstrate the reliability of performance of the Control System under operational conditions.

2. Acceptance testing shall be performed by the Purchaser. The Vendor shall remain on-call and participate in the Acceptance Test to resolve deficiencies identified in the Control System.

3. Any deficiencies identified in the Control System during this period shall be resolved by the Vendor in a timely fashion to the Purchaser's satisfaction.

4. Acceptance testing shall be deemed complete when the Control System demonstrates its ability to operate in accordance with the approved design during 30 consecutive days of operation after completion of start-up.

5. The Purchaser may simulate shutdown or other emergency conditions during the Acceptance Tests.

E. Test Equipment

The Vendor will provide the following equipment for the Purchaser's representative user while testing the System:

1. Adequate Physical Space and Electrical Power to perform the test.

2. Documentation on all equipment to be tested including:
   a. Configuration, panel layout and connection diagrams
   b. Hardware manuals on Purchaser-furnished equipment
   c. Any Vendor developed shop drawings and documents

3. Test equipment for the Purchaser's use during functional testing including:
   a. One 4-20 milliamp signal generator
   b. Two multimeters
   c. A supply of electrical jumpers to fully test the Input/Output equipment

3.09 IDENTIFICATION

The Vendor shall propose an identification system for the approval of the Purchaser.

3.10 OPERATOR TRAINING

A. General

1. The Vendor shall provide training for designated operations personnel. Operator training shall be conducted in three phases:

   a. Classroom training
   b. Initial site training
   c. Follow-up site training.

2. All operator training sessions will be attended by a maximum of six operating personnel.

3. The Vendor shall coordinate the schedule for all training with the Purchaser.

4. A detailed plan for operator training, including course content and agendas, shall be prepared by the Vendor for Purchaser review and approval.

5. For guidance in planning the required instruction, the Vendor should assume that attendees have a high school education or equivalent and have a technical background, but are not otherwise familiar with control systems.

B. Classroom Training

1. Classroom training shall be conducted in Ventura, California, in facilities provided by the Purchaser.

2. Classroom training shall be conducted a minimum of 2 weeks prior to scheduled Control System check-out.

3. Classroom training shall include a review of the content of the Operating Manuals prepared by the Vendor. The draft Operating Manuals shall be reviewed and approved by the Purchaser prior to the classroom training session.

4. Classroom training is expected to consist of a minimum of 6- to 8-hours of instruction.

5. Classroom training shall include discussion of the following topics, at a minimum:

   a. Operation of Control System equipment
   b. Programming procedures
   c. Diagnostic procedures
   d. Failure recovery procedures
   e. Alarm formats
   f. Maintenance and calibration procedures
   g. Trouble shooting, diagnostics, and repair instructions
   h. Report generation procedures and capabilities
   i. Data base entry
   j. Reports and logs
   k. Color graphics generation
   l. Preventive maintenance procedures and schedules.

C. Initial Site Training

1. Initial site training shall be conducted at the job site.

2. Initial site training shall be conducted within 2 weeks of completion of start-up activities in accordance with the requirements of Paragraph 3.06.

3. Initial site training shall include a review of the revised Operating Manual. The revised Operating Manual shall incorporate revisions that include changes identified during start-up activities. The revised Operating Manual shall be reviewed and approved by the Purchaser prior to the initial site training.

4. Initial site training is expected to include a minimum of two 8-hour days of instruction.

5. Initial site training shall include the following items, at a minimum:

   a. A review of Control System and Operating Manual revisions
   b. A walk-through and description of the Control System
   c. Demonstration of normal start-up, operation, and shutdown procedures, emergency shutdown procedures, diagnostic procedures, failure recovery procedures, and basic calibration and maintenance procedures. The demonstration shall include instruction on graphics manipulation and capabilities.
   d. Report generation
   e. Observed, hands-on start-up and shut-down by each attendee.

6. Upon completing this training, each attendee should be able to perform basic operations by using appropriate documentation and be able to describe the general architecture and functionality of the Control System.

D. Follow-up Site Training

1. Follow-up site training shall be conducted at the job site.

2. Follow-up site training shall be conducted within 60 days after completion of the Acceptance Test in accordance with the requirements of Paragraph 3.08 D. The date to be determined by the Purchaser in coordination with the Vendor.

3. Follow-up site training shall include a review of all items included with classroom and initial site training, and a question and answer session.

4. Follow-up site training is expected to consist of a minimum of 8 hours of instruction.

5. Upon completion of the follow-up training, the attendees should be fully proficient in the operation and basic maintenance of the Control System.

3.11 DELIVERY, STORAGE, AND HANDLING

A. The Control System shall be dry, thoroughly cleaned inside and outside, and free of all loose foreign materials.

B. The Control System shall be stored at the Vendor's facility upon completion until ready for installation at the site. The ship date shall be provided by the Purchaser.

C. The Vendor shall prepare the Control System for shipment to the site.

D. Lifting points for enclosure shall be clearly identified.

E. Each container shall be marked with the address, Purchaser's job number, purchase order number, equipment tag number, and equipment serial number. Crated equipment shall be shipped with duplicate packing lists, one inside and one outside of the shipping container.

F. The Vendor shall furnish recommendations for protective measures to be applied to the Control System after its delivery to the site.

3.12 WARRANTY

The Vendor shall provide a written statement of warranty with the Vendor quotation.

END OF SECTION

ATTACHMENTS

TABLES

Table Number	Description
1	Shutdown Alarms
2	Warning Alarms
3	Inputs and Outputs Summary
4	Timers Summary

ATTACHMENTS

Exhibit Number	Description
1	Treatment Control System Description, Pemaco Superfund Site, Maywood, California

TABLE 1
SHUTDOWN ALARMS
PEMACO SUPERFUND SITE

FTO VAPOR TREATMENT SYSTEM SHUTDOWN ALARMS

Tag No.	Description	Set Point	Set Point Range	Units	Notes
AAH-301	High pH at FTO H-301	Fixed	None	None	From FTO Control Panel
AAL-301	Low pH at FTO H-301	Fixed	None	None	From FTO Control Panel
FAH-301	High Flow Alarm in FTO H-301	Fixed	None	None	From FTO Control Panel
FAL-301	High Flow Alarm in FTO H-301	Fixed	None	None	From FTO Control Panel
JRA-101 and JRA-102	Run Run Fail of Both Blowers P-101 and P-102	Fixed	None	None	
JRA-103	Blower P-103 Run Run Fail	Fixed	None	None	
JRA-201	Pump P-201 Run Run Fail	Fixed	None	None	
JRA-301	FTO H-301 Run Failure	Fixed	None	None	From FTO Control Panel
JRA-302	Air Cooler H-101 Run Run Fail	Fixed	None	None	
JRA-303	Moisture Separator V-103 Run Run Fail	Fixed	None	None	
JRA-304	Air Warmer H-201 Run Run Fail	Fixed	None	None	
LAHH-101	High-High Level Alarm in Moisture Separator V-101 at LSHH-101	Fixed	None	None	
LAH-301	High Level Alarm in FTO H-301 Water	Fixed	None	None	From FTO Control Panel
LAL-301	Low Level Alarm in FTO H-301 Water	Fixed	None	None	From FTO Control Panel
PAHH-202	High-High Pressure Alarm at Filters F-105 and F-106 Inlet at PT-202	15	10-20	psi	
TAHH-103	High-High Temperature Alarm at Vapor Conditioning Package Outlet at TIT-103	130	100-140	degree F	
TAH-301	High Temperature Alarm at FTO H-301	Fixed	None	None	From FTO Control Panel
TAL-301	Low Temperature Alarm at FTO H-301	Fixed	None	None	From FTO Control Panel

CARBON VAPOR TREATMENT SYSTEM SHUTDOWN ALARMS

Tag No.	Description	Set Point	Set Point Range	Units	Notes
JRA-101 and JRA-102	Run Run Fail of Both Blowers P-101 and P-102	Fixed	None	None	
JRA-103	Blower P-103 Run Run Fail	Fixed	None	None	
JRA-201	Pump P-201 Run Run Fail	Fixed	None	None	
JRA-302	Air Cooler H-101 Run Run Fail	Fixed	None	None	
JRA-303	Moisture Separator V-103 Run Fail	Fixed	None	None	
JRA-304	Air Warmer H-201 Run Run Fail	Fixed	None	None	
LAHH-101	High-High Level Alarm in Moisture Separator V-101 at LSHH-101	Fixed	None	None	
PAHH-202	High-High Pressure Alarm at Filters F-105 and F-106 Inlet at PT-202	15	10-20	psi	
TAHH-103	High-High Temperature Alarm at Vapor Conditioning Package Outlet at TIT-103	130	100-140	degree F	

TABLE 1
SHUTDOWN ALARMS
PEMACO SUPERFUND SITE

GROUNDWATER TREATMENT SYSTEM SHUTDOWN ALARMS

Tag No.	Description	Set Point	Set Point Range	Units	Notes
JRA-202	Pump P-202 Run Run Fail	Fixed	None	None	
JRA-203	Pump P-203 Run Run Fail	Fixed	None	None	
LALL-102	Low-Low Level Alarm in Holding Tank V-106 at LSLL-102	Fixed	None	None	
LAHH-201	High-High Level Alarm in Groundwater Booster Tank V-110 for a specified period of time at LSHH-201	5	0-10	minutes	
LALL-201	Low-Low Level Alarm in Groundwater Booster Tank V-110 at LSLL-201	Fixed	None	None	
LAHH-202	High-High Level Alarm in Secondary Containment Sump at LSHH-202	Fixed	None	None	
PAHH-201	High-High Pressure Alarm at Filters F-107 and F-108 Inlet at PT-201	20	10-25	psi	
PAHH-203	High-High Pressure Alarm at Filters F-109 and F-110 Inlet at PT-203	Fixed	None	None	
PAHH-204	High-High Pressure Alarm at Carbon Adsorbers V-107 and V-108 Inlet at PT-204	20	10-25	psi	

UNIVERSAL SHUTDOWN ALARMS (SHUTDOWN FOR ALL TREATMENT SYSTEMS)

Tag No.	Description	Set Point	Set Point Range	Units	Notes
NA-101	Power Failure at Control System	Fixed	None	None	
LAHH-102	High-High Level Alarm in Holding Tank V-106 at LSHH-102	Fixed	None	None	
PAL-301	Low Pressure Alarm at Air Compressor P-301 at PS-101	85	23-100	psi	
ZA-101	Emergency Stop for Blowers P-101 and P-102	Fixed	None	None	
ZA-102	Emergency Stop for FTO H-301	Fixed	None	None	
ZA-103	Emergency Stop in Control Room	Fixed	None	None	
ZA-104	Emergency Stop near Carbon Adsorber V-108	Fixed	None	None	

TABLE 2
WARNING ALARMS
PEMACO SUPERFUND SITE

FTO VAPOR TREATMENT SYSTEM WARNING ALARMS

Tag No.	Description	Set Point	Set Point Range	Units	Notes
JRA-101	Blower P-101 Run Run Failure	Fixed	None	None	
JRA-102	Blower P-102 Run Run Failure	Fixed	None	None	
LAL-103	FTO H-301 Low Level Alarm in Caustic Soda Tank V-102	Fixed	None	None	From FTO H-301 Control Panel
PAH-202	High Pressure Alarm at Filters F-105 and F-106 Inlet at PT-202	15	10-20	psi	
TAH-103	High Temperature Alarm at Vapor Conditioning Package Outlet at TIT-103	120	80-140	degree F	

CARBON VAPOR TREATMENT SYSTEM WARNING ALARMS

Tag No.	Description	Set Point	Set Point Range	Units	Notes
JRA-101	Blower P-101 Run Run Failure	Fixed	None	None	
JRA-102	Blower P-102 Run Run Failure	Fixed	None	None	
PAH-202	High Pressure Alarm at Filters F-105 and F-106 Inlet at PT-202	15	10-20	psi	
TAH-103	High Temperature Alarm at Vapor Conditioning Package Outlet at TIT-103	120	80-140	degree F	

GROUNDWATER TREATMENT SYSTEM WARNING ALARMS

Tag No.	Description	Set Point	Set Point Range	Units	Notes
JRA-204	Pump P-204 Run Run Failure	fixed	none	none	
PAH-201	High Pressure Alarm at Filters F-107 and F-108 Inlet at PT-201	15	10-20	psi	
PAH-203	High Pressure Alarm at Filters F-109 and F-110 Inlet at PT-203	15	10-20	psi	
PAH-204	High Pressure Alarm at Carbon Adsorbers V-107 and V-108 Inlet at PT-204	10	10-20	psi	

TABLE 3
INPUTS AND OUTPUTS SUMMARY
PEMACO SUPERFUND SITE

DISCRETE INPUTS

Tag No.	Description	Location	Range	Unit of Measure	Power Supply[1]	Load[1]
FSH-301	High Flow Switch for FTO H-301	FTO H-301 Control Panel	On-Off	None	24 VDC	Transistor
FSL-201	Low Flow Switch for FTO H-301	FTO H-301 Control Panel	On-Off	None	24 VDC	Transistor
JI-101	Blower P-101 Status	MCC	On-Off	None	24 VDC	Transistor
JI-102	Blower P-102 Status	MCC	On-Off	None	24 VDC	Transistor
JI-103	Blower P-103 Status	MCC	On-Off	None	24 VDC	Transistor
JI-201	Pump P-201 Status	MCC	On-Off	None	24 VDC	Transistor
JI-202	Pump P-202 Status	MCC	On-Off	None	24 VDC	Transistor
JI-203	Pump P-203 Status	MCC	On-Off	None	24 VDC	Transistor
JI-204	Pump P-204 Status	MCC	On-Off	None	24 VDC	Transistor
JI-301	FTO H-301 Status	FTO H-301 Control Panel	On-Off	None	24 VDC	Transistor
JI-302	Air Cooler H-101 Status	MCC	On-Off	None	24 VDC	Transistor
JI-303	Moisture Separator V-103 Status	MCC	On-Off	None	24 VDC	Transistor
JI-304	Air Warmer H-201 Status	MCC	On-Off	None	24 VDC	Transistor
LSH-101	Level Switch High in Moisture Separator V-101	Moisture Separator V-101	On-Off	None	24 VDC	Transistor
LSH-201	Level Switch High in Groundwater Booster Tank V-110	Groundwater Booster Tank V-110	On-Off	None	24 VDC	Transistor
LSH-202	Level Switch High in Secondary Containment Sump	Secondary Containment Sump	On-Off	None	24 VDC	Transistor
LSHH-101	Level Switch High-High in Moisture Separator V-101	Moisture Separator V-101	On-Off	None	24 VDC	Transistor
LSHH-102	Level Switch High-High in Holding Tank V-106	Holding Tank V-106	On-Off	None	24 VDC	Transistor
LSHH-201	Level Switch High-High in Groundwater Booster Tank V-110	Groundwater Booster Tank V-110	On-Off	None	24 VDC	Transistor
LSHH-202	Level Switch High-High in Secondary Containment Sump	Secondary Containment Sump	On-Off	None	24 VDC	Transistor
LSL-101	Level Switch Low in Moisture Separator V-101	Moisture Separator V-101	On-Off	None	24 VDC	Transistor
LSL-103	Level Switch Low in Caustic Soda Tank V-102	Caustic Soda Tank V-102	On-Off	None	24 VDC	Transistor
LSL-201	Level Switch Low in Groundwater Booster Tank V-110	Groundwater Booster Tank V-110	On-Off	None	24 VDC	Transistor
LSL-202	Level Switch Low in Secondary Containment Sump	Secondary Containment Sump	On-Off	None	24 VDC	Transistor
LSLL-102	Level Switch Low-Low in Holding Tank V-106	Holding Tank V-106	On-Off	None	24 VDC	Transistor
LSLL-201	Level Switch Low-Low in Groundwater Booster Tank V-110	Groundwater Booster Tank V-110	On-Off	None	24 VDC	Transistor
NI-101	Control System Power Status	Control Panel	On-Off	None	24 VDC	Transistor
PSL-101	Pressure Switch for Air Compressor P-301	Air Compressor P-301	On-Off	None	TBD	Transistor
ZHS-101	Emergency Stop for Blowers P-101 and P-102	Blowers P-101 and P-102	On-Off	None	24 VDC	Transistor
ZHS-102	Emergency Stop for FTO H-301	FTO H-301 Control Panel	On-Off	None	24 VDC	Transistor
ZHS-103	Emergency Stop in Control Room	E-stop in Control Room	On-Off	None	24 VDC	Transistor
ZHS-104	Emergency Stop near Carbon Adsorber V-108	E-stop near V-108	On-Off	None	24 VDC	Transistor

TABLE 3
INPUTS AND OUTPUTS SUMMARY
PEMACO SUPERFUND SITE

DISCRETE INPUTS

Tag No.	Description	Location	Range	Unit of Measure	Power Supply[1]	Load[1]
ZS-301	FTO H-301 Start Up Switch	FTO H-301 Control Panel	On-Off	None	24 VDC	Transistor
ZS-302	FTO H-301 Shutdown Switch	FTO H-301 Control Panel	On-Off	None	24 VDC	Transistor

TOTAL DISCRETE INPUT POINTS 34

ANALOG INPUTS

Tag No.	Description	Location	Range	Unit of Measure	Power Supply[1]	Load[1]
dPIT-101	Differential Pressure for Wellfield Inlet Flow Rate*	Wellfield Inlet Flow Rate FT-101	0-10	inches WC	24 VDC	4-20 mA
TIT-301	FTO H-301 Temperature	FTO H-301 Control Panel	0-3000	degree F	24 VDC	4-20 mA
AT-301	FTO H-301 pH	FTO H-301 Control Panel	0-14	pH units	24 VDC	4-20 mA
PT-101	Blowers P-101 and P-102 Outlet Pressure	Blowers P-101 and P-102 Outlet	0-15	psi	24 VDC	4-20 mA
TIT-203	Blow Down Water Temperature from FTO H-301	FTO H-301 Water Outlet	0-200	degree F	24 VDC	4-20 mA
PT-201	Filters F-107 to F-110 Inlet Pressure	Filters F-107 to F-110 Inlet	0-60	psi	24 VDC	4-20 mA
PT-202	Filters F-105 and F-106 Inlet Pressure	Filters F-105 and F-106 Inlet	0-60	psi	24 VDC	4-20 mA
PT-203	Filters F-113 and F-114 Inlet Pressure	Filters F-113 and F-114 Inlet	0-60	psi	24 VDC	4-20 mA
PT-204	Carbon Adsorber V-107 and V-108 Inlet Pressure	V-107 & V-108 Inlet	0-60	psi	24 VDC	4-20 mA
PT-102	Holding Tank V-106 Pressure (to control P-202 VFD)*	Holding Tank V-106	0-5	psi	24 VDC	4-20 mA
TIT-202	Moisture Separator V-101 Outlet Temperature	Moisture Separator V-101 Outlet	0-200	degree F	24 VDC	4-20 mA
FQI-202A	Moisture Separator V-101 Outlet Flow Totalizer	Moisture Separator V-101 Outlet		gallons	24 VDC	4-20 mA
FQI-202B	Moisture Separator V-101 Outlet Flow Rate	Moisture Separator V-101 Outlet	20-200	gpm	24 VDC	4-20 mA
FQI-201A	Wellfield Groundwater Inlet Flow Totalizer	Wellfield Groundwater Inlet		gallons	24 VDC	4-20 mA
FQI-201B	Wellfield Groundwater Inlet Flow Rate	Wellfield Groundwater Inlet	22-450	gpm	24 VDC	4-20 mA
TIT-101	Wellfield Vapor Inlet Temperature	Wellfield Vapor Inlet	0-200	degree F	24 VDC	4-20 mA
TIT-102	Blowers P-101 and P-102 Outlet Temperature	Blowers P-101 and P-102 Outlet	0-200	degree F	24 VDC	4-20 mA
TIT-103	Air Warmer H-201 Outlet Temperature	Air Warmer H-201 Outlet	0-200	degree F	24 VDC	4-20 mA
TIT-201	Wellfield Groundwater Inlet Temperature	Wellfield Groundwater Inlet	0-200	degree F	24 VDC	4-20 mA
VIT-101	Wellfield Vapor Inlet Vacuum	Wellfield Vapor Inlet	0-30	inches Hg	24 VDC	4-20 mA

TOTAL ANALOG INPUT POINTS 20

*Requires a calculation see Attachment 1 for details

TABLE 3
INPUTS AND OUTPUTS SUMMARY
PEMACO SUPERFUND SITE

DISCRETE OUTPUTS

Tag No.	Description	Location	Range	Unit of Measure	Power Supply[1]	Load[1]
CV-101	CV-101 Open/Close Solenoid FTO H-301 Air Inlet	MCC	On-Off	None	TBD	Relay
CV-201	CV-201 Open/Close Solenoid Wellfield Air Inlet	MCC	On-Off	None	TBD	Relay
CV-203	CV-203 Open/Close Solenoid Wellfield Groundwater Inlet	MCC	On-Off	None	TBD	Relay
HS-101	Blower P-101 Start/Stop Relay	MCC	On-Off	None	TBD	Relay
HS-102	Blower P-102 Start/Stop Relay	MCC	On-Off	None	TBD	Relay
HS-103	Blower P-103 Start/Stop Relay	MCC	On-Off	None	TBD	Relay
HS-201	Pump P-201 Start/Stop Relay	MCC	On-Off	None	TBD	Relay
HS-202	Pump P-202 Start/Stop Relay	MCC	On-Off	None	TBD	Relay
HS-203	Pump P-203 Start/Stop Relay	MCC	On-Off	None	TBD	Relay
HS-204	Pump P-204 Start/Stop Relay	MCC	On-Off	None	TBD	Relay
HS-301	FTO H-301 Permissive Relay	MCC	On-Off	None	TBD	Relay
HS-302	Air Compressor P-301 Permissive Relay	MCC	On-Off	None	TBD	Relay
HS-303	Air Cooler H-101 Start/Stop Relay	MCC	On-Off	None	TBD	Relay
HS-304	Moisture Separator V-103 Permissive Relay	MCC	On-Off	None	TBD	Relay
HS-305	Air Warmer H-201 Start/Stop Relay	MCC	On-Off	None	TBD	Relay
ZS-101	Open Switch for Actuated Valve CV-201	MCC	On-Off	None	TBD	Relay
ZS-101	Close Switch for Actuated Valve CV-201	MCC	On-Off	None	TBD	Relay

TOTAL DISCRETE OUTPUT POINTS 17

ANALOG OUTPUTS

Tag No.	Description	Location	Range	Unit of Measure	Power Supply[1]	Load[1]
PC-201	Pressure Control Signal to Pump P-202 (VFD)	MCC	0-100	Percent	24 VDC	4-20 mA

TOTAL ANALOG OUTPUT POINTS 1

Notes:

[1]The power supply and load may change based on value engineering, vendor expertise, or instrumentation specificiation. Vendor to confirm prior to installation.
[2]The FTO and vapor conditioning package (air stream cooler H-101, moisture separator V-103, air stream heater H-201, and blower P-103) will be provided by others. The design of the FTO and vapor conditioning package has not been finalized and the control system operation may change slightly upon issue of final design. These areas are considered to be non-critical with respect to your ability to prepare an accurate bid.
[3]The FTO Control Panel and the instrumentation for the FTO will be provided by others. Subcontractor will only be responsible for electrical wiring from the FTO Control Panel to the Control Panel and the MCC.

TABLE 4
TIMERS SUMMARY
PEMACO SUPERFUND SITE

Tag No.	Description	Unit of Measure
KR-101	Hours of Operation for Blowers P-101 and P-102	hours
KR-102	Hours of Operation for FTO Vapor Treatment System	hours
KR-103	Hours of Operation for Carbon Vapor Treatment System	hours
KR-104	Hours of Operation for Water Treatment System	hours

EXHIBIT 1

TREATMENT CONTROL SYSTEM DESCRIPTION
PEMACO SUPERFUND SITE
MAYWOOD, CALIFORNIA

1.0 CONTROL SYSTEM DESCRIPTION

The control system for the Pemaco treatment system has been outlined on the piping and instrumentation diagram (PID) (Figure M-1) and the treatment compound process layout (Figure M-4). The following will provide a description of the operation of the control system.

The control system will be an automated microprocessor-based control system with a computer human machine interface (HMI). The control system will consist of the following major elements: the programmable logic controller (PLC), the computer HMI, and the instrumentation and end-devices.

The PLC will consist of an Allen-Bradley PLC-500 family processor or Purchaser-approved equal. The HMI will consist of a computer with a HMI software package configured to interrogate the PLC to display status and alarm screens. The HMI will also perform data acquisition and storage for control system parameters. The HMI will allow for the control of the vapor and groundwater extraction treatment systems including: start, stop, alarm monitoring, and manual operation of the treatment system components. The instruments and end devices will include all transmitters, gauges, meters, regulators, level switches, control valves, sensors, switches, and control elements for the treatment system.

The control system consists of 4 primary interlocks, 34 shutdown alarms, 9 warning alarms, and 4 timers.

1.1 INTERLOCK DESCRIPTIONS

The interlocks provide action/reaction control of the treatment system. The interlocks are activated based on discrete events during the normal operation of the control system.

The following interlocks will be provided to control the treatment system:

- FTO Vapor Treatment System Interlock
- Carbon Vapor Treatment System Interlock
- Groundwater Treatment System Interlock
- Universal Interlock (All Treatment Systems)

1.1.1 VAPOR TREATMENT SYSTEM INTERLOCK

The Vapor Treatment System consists of two different options for treatment. The two options are the FTO Vapor Treatment System and the Carbon Treatment System. A selector switch will be located on the Treatment Systems Start/Stop screen, which enables the user to select the active Vapor Treatment System. The default system will be the FTO Vapor Treatment System.

The FTO Vapor Treatment System and the Carbon Vapor Treatment System each provide action/reaction control of the Vapor Treatment System during normal system operation.

1.1.1.1 FTO Vapor Treatment System

When the FTO Vapor Treatment System is the active Vapor Treatment System, the following conditions will result in a FTO Vapor Treatment System warning alarm (Table 2):

1. Failure of Blower P-101
2. Failure of Blower P-102
3. Low Level in Caustic Soda Tank V-102
4. High Pressure at Filters F-105 and F-106 Inlet at PT-202 (PAH-202)
5. High Temperature at Vapor Conditioning Package Outlet at TIT-103 (TAH-103)

The FTO Vapor Treatment System shutdown is an interlock that provides for an orderly shutdown of the FTO Vapor Treatment System by the control system in response to a process or equipment failure.

The following conditions will results in a FTO Vapor Treatment System shutdown interlock (Table 1):

1. High pH in FTO H-301 at AAH-301
2. Low pH in FTO H-301 at AAL-301
3. Low Flow in FTO H-301 at FAL-301
4. High Flow in FTO H-301 at FAH-301
5. Failure of Both Blowers P-101 and P-102
6. Failure of Blower P-103
7. Failure of Pump P-201
8. Failure of Air Cooler H-101
9. Failure of Moisture Separator V-103
10. Failure of Air Warmer H-201
11. High-High Level in Moisture Separator V-101 at LSHH-101 (LAHH-101)
12. High Level in FTO H-301 Water Stream at LAH-301
13. Low Level in FTO H-301 Water Stream at LAL-301
14. High-High Pressure at Filter F-105 and F-106 Inlet at PT-202 (PAHH-202)
15. High-High Temperature at Vapor Conditioning Package Outlet at TIT-103 (TAHH-103)
16. High Temperature in FTO H-301 at TAH-301
17. Low Temperature in FTO H-301 at TAL-301

The FTO Vapor Treatment System interlock shutdown consists of the following sequential shutdown:

1. Shutdown of Blower P-101
2. Shutdown of Blower P-102
3. Shutdown of FTO H-301
4. Shutdown of Pump P-201

The FTO will receive the shutdown signal and begin the shutdown sequence. Once the shutdown sequence is complete, the FTO will send a signal to the control system and the following sequential shutdown will occur:

1. Shutdown of Air Warmer H-201
2. Shutdown of Air Cooler H-101
3. Shutdown of Moisture Separator V-103

4. Shutdown of Blower P-103
5. De-activation of Solenoid CV-101 (assuming valve is normally closed)

1.1.1.2 Carbon Vapor Treatment System

When the Carbon Vapor Treatment System is the active Vapor Treatment System, the following conditions will result in a Carbon Vapor Treatment System warning alarm (Table 2):

1. Failure of Blower P-101
2. Failure of Blower P-102
3. High Pressure at Filters F-105 and F-106 Inlet at PT-202 (PAH-202)
4. High Temperature at Vapor Conditioning Package Outlet at TIT-103 (TAH-103)

The Carbon Vapor Treatment System shutdown is an interlock that provides for an orderly shutdown of the Carbon Vapor Treatment System by the control system in response to a process or equipment failure.

The following conditions will results in a Carbon Vapor Treatment System shutdown interlock (Table 1):

1. Failure of Both Blowers P-101 and P-102
2. Failure of Blower P-103
3. Failure of Pump P-201
4. Failure of Air Cooler H-101
5. Failure of Moisture Separator V-103
6. Failure of Air Warmer H-201
7. High-High Level in Moisture Separator V-101 at LSHH-101 (LAHH-101)
8. High-High Pressure at Filter F-105 and F-106 Inlet at PT-202 (PAHH-202)
9. High-High Temperature at Vapor Conditioning Package Outlet at TIT-103 (TAHH-103)

The Carbon Vapor Treatment System interlock shutdown consists of the following sequential shutdown:

1. Shutdown of Blower P-101
2. Shutdown of Blower P-102
3. Shutdown of Pump P-201
4. Shutdown of Air Warmer H-201
6. Shutdown of Air Cooler H-101
7. Shutdown of Moisture Separator V-103
8. Shutdown of Blower P-103

1.1.2 GROUNDWATER TREATMENT SYSTEM INTERLOCK

The Groundwater Treatment System interlock provides action/reaction control of the Groundwater Treatment System during normal system operation.

The following conditions will result in a Groundwater Treatment System warning alarm (Table 2):

1. Failure of Pump P-204
2. High Pressure at Filters F-107 and F-108 Inlet at PT-201 (PAH-201)
3. High Pressure at Filters F-109 and F-110 Inlet at PT-203 (PAH-203)
4. High Pressure at Carbon Adsorbers V-107 and V-108 Inlet at PT-204 (PAH-204)

The Groundwater Treatment System interlock shutdown is an interlock that provides for an orderly shutdown of the Groundwater Treatment System interlock system by the control system in response to a process or equipment failure.

The following conditions will results in a Groundwater Treatment System shutdown interlock (Table 1):

1. Failure of Pump P-202
2. Failure of Pump P-203
3. Low-Low Level in Holding Tank V-106 at LSLL-102 (LALL-102)
4. Low-Low Level in the Groundwater Booster Tank V-110 at LSLL-201 (LALL-201)
5. High-High Level in the Secondary Containment Sump at LSHH-202 (LAHH-202)
6. High-High Pressure at Filters F-107 and F-108 Inlet at PT-201 (PAHH-201)
7. High-High Pressure at Filters F-109 and F-110 Inlet at PT-203 (PAHH-203)
8. High-High Pressure at Carbon Adsorbers V-107 and V-108 Inlet at PT-204 (PAHH-204)

The Groundwater Treatment System shutdown interlock consists of the sequential shutdown:

1. De-activation of Solenoid CV-201 (assume normally closed)
2. Close Actuated Valve CV-203
3. Shutdown of Pump P-202
4. Shutdown of Pump P-203
5. Shutdown of Pump P-204

The Groundwater Treatment System shutdown interlock will activate heat exchanger H-202 if the FTO Vapor Treatment System is in operation when the interlock occurs. Heat Exchanger H-202 will continue to operate until:

1. The FTO Vapor Treatment System shutdown interlock is activated, or
2. The Water Treatment System is restarted.

1.1.3 UNIVERSAL INTERLOCK

The universal interlock provides action/reaction control of all the treatment systems during normal system operation. This includes the Groundwater Treatment System and the active vapor treatment system, FTO Vapor Treatment System and the Carbon Vapor Treatment System.

The universal interlock shutdown is an interlock that provides for an orderly shutdown of the treatment systems by the control system in response to a process or equipment failure.

The following conditions will result in a universal shutdown interlock (Table 1):

1. Power Failure at the Control System
2. High-High Level in the Holding Tank V-106 at LSHH-102 (LAHH-102)

3. Low Pressure Alarm at Air Compressor P-301 at PS-101 (PAL-301)
4. Activation of Emergency Stop for Blowers P-101 and P-102
5. Activation of Emergency Stop for FTO H-301
6. Activation of Emergency Stop in Control Room
7. Activation of Emergency Stop near Carbon Adsorber V-108

The Universal Shutdown Interlock consists of the sequential shutdown:

1. De-activation of Solenoid CV-201 (assume normally closed)
2. De-activation of Solenoid CV-101 (assume normally closed)
3. Shutdown of Active Vapor Treatment System (Section 1.1.1)
4. Shutdown of Groundwater Extraction Treatment system (Section 1.1.2)

1.2 START UP DESCRIPTIONS

The system will have two start buttons and two stop buttons on the Treatment System Start/Stop screen. One pair of start/stop buttons will be associated with the vapor treatment system and the other pair will be associated with the groundwater extraction treatment system. The system will also have on universal stop button to shutdown all of the treatment systems.

1.2.1 Vapor Treatment System Start Up

A selector switch will be located on the Treatment Systems Start/Stop screen, which enables the user to select the active Vapor Treatment System. The default system will be the FTO Vapor Treatment System.

1.2.1.1 FTO Vapor Treatment System Start Up

The FTO Vapor Treatment System start up consists of the following sequential start up:

1. Activate Solenoid CV-101 (assumed normally closed)
2. Start the FTO H-301
3. Start the Air Cooler H-101
4. Start the Air Warmer H-201
5. Start Blower P-103
6. Start Pump P-204

The FTO will receive the start up signal and begin the start up sequence. Once the start up sequence is complete, the FTO will send a signal to the control system and the following sequential start up will occur:

1. Start Blower P-101
2. Start Blower P-102
3. Activate Pump P-201
4. Activate Pump P-204

1.2.1.2 Carbon Vapor Treatment System Start Up

The Carbon Vapor Treatment System start up consists of the following sequential start up:

1. Start Blower P-101
2. Start Blower P-102
3. Start the Air Cooler H-101
4. Start the Air Warmer H-201
5. Start Blower P-103
6. Activate Pump P-201

1.2.2 Groundwater Treatment System

The groundwater treatment system start up consists of the following sequential start up:

1. Activate Pump P-202
2. Activate Pump P-203
3. Activate Pump P-204
4. Activate Solenoid CV-201 (assume normally closed)
5. Open Actuated Valve CV-203

1.3 Calculations

The following values need to be calculated by the control system during the both the FTO Vapor Treatment System and Carbon Vapor Treatment System operation:

1. Vapor Flow Rate FE-102 at Blower P-101 and P-102 Outlet
2. Convert the pressure at PT-102 from pounds per square inch (psi) to feet of water (ft H_2O)

1.3.1 Flow Rate at FT-101

The flow rate at FE-101 will be calculated using the differential pressure from dPIT-101. The flow rate equation is as follows.

$$Q = 5523\sqrt{\frac{P \times \Delta P}{(T + 460)}}$$

Where: Q = Flow rate in standard cubic feet per minute (SCFM)
P = Static line pressure (psia) from PT-101
ΔP = Differential pressure (inches of water column) from dPIT-101
T = Temperature (°F) from TIT-102

1.3.2 Pressure Conversion at PT-102

Convert the pressure PT-102 from psi to ft H_2O. The conversion is as follows.

$$1\ psi = 2.307\ \ ft\ H_2O$$

1.4 Control Loops

The holding tank (V-106) control loop is maintained by the control system during Groundwater Treatment System operation. This control loop maintains a constant pressure of 3.5 ft H_2O as measured by PT-102 with a set point range of 0 to 8 feet of water. A variable frequency drive (VFD) controls the current to Pump P-202 to maintain the pressure set point.

1.5 Pump Operation

Pumps P-201, P-203 and P-204 will be activated and de-activated by level switches. The level switches in the Moisture Separator (V-101) will activate/de-activate Transfer Pump P-201: level switch high LSH-101 will activate the pump and level switch low LSL-101 will de-activate the pump. The level switches in the Groundwater Booster Tank V-110 will activate/de-activate Booster Tank Pump P-203: level switch high LSH-201 will activate the pump and level switch low LSL-201 will de-activate the pump. The level switches in the Secondary Containment Sump will activate/de-activate the Secondary Containment Sump Pump P-204: level switch high LSH-202 will activate the pump and level switch low LSL-202 will de-activate the pump.

1.6 Alarms

Alarms are notifications to the operator that the treatment systems are operating at a process-upset condition. Alarms are classified into two types, shutdown alarms and warning alarms. Shutdown alarms notify the operator that a system condition has resulted in a shutdown and that immediate attention is required to correct the condition and restart the system. The shutdown alarms have been summarized in Table 1. Shutdown alarms will appear on the alarm pop-up screen and the auto-dialer will be activated to perform the call out sequence.

Warning alarms notify an operator of a system condition that, if not addressed, may result in a system shutdown. The warning alarm is intended to allow correction of system operating conditions prior to a system shutdown. Warning alarms will appear on the alarm pop-up screen and the auto-dialer will be activated to perform the call out sequence. The warning alarms have been summarized in Table 2.

1.7 Timers

The control system will record the hours of operation for the following:

1. Blowers P-101 and P-102
2. FTO Vapor Treatment System
3. Carbon Vapor Treatment System
4. Groundwater Treatment System

1.8 Summary of Inputs and Outputs

The minimum I/O have been summarized in Table 3. The control system will have the following minimum inputs and outputs (I/O):

Inputs

- Discrete 34
- Analog 20

Outputs

- Discrete 17
- Analog 1

1.9 Assumptions

The FTO and vapor conditioning package will be provided by others. The FTO Control Panel and instrumentation for the FTO will be provided by others. Subcontractor will only be responsible for electrical wiring from the FTO Control Panel to the Control Panel and the MCC. The FTO and vapor conditioning package designs have not been finalized and the control system operation may change slightly upon issue of final design. The electrical single line diagram currently shows the anticipated loads. The actual full loads may change and need to be finalized by the subcontractor prior to construction.

SECTION 15400

PROCESS PIPING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. The most recent version of the publication and test method shall be applicable in all cases.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 193/A	Stainless Steel Bolts
ASTM A 194/A	Stainless Steel Nuts
ASTM F 1664	Poly(Vinyl Chloride) (PVC) Coated Steel Pipe
ASTM D 1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2104	Polyethylene (PE) Plastic Pipe, Schedule 40
ASTM D 2239	Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2241	Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2447	Polyethylene (PE) Plastic Pipe, Schedule 40
ASTM D 2464	Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	Poly(Vinyl Chloride) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2609	Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe
ASTM D 2683	Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	Polyethylene (PE) Plastic Tubing
ASTM D 2774	Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3035	Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3261	Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	Polytetrafluorethylene (PTFE) Resin Skived Tape
ASTM D 3350	Polyethylene Plastics Pipe and Fitting Materials
ASTM F 402	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 656	Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) Plastic Pipe and Fittings
ASTM F 714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 1055	Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
ASTM F 1056	Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe or Tubing and Fittings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2	Air Gaps in Plumbing Systems
ASME B.1.20	Pipe Threads, General Purpose (Inch)
ASME B16.1	Flanges and Flanged Fittings
ASME B16.3	Malleable Iron Threaded Fittings
ASME 16.5	Flange Dimensions
ASME B16.11	Forged Fitting, Socket-Welding and Threaded
ASME B16.34	Valves – Flanged, Threaded and Welding End
ASME B31.3	Process Piping

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE) FOR PLUMBING AND SANITARY RESEARCH

ASSE 1011	Hose Connection Vacuum Breakers

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C800	Underground Service Line Valves and Fittings
AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing, ½ In. through 3 In., for Water Service

MANUFACTURERS STANDARDIZATION SOCIETY (MSS) OF THE VALVE AND FITTING INDUSTRY

MSS SP-58	Pipe Hangers and Supports – Materials, Designs, and Manufacture
MSS SP-69	Pipe Hangers and Supports – Selection and Application
MSS SP-80	Bronze Gate, Globe, Angle, and Check Valves
MSS SP-110	Ball Valves, Threaded

NATIONAL ASSOCIATION OF PLUMBING-HEATING-EPAOLING EPANTRACTORS (NAPHCC)

NAPHCC Code	Plumbing code

NSF INTERNATIONAL (NSF)

NSF 14	Plastics Piping Components and Related Materials
NSF 61	Drinking Water System Components – Health Effects (Sections 1 – 9)

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data
Installation;
The manufacturer’s recommendations for each material or procedure to be utilized.

Waste Water Disposal Method; G.
The method proposed for disposal of waste water from hydrostatic tests, prior to performing hydrostatic tests.

Satisfactory Installation; G.
A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the Drawings and specifications, and the manufacturer’s prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-06 Test Reports
Hydrostatic testing; G.

SD-07 Certificates
Manufacturer's Representative;
The name and qualifications of the manufacturer's representative and written certification from the manufacturer that the representative is technically qualified in all phases of pipe laying and jointing and experienced to supervise the work and train Contractor's field installers, prior to commencing installation.

Plastic Piping System; G.
Documentation certifying that the manufacturer of each thermoplastic piping system is listed with the Plastic Pipe Institute as meeting the recipe and mixing requirements of the resin manufacturer for the resin used to manufacture each of the respective thermoplastic pipe systems.

Installation; G.
A statement signed by the manufacturer's field representative certifying that Contractor's personnel are capable of properly installing the pipe on the project.

1.3 SYSTEM DESCRIPTION

This section describes specifications and performance requirements for process piping, fittings, adapters, valves, expansion joints, and other appurtenances to convey groundwater, compressed air, and a combined flow of water and vapor from perched wells and deep wells to the treatment plant as shown on Drawing C-3. Additional piping and trenching details are shown on Drawings C-2 through C-10. Process connection piping shall use single wall polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) as indicated on the Tables 15400-1 attached to this Section. The Tables summarize pipe sizing and material, operating specifications, trench installation locations and subsurface service zones.

Contractor shall make all arrangements for the installation of piping including completion of any necessary permits and fees. The process lines shall be run underground from each well in trenches to the Treatment Plant shown on the Drawings. Contractor shall provide all materials, equipment, and labor needed to install the process lines and associated equipment in accordance with the Drawings.

1.3.1 Performance Requirements

The process pipe installation shall conform to these specifications and drawings and any manufacturer's instructions. The pressure ratings and materials specified represent minimum acceptable standards for the process piping. Unless otherwise stated, the minimum required pressure rating for process piping and associated equipment is 110 pounds per square inch gauge (psig). The piping systems shall be suitable for the services specified and intended. The pipe, valves, fittings, expansion joints and appurtenances shall have a pressure rating no less than that required for the system in which they are installed. Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the Site at all times.

1.3.2 Plastic Piping System

Piping for process lines shall be PVC or CPVC unless otherwise shown or specified.

1.4 GENERAL JOB REQUIREMENTS

Piping materials and appurtenances shall be as specified and as shown on the Drawings, and shall be suitable for the service intended. Piping materials, appurtenances and equipment supplied as part of this contract shall be new and unused except for testing equipment. Components that serve the same function and are the same size shall be identical products from the same manufacturer.

1.5 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition. If the pipe or fittings are damaged, Contractor shall make the repair in a satisfactory manner, at no additional cost to the Government. Pipe shall be carried into position and not dragged. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after installation shall be replaced with sound material without additional expense to the Government. If applicable, rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.5.1 Verification of Dimensions

After becoming familiar with all details of the work, Contractor shall verify all dimensions in the field and shall advise the Project Engineer or Construction Manager of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 PIPE, JOINTS, AND FITTINGS

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Polyvinyl Chloride Process Pipe

PVC pipe shall be Type 1, Grade 1, with minimum cell classification 1245-B, and shall meet the specification for rigid PVC per ASTM D 1784. Where PVC process pipe is used it shall be Schedule 40 PVC conforming to ASTM D 1785.

2.1.2 Polyvinyl Chloride Joints

PVC piping systems shall be joined by socket-weld or flanged connections except where connecting to unions, valves, and equipment with threaded connections that may require future disassembly. Connections at those points shall be threaded.

2.1.3 Polyvinyl Chloride Fittings

The schedule rating for the fittings shall not be less than that for the associated pipe. Fittings shall conform to ASTM D 1785 Schedule 40 PVC or ASTM D 1784, minimum cell classification 1245-B, Schedule 80 PVC threaded in accordance with ASME B1.20.1. Schedule 40 PVC socket type shall conform to ASTM D 2467 and Schedule 80 PVC socket type shall conform to ASTM D 2466.

Push-on Joints. Push-on type joints shall be sealed ethylene propylene diene monomer (EPDM) gaskets.

Flanged Fittings. Flanges and flanged fitting shall be Class 125, one piece, molded hub type, flat faced, or two piece van stone type and shall conform to ASME B16.1 or ASME B16.5.

Flanged connections shall have the same pressure rating as the pipe or greater. Bolting shall be 316 stainless steel, ASTM A 193, Grade B8 hex head bolts and ASTM A 194, Grade 8 hex head nuts. Bolts shall be provided with washers of the same material as the bolts. Gaskets shall be full-faced, maximum 1/8 inch thick, fabricated from EPDM. When the mating flange has a raised face, a flat ring gasket shall be used and a filler gasket shall be provided between outer diameter of the raised face and the flange outer diameter to protect the PVC flange from bolting moment.

2.1.4 Polyvinyl Chloride Solvent Cement

Socket connections shall be joined with PVC solvent cement conforming to ASTM D 2564. Manufacture and viscosity shall be as recommended by the pipe and fitting manufacturer to assure compatibility. Joints shall be prepared with primers conforming to ASTM F 656 prior to cementing and assembly.

2.2 VALVES

The valves shall be suitable for the intended service. Renewable parts are not to be of a lower quality than those specified. Valve ends shall be compatible with adjacent piping system. The valve shall be sized to operate at the full range of pressures and velocities. Valves shall be provided on supplies to equipment and fixtures. Valves shall be PVC, CPVC, or stainless steel. Pressure ratings shall be based upon the application, 125 psig minimum. Valves shall conform to the following standards shown in Table – Valve Standards.

VALVE STANDARDS

Description	Standard
Ball valves, threaded	MSS SP-110
Gate, Globe, and Check Valves	MSS SP-80

2.2.1 Air Release Valve

Air release vents shall be installed in all pressurized and vacuum conveyance lines. Air release valves shall be located as indicated on the drawings. All pipeline high points shall have air release valve. Vacuum breakers shall be provided on all tanks and process equipment.

2.2.2 Air Release Valve (Combination Air and Vacuum Valve)

The valve combines the operating functions of both an air and vacuum valve and an air release valve. The air and vacuum portion shall automatically exhaust air during filling of a piping system and allow air to re-enter during draining or when a vacuum occurs. Air release portion shall automatically exhaust entrained air that accumulates in the piping system. The valve shall be a single body unit. The valve shall be rated for 110 psig working pressure and built with a special short body (6-inch maximum height). The valve shall have a cast iron, ductile iron, or semi-steel body and cover, with stainless steel or bronze float and trim. Valve end connection shall be ASME B1.20.1 pipe threaded. The air release valve shall be mounted with a quick disconnect coupling such as a Chicago style fitting to the piping system with a blow-off valve between the valve and the main piping. Val-Matic Valve and Manufacturing Corporation Model No. 15A with a 1-inch Female National Pipe Thread (FNPT) connection or equivalent.

2.2.3 Ball Valves

General purpose ball valves shall conform to the following: Ball valves used in the process piping system shall be end entry type with PVC, CPVC, stainless steel, bronze, or brass bodies as shown on the Drawings and be threaded, in accordance with ASME B1.29.1, full bore ports.

Valves shall have PTFE seats and packing, stainless steel balls and hand lever operators. The ball valves shall be provided with NPT connects and be turned on or off in a minimum of 90 degrees of rotation. Valves shall be rated for 110 psig service at 140°F and shall conform to ASME B16.34. A union shall be installed adjacent to the valves to provide access to the seat when the valve is located between fixed equipment and piping. Valves used in the system shall range in size from ¼ to 2-inch NPT ball valves unless otherwise indicated on the Drawings.

2.2.4 Thermoplastic Butterfly Valves

Thermoplastic butterfly valves, 1.5 inch and larger, shall have wafer style bodies constructed of PVC or polypropylene (PP). Valves shall have PVC, PP, PTFE discs; EPDM- or Viton-backed seats and seals; and lever operators. Valves shall be rated for 110 psig service at 140°F.

2.2.5 Gate Valves

Gate valves shall be designed for a working pressure of not less than 110 psig. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening. Valves shall be all bronze and shall conform to MSS SP-80, Type 1, Class 150. Gate Valves, shall have bronze bodies and stems, screwed or union bronze bonnets, single solid wedge bronze discs, and non-rising stems. Valves shall conform to ASME B16.34. End connections shall be ASME B16.11 threaded. Valves shall be equipped with hand-wheel for operators.

2.2.6 Check Valves

2.2.6.1 Elastometer Check Sleeve

Contractor shall provide elastomer sleeve style check valves for installation where indicated on the Drawings and be constructed from Buna-N, EPDM, or Viton. They shall be silent, non-slamming, close on entrapped solids, and seal 100 percent on reverse flow. Valves shall be rated for 110 psig service and shall close when subjected to as little as 3 psig backpressure. The check valve shall have a directional arrow to indicate the flow direction. Check valves shall have stainless steel bodies and have threaded FNPT fittings, Red Valve Company Series 2633 or equivalent. Check valves larger than 2 inches may use the elastomer sleeve without the body and be installed between pipe flanges, Red Valve Company Series 37 or equivalent.

2.2.6.2 Swing Check Valves

Swing check valves, 2.5 inches and larger shall have PVC or PP body, with flanged ends. Valves shall have top entry to allow for easy access to internal components without removal of the line. Valves shall be rated for 110 psig service and shall close when subjected to as little as 3 psig backpressure. Swing check valve shall have a directional arrow to indicate the position of the disc. The swing check valve shall have high visibility direction arrow and be manufactured by Spears or equivalent.

2.2.7 Thermoplastic Ball Check Valve

Thermoplastic check valves shall be a ball-check design, manufactured of PVC or PP with flanged or true double-union socket end connections. Valves shall be rated for 110 psig service. Valves shall have EPDM or Viton O-ring seals and seats. Hayward Ball Check or equivalent.

2.3 DRAINS

Valved drains may not be shown on the detailed drawings for individual pipelines; their absence will not relieve Contractor of the responsibility for providing and installing them as indicated in the piping and instrumentation diagrams to complete the piping system for the use intended.

2.3.1 Drain Locations

Drains shall be located as indicated on the drawings. However, all pipeline low points shall have provisions for drainage.

2.3.2 Drain Sizes

Unless indicated on the drawings, for pipelines 2 inches and smaller, drains shall be 0.5 inch and equipped with ball valve. For pipelines 2.5 inches and larger, drains shall be 0.75 inch and equipped with ball valves.

2.4 SAMPLE PORTS

Sample ports, shown on the flow diagrams of the drawings, may not be shown on the detailed drawings of the individual pipelines; their absence shall not relieve Contractor of the responsibility for providing them. Sample ports shall be provided as indicated in the piping diagrams to complete the piping systems for the use intended. The sample ports shall be located in easily accessible locations, and shall avoid potential stagnant points and/or areas where material could collect. A plug-type sampling valve with a stainless steel piston that extends beyond the inner surface of the pipe when closed shall be provided at all the sampling ports indicated. The piston shall be sealed by two compressible replaceable PTFE rings, one above the discharge port, the other below the discharge port. The valve body shall be stainless steel Class 150 with a male ASME B1.20.1 pipe threads inlet connection and female ASME B1.20.1 pipe threads outlet connection. Sampling ports shall be comprised of pipe fittings, pipe, and ball valves which comply with material, temperature, and pressure requirements of the associated piping system as specified elsewhere in this section.

2.4.1 Strainers

Strainers shall be simplex with a Y-pattern or basket type with thermoplastic body. Port sizes shall be 1-inch minimum and have threaded female NPT connections. The strainers shall be rated for 110 psig working pressure at 140°F. The body shall be PVC or PP with a bolted cap. The strainer screen shall be 304 or 316 stainless steel, 30 mesh and be equipped with a ASME B1.20 pipe threaded blowoff hole. O-ring seals shall be EPDM or Viton. Strainer shall be Y type with 1-inch connections and be manufactured from clear PVC by Spears or equivalent.

2.5 VALVE BOXES

Valve boxes shall be cast iron, lightweight polymer or concrete, except that concrete and polymer boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 3/16 inch. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment complete with identifying covers. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location. Valve boxes shall be provided with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the valve. Oldcastle precast polymer hand holes or equivalent.

2.6 WELL VAULTS

The vaults associated with each well shall be of sufficient size to encompass all the equipment shown on the drawings. The vault shall be provided with a bottom (floor) that self drains and a cover that can be locked. Refer to the Drawings (C-6, C-7, and C-8) for additional well vault construction details.

PART 3 EXECUTION

3.1 INSTALLATION AND PREPARATION

3.1.1 Protection

Pipe and equipment openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. Pipe and fittings shall be inspected before exposed piping is installed or buried piping is lowered into the trench. Contractor shall clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after laying.

3.1.2 Couplings and Adapters

Pipes shall be thoroughly cleaned of oil, scale, rust, and dirt in order to provide a clean seat for gaskets. Gaskets shall be wiped clean prior to installation. Flexible couplings and flanged coupling adapter gaskets shall be lubricated with soapy water or the manufacturer's standard lubricant before installation on the pipe ends. Couplings, valves, and other equipment shall be installed in accordance with manufacturer's instructions. Bolts shall be tightened progressively, drawing up bolts on opposite sides a little at a time until all bolts have a uniform tightness. Torque-limiting wrenches shall be used to tighten bolts to manufacturer's specifications.

3.1.3 Piping Equipment/Component Installation

Piping components and indicators shall be installed in accordance with manufacturer's instructions. Required upstream and downstream clearances, isolation valves, and miscellaneous devices shall be provided for an operable installation.

3.1.4 Plastic Pipe Installation

Plastic pipe shall be cut, fabricated and installed in strict conformance with the pipe manufacturer's recommendations. All plastic pipe shall be cut, made up, and installed in accordance with the pipe manufacturer's recommendations. Where PVC is used schedule 40 PVC pipe shall not be threaded. Schedule 80 PVC threaded nipples shall be used where necessary to connect to threaded valves or fittings. Strap wrenches shall be used for tightening threaded plastic joints, and care shall be taken not to overtighten these fittings. Pipe shall not be laid when the temperature is below 40°F, nor above 90°F when exposed to direct sunlight. Any plastic pipe intended for permanent installation above grade and outdoors shall be ultraviolet (UV) protected or UV resistant. The pipe ends that are to be joined shall be shielded from direct sunlight prior to and during the laying operation. Adequate ventilation shall be provided when working with pipe joint solvent cement and the handling of solvent cements, primers and cleaners shall be in accordance with ASTM F 402.

Contractor shall provide and install supports and hangers where necessary in accordance with the manufacturer's recommendations. All lines shall be hydrostatically tested at the maximum operating pressures. Offset loops from the placement centerline shall be as recommended by the manufacturer for the maximum temperature variation between the installation pipe temperature at the time of solvent welding or fusion and operating temperature. Flexible plastic pipe connected to heavy fittings, or rigid structures shall be supported in such a manner that no subsequent relative movement between the plastic pipe at the fitting or the rigid structures is possible. Thrust blocking shall not be used for flexible plastic piping. The piping shall be designed and installed to withstand the compression and expansion forces imposed by the trench conditions.

3.1.5 Polyvinyl Chloride Piping

Solvent-cemented joints shall be constructed in accordance with ASTM D 2855.

3.1.6 Placing and Laying

Pipe and accessories shall be carefully laid in the trench by means of derrick, ropes, belt slings, or other authorized equipment. Process pipeline materials shall not be dropped or dumped onto the trench. Abrasion of the pipe shall be avoided. The full length of each section of pipe shall rest solidly upon the geomembrane or the pipe bed, with recesses excavated to accommodate couplings, and joints. Pipe that had the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the pipe is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner.

3.1.7 Piping Expansion Provisions

Provisions for expansion and contraction of plastic piping must be provided when severe fluctuations of temperature are anticipated. This shall be accomplished with the use of offset piping arrangements. The piping shall be installed to allow for thermal expansion resulting from the difference between installation and operating temperatures. Other expansion devices, if needed, shall be installed in accordance with the manufacturer's instructions.

3.1.8 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Project Engineer, cutting shall be done with an approved type mechanical cutter.

3.1.9 Connecting Dissimilar Pipe

Flexible transition couplings and isolation joints shall be installed in accordance with the manufacturer's instructions.

3.1.10 Jointing

3.1.10.1 Polyethylene Piping Connections

Jointing shall comply with ASTM D 3261, Technique I-Socket Fusion or Technique II-Butt Fusion. Where connections are made between new work and existing mains, the connections shall be made by using special fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Project Engineer or Construction Manager.

3.1.10.2 Joint Deflection

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Project Engineer, but shall not exceed 5 degrees.

3.1.10.3 Isolation Joints and Dielectric Fittings

Isolation joints and dielectric fittings shall be installed in accordance with manufacturer's recommendations.

3.1.10.4 Transition Fittings
Connections between different types of pipe and accessories shall be made with transition fittings approved by the Project Engineer.

3.1.11 Valve Installation
Threaded ends shall have the threads cleaned by wire brushing or swabbing prior to installation. Flanged valve bolt holes shall be installed so as to straddle the vertical centerline of pipe. Flanged faces shall be cleaned prior to inserting the gasket and bolts, and then the nuts shall be tightened progressively and uniformly. Threaded ends shall have the threads cleaned by wire brushing or swabbing prior to installation. All flanged components shall be connected with 316 stainless steel bolts and associated washers and nuts.

3.1.11.1 Location of Valves
Valves and valve boxes shall be installed where shown or specified on the Drawings, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Earth fill shall be tamped around each valve box or pit to a horizontal distance of 4 feet on all sides of the box, or the undisturbed trench face if less that 4 feet. If valve wrenches are necessary to operate a valve, three wrenches shall be provided by Contractor.

3.1.11.2 Operator Extension Stems
Where the depth of the valve is such that its centerline is more than 3 feet below grade, an operator extension stem shall be furnished with a 2 inch operating nut to bring the operating nut to a point 5.9 inches below the surface of the ground and/or box cover. The operating nut shall be located in a floor box.

3.1.11.3 Butterfly Valves
Orientation of butterfly valves shall take into account changes in pipe direction. Valve shafts shall be oriented so that unbalanced flows caused by pipe direction changes or other disturbances are equally divided to each half of the disc.

3.1.11.4 Drains (Condensate Sumps), and Sample Ports
Sample ports shall be provided where indicated on the Drawings.   Condensate sumps shall be installed in the low points of vapor pipelines regardless of whether shown on drawings.

3.1.12 Piping Support Systems Installation
The absence of pipe supports and details on the Drawings shall not relieve Contractor of responsibility for sizing and providing supports if necessary to conform to manufacturer's recommendations and site conditions.

3.1.12.1 General Support Requirements
Pipe support systems shall meet the requirements of MSS SP-58. Contractor-designed and selected support systems shall be installed in accordance with MSS SP-69, and as specified herein. Piping connections to equipment shall be supported by pipe supports and not off the equipment. Large or heavy valves, fittings, and/or equipment shall be supported independently of associated piping. Pipes shall not be supported off other pipes. Supports shall be provided at piping changes in direction or in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the Drawings.

3.1.13 Backfilling

Backfilling shall be accomplished after inspection by the Project Engineer, Construction Manager, or QC Engineer. Contractor shall exercise care when lowering pipe into the trench to prevent damage or twisting of the pipe.

3.1.14 Expansion

Contractor shall provide all structural work and equipment required to control expansion and contraction of piping. Contractor shall verify that the anchors, guides, and expansion joints provided adequately protect the piping systems.

3.2 HYDROSTATIC TESTS

3.2.1 Pressure Tests

After the pipe is laid, the joints completed, valves permanently installed and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 110 psig.

3.2.1.1 Pressure Testing of Groundwater Piping

Pressure tests shall be performed in accordance with manufacturer's recommendations for the water supply line and unused conduit. Pipe shall be pressure tested with water in accordance with the manufacturer's recommendations, and other requirements of this section. The pipe should be covered or otherwise supported at intervals to hold it in place during pressure tests. After all free air is removed from the test section, raise the pressure at a steady rate at 25 psig increments to a test pressure equal to 110 psig. Thermal expansion may cause pressure change during the initial testing. Following an equilibration period of 1 hour, adjust the piping pressure back to the test pressure and monitor this pressure for an additional hour. Pressure drop may continue to occur during the pressure testing. "Make up" water may be required to return the section to test pressure. An allowable amount of "make up" water for a satisfactory test will be 0.1 U.S. gallons per 100 feet of pipe for the 1 hour test. All pipes, fittings, and valves shall be subject to the pressure test. The following items shall be removed from the pipe, or isolated from pressure during the pressure test: regulators, valves, flex hoses, gauges, controls, instruments or equipment that would be damaged as a result of the pressure test. Each valve shall be opened and closed several times during the test.

Exposed pipe, joints, fittings, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Project Engineer or Construction Manager when one or more of the following conditions are encountered:

Wet or unstable soil conditions in the trench
Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.

Maintaining the trench in an open condition would delay the completion of the project.
Contractor may request a waiver, setting forth in writing the reasons for the request and stating

the alternative procedure proposed to comply with the required hydrostatic tests. Contractor is responsible for all equipment and materials required to complete the test.

When pressure testing, extreme caution shall be used when working around the pipe being tested, adequate barricade and safety precautions must be used to protect people and property. Support piping as necessary to prevent displacement in the event of test failure.
The piping network may be tested in sections or as an entire assembly at Contractor's discretion. All pipes or joints disconnected for testing purposes shall be reconnected using proven joining techniques. Contractor shall provide all temporary plugs, flanges, or other sealing devices needed for the pressure testing. Provide suitable notification and access so that all testing may be witnessed by the Project Engineer, Construction Manager, or QC Engineer, unless other arrangements have been made in advance and in writing.

3.2.1.2 Leakage Test
Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 110 psig pressure. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 5 psig of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

L=0.0001351 N x C x D x (P raised to 0.5 power)

Where:

L= Allowable leakage in gallons per hour
N= Number of joints in the length of the pipeline tested
D= Nominal diameter of the pipe in inches
P= Average test pressure during the leakage test, in psig

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.1.3 Time for Making Test
Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subject to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill.

3.2.1.4 Testing New to Existing Connections
New piping connected to existing pipe shall be tested. Contractor shall isolate the new piping with pipe caps, spectacle blinds, or blind flanges. The joint between new piping and existing piping shall be tested by methods that do not place the entire existing system under the test load. Contractor shall then proceed with the testing of new piping systems as specified herein.

3.2.1.5 Concurrent Hydrostatic Tests
Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required

shall be accomplished by Contractor at no additional cost to the Government. Pressure test and leakage test may be conducted concurrently.

3.3 PNEUMATIC TESTS

3.3.1 Pressure Tests

After the pipe is laid, the joints completed, valves permanently installed and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to an air pressure test of 5 psig.

3.3.1.1 Pressure Testing of Vacuum Piping

Air pressure tests shall be performed in accordance with manufacturer's recommendations for the vacuum line. Pipe shall be pressure tested with air in accordance with the manufacturer's recommendations, and other requirements of this section. The pipe should be covered or otherwise supported at intervals to hold it in place during pressure tests. Prior to any air pressure testing, all pipe fittings shall be checked with a soap solution to detect any air leakage. After air compressor pump connecting to the test section, raise the pressure at a steady rate increments to a test pressure equal to 5 psig. Thermal expansion may cause pressure change during the initial testing. Following an equilibration period of 1 hour, adjust the piping pressure back to the test pressure and monitor this pressure for an additional hour. Pressure drop may continue to occur during the pressure testing. After the temperature has stabilized and no air leaks at the fittings have been found, the pressure shall be maintained at least 4 psig within an hour for a satisfactory test. All pipes, fittings, and valves shall be subject to the pressure test. The following items shall be removed from the pipe, or isolated from pressure during the pressure test: regulators, valves, flex hoses, gauges, controls, instruments or equipment that would be damaged as a result of the pressure test. Each valve shall be opened and closed several times during the test.

3.3.1.2 Pressure Testing of Compressed Air Piping (ABS Air-line)

Air pressure tests shall be performed in accordance with manufacturer's recommendations for the ABS Air-line. Pipe shall be pressure tested with air in accordance with the manufacturer's recommendations, and other requirements of this section. The Air-line should be covered or otherwise supported at intervals to hold it in place during pressure tests. Prior to any air pressure testing, all pipe fittings shall be checked with a soap solution to detect any air leakage. The average operating pressure is 55 psig based on QED Long AP-4/BL Performance Curve: ¾-inch I.D. Discharge. Therefore, after air compressor pump connecting to the test section, raise the pressure at a steady rate increment to a test pressure equal to 110 psig (Additional 100% of average operating pressure). Thermal expansion may cause pressure change during the initial testing. Following an equilibration period of 1 hour, adjust the piping pressure back to the test pressure and monitor this pressure for an additional hour. Pressure drop may continue to occur during the pressure testing. After the temperature has stabilized and no air leaks at the fittings have been found, the pressure shall be maintained at least 100 psig within an hour for a satisfactory test. All pipes, fittings, and valves shall be subject to the pressure test. The following items shall be removed from the pipe, or isolated from pressure during the pressure test: regulators, valves, flex hoses, gauges, controls, instruments or equipment that would be damaged as a result of the pressure test. Each valve shall be opened and closed several times during the test.

3.4 FINAL CLEANING

3.4.1 Interim Cleaning

Contractor shall prevent the accumulation of pipe cuttings and filings, gravel, cleaning rags, and other foreign material within piping sections during fabrication. The piping shall be examined to assure removal of these and other foreign objects prior to assembly and installation.

3.4.2 Flushing

Following assembly and testing, and prior to final acceptance, piping systems shall be flushed with water to remove accumulated construction debris and other foreign matter. The piping shall be flushed until all foreign matter is removed from the pipeline. Contractor shall provide all hoses, temporary pipes, ditches, and other items as required to properly dispose of flushing water without damage to adjacent properties. The minimum flushing velocity shall be 2.5 feet per second (fps). Cone strainers shall be installed in the flushing connections of attached equipment and left in place until cleaning is completed. Accumulated debris shall be removed through drains, or by removing spools or valves.

3.4.3 Waste water disposal

The water use for testing, cleaning, and/or flushing shall be disposed of in accordance with all applicable regulations. Disposal is solely the responsibility of Contractor. The method proposed for disposal of waste water shall be provided to, and approved by, the Project Engineer prior to performing any testing, cleaning, flushing and disinfection activities.

3.4.4 Cleanup

Upon completion of the installation of process lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed from the project site and properly disposed of.

END OF SECTION

TABLE 15400-1
PIPELINE SUMMARY
WEST TRENCH HEADER DPE-A-LIGHT BLUE LINE ON DRAWING C-2 AND M-2
5 DPE Wells on Header DPE-A Total (PA-1 to PA-5)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	PIPE SPEC./ SCHEDULE	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	PRESSURE [1] (PSIG)	DESIGN TEMP.[2] (ºF)	MIN. TEST PRESSURE [3] (PSIG) AIR	ESTIMATED OPER. TEMP [4] (ºF)
1-1/2	PVC/40	101	Perched Zone	DPE	115	PA-5	2" Header Line 104	-11	140	5	70
1-1/2	PVC/40	102	Perched Zone	DPE	4	PA-3	1-1/2" Branch Line 101	-11	140	5	70
1-1/2	PVC/40	103	Perched Zone	DPE	42	PA-4	2" Header Line 104	-11	140	5	70
2	PVC/40	104	Perched Zone	DPE	100	1-1/2" Branch Line 101	6" Header Line 106	-11	140	5	70
2	PVC/40	105	Perched Zone	DPE	50	PA-2	6" Header Line 106	-11	140	5	70
6	PVC/40	106	Perched Zone	DPE	250	2" Branch Line 104	8" Manifold	-11	140	5	70
2	PVC/40	107	Perched Zone	DPE	16	PA-1	6" Header Line 106	-11	140	5	70

Notes:
1. Anticipated maximum operating vacuum based on blower performance curve for DVT VMX 1103K (75-hp)
2. Manufacturers maximum operating temperature
3. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.4 Air Pressure Test. Air pressure shall be maintained at 5 psi for at least 1 hour.
4. Average estimated temperature of air in pipeline.

TABLE 15400-1
PIPELINE SUMMARY
WEST TRENCH HEADER DPE-B-DARK BLUE LINE ON DRAWING C-2 AND M-2

7 DPE Wells on Header DPE-B Total (PB-1 to PB-7)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	**PIPE SPEC./ SCHEDULE**	**LINE NO.**	**SERVICE**	**PHASE**	**APPROX. LENGTH (FT.)**	**FROM**	**TO**	**PRESSURE [1] (PSIG)**	**DESIGN TEMP.[2] (°F)**	**MIN. TEST PRESSURE [3] (PSIG) AIR**	**ESTIMATED OPER. TEMP [4] (°F)**
2	PVC/40	201	Perched Zone	DPE	83	PB-7	4" Header Line 203	-11	140	5	70
2	PVC/40	202	Perched Zone	DPE	60	PB-6	4" Header Line 203	-11	140	5	70
4	PVC/40	203	Perched Zone	DPE	150	2" Branch Line 201	6" Header Line 209	-11	140	5	70
2	PVC/40	204	Perched Zone	DPE	10	PB-5	4" Header Line 203	-11	140	5	70
2	PVC/40	205	Perched Zone	DPE	76	PB-4	4" Header Line 208	-11	140	5	70
2	PVC/40	206	Perched Zone	DPE	10	PB-3	4" Header Line 208	-11	140	5	70
2	PVC/40	207	Perched Zone	DPE	10	PB-2	4" Header Line 208	-11	140	5	70
4	PVC/40	208	Perched Zone	DPE	102	2" Branch Line 205	6" Header Line 209	-11	140	5	70
6	PVC/40	209	Perched Zone	DPE	544	4" Header Line 203	8" Manifold	-11	140	5	70
2	PVC/40	210	Perched Zone	DPE	50	PB-1	6" Header Line 209	-11	140	5	70

Notes:
1. Anticipated maximum operating vacuum based on blower performance curve for DVT VMX 1103K (75-hp)
2. Manufacturers maximum operating temperature
3. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.4 Air Pressure Test. Air pressure shall be maintained at 5 psi for at least 1 hour.
4. Average estimated temperature of air in pipeline.

TABLE 15400-1
PIPELINE SUMMARY
EAST TRENCH HEADER DPE-C-BROWN LINE ON DRAWING C-2 AND M-2

4 DPE Wells on Header DPE-C Total (PC-1 to 2 and PC-5 to PC-6)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	PIPE SPEC./ SCHEDULE	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	PRESSURE [1] (PSIG)	DESIGN TEMP.[2] (ºF)	MIN. TEST PRESSURE [3] (PSIG) AIR	ESTIMATED OPER. TEMP [4] (ºF)
2	PVC/40	301	Perched Zone	DPE	96	PC-6	4" Header Line 303	-11	140	5	70
2	PVC/40	302	Perched Zone	DPE	17	PC-5	2" Header Line 301	-11	140	5	70
4	PVC/40	303	Perched Zone	DPE	276	2" Header Line 301	6" Header Line 305	-11	140	5	70
2	PVC/40	304	Perched Zone	DPE	9	PC-2	4" Header Line 303	-11	140	5	70
6	PVC/40	305	Perched Zone	DPE	190	4" Header Line 303	8" Manifold	-11	140	5	70
2	PVC/40	306	Perched Zone	DPE	24	PC-1	6" Header Line 305	-11	140	5	70

Notes:
1. Anticipated maximum operating vacuum based on blower performance curve for DVT VMX 1103K (75-hp)
2. Manufacturers maximum operating temperature
3. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.4 Air Pressure Test. Air pressure shall be maintained at 5 psi for at least 1 hour.
4. Average estimated temperature of air in pipeline.

TABLE 15400-1
PIPELINE SUMMARY
EAST TRENCH HEADER DPE-D-PURPLE LINE ON DRAWING C-2 AND M-2

7 DPE Wells on Header DPE-D Total (PD-1 and PD-4 to PD-9)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	PIPE SPEC./ SCHEDULE	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	PRESSURE [1] (PSIG)	DESIGN TEMP.[2] (°F)	MIN. TEST PRESSURE [3] (PSIG) AIR	ESTIMATED OPER. TEMP [4] (°F)
2	PVC/40	401	Perched Zone	DPE	67	PD-9	4" Header Line 404	-11	140	5	70
2	PVC/40	402	Perched Zone	DPE	25	PD-8	4" Header Line 404	-11	140	5	70
2	PVC/40	403	Perched Zone	DPE	40	PD-7	4" Header Line 404	-11	140	5	70
4	PVC/40	404	Perched Zone	DPE	225	2" Header Line 401	6" Header Line 408	-11	140	5	70
2	PVC/40	405	Perched Zone	DPE	37	PD-6	4" Header Line 404	-11	140	5	70
2	PVC/40	406	Perched Zone	DPE	37	PD-5	4" Header Line 404	-11	140	5	70
2	PVC/40	407	Perched Zone	DPE	33	PD-4	6" Header Line 408	-11	140	5	70
6	PVC/40	408	Perched Zone	DPE	480	4" Header Line 404	8" Manifold	-11	140	5	70
2	PVC/40	409	Perched Zone	DPE	36	PD-1	6" Header Line 408	-11	140	5	70

Notes:
1. Anticipated maximum operating vacuum based on blower performance curve for DVT VMX 1103K (75-hp)
2. Manufacturers maximum operating temperature
3. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.4 Air Pressure Test. Air pressure shall be maintained at 5 psi for at least 1 hour.
4. Average estimated temperature of air in pipeline.

TABLE 15400-1
PIPELINE SUMMARY
SOUTH TRENCH HEADER VE-1-RED LINE ON DRAWING C-2 AND M-3

7 Deep Wells on Header SVE-1 Total (DAB-1 TO DAB-7)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	PIPE SPEC./ SCHEDULE	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	PRESSURE [1] (PSIG)	DESIGN TEMP.[2] (ºF)	MIN. TEST PRESSURE [3] (PSIG) AIR	ESTIMATED OPER. TEMP [4] (ºF)
2	PVC/40	501	Exposition A and B Zones	Vapor	50	DAB-1	4" Header Line 508	-11	140	5	70
2	PVC/40	502	Exposition A and B Zones	Vapor	5	DAB-2	4" Header Line 508	-11	140	5	70
2	PVC/40	503	Exposition A and B Zones	Vapor	5	DAB-3	4" Header Line 508	-11	140	5	70
2	PVC/40	504	Exposition A and B Zones	Vapor	5	DAB-4	4" Header Line 508	-11	140	5	70
2	PVC/40	505	Exposition A and B Zones	Vapor	23	DAB-5	4" Header Line 508	-11	140	5	70
2	PVC/40	506	Exposition A and B Zones	Vapor	28	DAB-6	6" Header Line 509	-11	140	5	70
2	PVC/40	507	Exposition A and B Zones	Vapor	82	DAB-7	6" Header Line 509	-11	140	5	70
4	PVC/40	508	Exposition A and B Zones	Vapor	430	2" Branch Line 501	6" Header Line 509	-11	140	5	70
6	PVC/40	509	Exposition A and B Zones	Vapor	200	4" Header Line 509	8" Manifold	-11	140	5	70

Notes:
1. Anticipated maximum operating vacuum based on blower performance curve for DVT VMX 1103K (75-hp)
2. Manufacturers maximum operating temperature
3. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.4 Air Pressure Test. Air pressure shall be maintained at 5 psi for at least 1 hour.
4. Average estimated temperature of air in pipeline.

TABLE 15400-1
PIPELINE SUMMARY
WEST TRENCH HEADER SVE-2-RED LINE ON DRAWING C-2 AND M-3

15 Deep Wells on Header VE-2 Total (DAB-8, DA/DB-1 TO DA/DB-7)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	PIPE SPEC./ SCHEDULE	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	PRESSURE [1] (PSIG)	DESIGN TEMP.[2] (°F)	MIN. TEST PRESSURE [3] (PSIG) AIR	ESTIMATED OPER. TEMP [4] (°F)
2	PVC/40	601	Exposition A and B Zones	Vapor	110	DAB-8	4" Header Line 615	-11	140	5	70
2	PVC/40	602	Exposition A Zone	Vapor	8	DA-1	4" Header Line 615	-11	140	5	70
2	PVC/40	603	Exposition B Zone	Vapor	8	DB-1	4" Header Line 615	-11	140	5	70
2	PVC/40	604	Exposition B Zone	Vapor	5	DA-2	2" Branch Line 605	-11	140	5	70
2	PVC/40	605	Exposition A Zone	Vapor	110	DB-2	4" Header Line 608	-11	140	5	70
2	PVC/40	606	Exposition B Zone	Vapor	5	DB-3	4" Header Line 608	-11	140	5	70
2	PVC/40	607	Exposition A Zone	Vapor	5	DA-3	4" Header Line 608	-11	140	5	70
4	PVC/40	608	Exposition A and B Zones	Vapor	154	2" Branch Line 605	6" Header Line 616	-11	140	5	70
2	PVC/40	609	Exposition A Zone	Vapor	10	DA-4	6" Header Line 616	-11	140	5	70
2	PVC/40	610	Exposition B Zone	Vapor	10	DB-4	6" Header Line 616	-11	140	5	70
2	PVC/40	611	Exposition A Zone	Vapor	14	DA-5	6" Header Line 616	-11	140	5	70
2	PVC/40	612	Exposition B Zone	Vapor	14	DB-5	6" Header Line 616	-11	140	5	70
2	PVC/40	613	Exposition A Zone	Vapor	20	DA-6	2" Branch Line 614	-11	140	5	70
2	PVC/40	614	Exposition B Zone	Vapor	55	DB-6	6" Header Line 616	-11	140	5	70
4	PVC/40	615	Exposition A and B Zones	Vapor	120	2" Branch Line 601	6" Header Line 616	-11	140	5	70
6	PVC/40	616	Exposition A and B Zones	Vapor	375	4" Header Line 615	8" Manifold	-11	140	5	70
2	PVC/40	617	Exposition A Zone	Vapor	12	DA-7	2" Branch Line 619	-11	140	5	70
2	PVC/40	618	Exposition B Zone	Vapor	12	DB-7	2" Branch Line 619	-11	140	5	70
2	PVC/40	619	Exposition A and B Zones	Vapor	90	2" Branch Line 618	6" Header Line 616	-11	140	5	70

Notes:
1. Anticipated maximum operating vacuum based on blower performance curve for DVT VMX 1103K (75-hp)
2. Manufacturers maximum operating temperature
3. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.4 Air Pressure Test. Air pressure shall be maintained at 5 psi for at least 1 hour.
4. Average estimated temperature of air in pipeline

TABLE 15400-1
PIPELINE SUMMARY
EAST TRENCH HEADER VE-3-ORANGE LINE ON DRAWING C-2 AND M-3

6 Deep Wells on Header SVE-3 Total (DA/DB-8 to DA/DB-10)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	PIPE SPEC./ SCHEDULE	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	PRESSURE [1] (PSIG)	DESIGN TEMP.[2] (ºF)	MIN. TEST PRESSURE [3] (PSIG) AIR	ESTIMATED OPER. TEMP [4] (ºF)
2	PVC/40	701	Exposition A Zone	Vapor	120	DA-9	4" Header Line 705	-11	140	5	70
2	PVC/40	702	Exposition B Zone	Vapor	5	DB-9	2" Branch Line 701	-11	140	5	70
2	CPVC/80	703	Exposition A Zone	Vapor	5	DA-10	4" Header Line 705	-11	200	5	136
2	CPVC/80	704	Exposition B Zone	Vapor	5	DB-10	4" Header Line 705	-11	200	5	136
4	CPVC/80	705	Exposition A and B Zones	Vapor	120	2" Branch Line 701	6" Header Line 708	-11	200	5	136
2	CPVC/80	706	Exposition A Zone	Vapor	20	DA-8	6" Header Line 708	-11	200	5	100
2	CPVC/80	707	Exposition B Zone	Vapor	20	DB-8	6" Header Line 708	-11	200	5	100
6	CPVC/80	708	Exposition A and B Zones	Vapor	320	4" Header Line 705	4" Header Line 705	-11	200	5	120

Notes:
1. Anticipated maximum operating vacuum based on blower performance curve for DVT VMX 1103K (75-hp)
2. Manufacturers maximum operating temperature
3. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.4 Air Pressure Test. Air pressure shall be maintained at 5 psi for at least 1 hour.
4. Average estimated temperature of air in pipeline.

TABLE 15400-1
PIPELINE SUMMARY
EAST TRENCH HEADER SVE-4-ORANGE LINE ON DRAWING C-2 AND M-3

4 Deep Wells on Header VE-4 Total (DA/DB-11 and DA/DB-12)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	PIPE SPEC./ SCHEDULE	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	PRESSURE [1] (PSIG)	DESIGN TEMP.[2] (ºF)	MIN. TEST PRESSURE [3] (PSIG) AIR	ESTIMATED OPER. TEMP [4] (ºF)
2	CPVC/80	801	Exposition A Zone	Vapor	9	DA-11	6" Header Line 805	-11	200	5	136
2	CPVC/80	802	Exposition B Zone	Vapor	9	DB-11	6" Header Line 805	-11	200	5	136
2	CPVC/80	803	Exposition A Zone	Vapor	11	DA-12	6" Header Line 805	-11	200	5	136
2	CPVC/80	804	Exposition B Zone	Vapor	11	DB-12	6" Header Line 805	-11	200	5	136
6	CPVC/80	805	Exposition A and B Zones	Vapor	300	2" Branch Line 801	8" Manifold	-11	200	5	136

Notes:
1. Anticipated maximum operating vacuum based on blower performance curve for DVT VMX 1103K (75-hp)
2. Manufacturers maximum operating temperature
3. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.4 Air Pressure Test. Air pressure shall be maintained at 5 psi for at least 1 hour.
4. Average estimated temperature of air in pipeline.

TABLE 15400-1
PIPELINE SUMMARY
SOUTH TRENCH HEADER GW-1-GREEN LINE ON DRAWING C-2 AND M-3
7 Deep Wells on Header GW-1 Total (DAB-1 to DAB-7)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)[1]	**PIPE SPEC./ SCHEDULE**	**LINE NO.**	**SERVICE**	**PHASE**	**APPROX. LENGTH (FT.)**	**FROM**	**TO**	**PRESSURE** [2] **(PSIG)**	**DESIGN TEMP.**[3] **(ºF)**	**MIN. TEST PRESSURE** [4] **(PSIG) Hydrostatic**	**ESTIMATED OPER. TEMP** [5] **(ºF)**
2/4	PVC/40	901	Exposition A and B Zones	Liquid	50	DAB-1	2" Header Line 908	50	140	110	60
2/4	PVC/40	902	Exposition A and B Zones	Liquid	10	DAB-2	2" Header Line 908	50	140	110	60
2/4	PVC/40	903	Exposition A and B Zones	Liquid	10	DAB-3	2" Header Line 908	50	140	110	60
2/4	PVC/40	904	Exposition A and B Zones	Liquid	10	DAB-4	4" Header Line 909	50	140	110	60
2/4	PVC/40	905	Exposition A and B Zones	Liquid	10	DAB-5	4" Header Line 909	50	140	110	60
2/4	PVC/40	906	Exposition A and B Zones	Liquid	10	DAB-6	4" Header Line 909	50	140	110	60
2/4	PVC/40	907	Exposition A and B Zones	Liquid	10	DAB-7	4" Header Line 909	50	140	110	60
2/4	PVC/40	908	Exposition A and B Zones	Liquid	336	2" Branch Line 901	4" Header Line 909	50	140	110	60
3/6	PVC/40	909	Exposition A and B Zones	Liquid	525	2" Header Line 908	GW Sump	50	140	110	60

Notes:
1. Groundwater piping system consists of 2" or 3" Schedule 40 PVC inside and 4" or 6" Schedule 40 PVC (for secondary containment).
2. Anticipated maximum operating pressure.
3. Manufacturers maximum operating temperature
4. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.1 General.
   Water pressure test: Additional 120% of maximum operating pressure shall be held at least 1 hour. (Test pressure = 50 psi + (50 psi x 120%) = 110 psi)
5. Average estimated temperature of water in pipeline.

TABLE 15400-1
PIPELINE SUMMARY
WEST TRENCH HEADER GW-2-GREEN LINE ON DRAWING C-2 AND M-3
15 Deep Wells on Header GW-2 Total (DAB-8, DA/DB-1 TO DA/DB-7)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)[1]	PIPE SPEC./ SCHEDULE	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	PRESSURE (PSIG)	DESIGN TEMP.[2] (ºF)	MIN. TEST PRESSURE (PSIG) Hydrostatic	ESTIMATED OPER. TEMP (ºF)
2/4	PVC/40	1001	Exposition A and B Zones	Liquid	120	DAB-8	4" Header Line 1015	50	140	110	60
2/4	PVC/40	1002	Exposition A Zone	Liquid	5	DA-1	4" Header Line 1015	50	140	110	60
2/4	PVC/40	1003	Exposition B Zone	Liquid	5	DB-1	4" Header Line 1015	50	140	110	60
2/4	PVC/40	1004	Exposition B Zone	Liquid	10	DB-2	2" Branch Line 1008	50	140	110	60
2/4	PVC/40	1005	Exposition A Zone	Liquid	10	DA-2	2" Branch Line 1008	50	140	110	60
2/4	PVC/40	1006	Exposition B Zone	Liquid	5	DB-3	2" Branch Line 1008	50	140	110	60
2/4	PVC/40	1007	Exposition A Zone	Liquid	5	DA-3	2" Branch Line 1008	50	140	110	60
2/4	PVC/40	1008	Exposition A and B Zones	Liquid	132	2" Branch Line 1004	4" Header Line 1015	50	140	110	60
2/4	PVC/40	1009	Exposition A Zone	Liquid	10	DA-4	4" Header Line 1015	50	140	110	60
2/4	PVC/40	1010	Exposition B Zone	Liquid	10	DB-4	4" Header Line 1015	50	140	110	60
2/4	PVC/40	1011	Exposition A Zone	Liquid	10	DA-5	4" Header Line 1015	50	140	110	60
2/4	PVC/40	1012	Exposition B Zone	Liquid	10	DB-5	4" Header Line 1015	50	140	110	60
2/4	PVC/40	1013	Exposition A Zone	Liquid	20	DA-6	2" Branch Line 1014	50	140	110	60
2/4	PVC/40	1014	Exposition B Zone	Liquid	50	DB-6	4" Header Line 1015	50	140	110	60
3/6	PVC/40	1015	Exposition A and B Zones	Liquid	560	2" Branch Line 1001	GW Sump	50	140	110	60
2/4	PVC/40	1016	Exposition A Zone	Liquid	10	DA-7	2" Branch Line 1018	50	140	110	60
2/4	PVC/40	1017	Exposition B Zone	Liquid	10	DB-7	2" Branch Line 1018	50	140	110	60
2/4	PVC/40	1018	Exposition A and B Zones	Liquid	130	2" Branch Line 1017	4" Header Line 1015	50	140	110	60

Notes:
1. Groundwater piping system consists of 2" or 3" Schedule 40 PVC inside and 4" or 6" Schedule 40 PVC (for secondary containment).
2. Anticipated maximum operating pressure.
3. Manufacturers maximum operating temperature
4. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.1 General.
   Water pressure test: Additional 120% of maximum operating pressure shall be held at least 1 hour. (Test pressure = 50 psi + (50 psi x 120%) = 110 psi)
5. Average estimated temperature of water in pipeline.

TABLE 15400-1
PIPELINE SUMMARY
EAST TRENCH HEADER GW-3-GREEN LINE ON DRAWING C-2 AND M-3
10 Deep Wells and 1 Monitoring Well on Header GW-3 Total (DA/DB-8 TO DA/DB-12, MW-24-140)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)[1]	**PIPE SPEC./ SCHEDULE**	**LINE NO.**	**SERVICE**	**PHASE**	**APPROX. LENGTH (FT.)**	**FROM**	**TO**	**PRESSURE (PSIG)**	**DESIGN TEMP.[2] (°F)**	**MIN. TEST PRESSURE (PSIG) Hydrostatic**	**ESTIMATED OPER. TEMP (°F)**
2/4	PVC/40	1101	Exposition A Zone	Liquid	138	DA-9	4" Header Line 1113	50	140	110	55
2/4	PVC/40	1102	Exposition B Zone	Liquid	10	DB-9	2" Header Line 1101	50	140	110	55
2/4	CPVC/40	1105	Exposition A Zone	Liquid	10	DA-10	4" Header Line 1113	50	200	110	120
2/4	CPVC/40	1106	Exposition B Zone	Liquid	10	DB-10	4" Header Line 1113	50	200	110	120
2/4	CPVC/40	1107	Exposition A Zone	Liquid	15	DA-11	4" Header Line 1113	50	200	110	120
2/4	CPVC/40	1108	Exposition B Zone	Liquid	15	DB-11	4" Header Line 1113	50	200	110	120
2/4	CPVC/40	1109	Exposition A Zone	Liquid	20	DA-12	4" Header Line 1113	50	200	110	120
2/4	CPVC/40	1110	Exposition B Zone	Liquid	20	DB-12	4" Header Line 1113	50	200	110	120
2/4	CPVC/40	1111	Exposition A Zone	Liquid	25	DA-8	4" Header Line 1113	50	200	110	120
2/4	CPVC/40	1112	Exposition B Zone	Liquid	25	DB-8	4" Header Line 1113	50	200	110	120
3/6	CPVC/40	1113	Exposition D Zone	Liquid	450	2" Header Line 1101	GW Sump	50	200	110	120
2/4	CPVC/40	1114	Exposition A and B Zones	Liquid	41	MW-24-140	4" Header Line 1113	50	200	110	120

Notes:
1. Groundwater piping system consists of 2" or 3" Schedule 40 PVC inside and 4" or 6" Schedule 40 PVC (for secondary containment).
2. Anticipated maximum operating pressure.
3. Manufacturers maximum operating temperature
4. Based on "Greenbook - Standard Specifications for Public Works Construction 2003 Edition" 306-1.4.1 General.
   Water pressure test: Additional 120% of maximum operating pressure shall be held at least 1 hour. (Test pressure = 50 psi + (50 psi x 120%) = 110 psi)
5. Average estimated temperature of water in pipeline.

TABLE 15400-1
PIPELINE SUMMARY
SOUTH TRENCH COMPRESSED AIR LINE
7 Deep Wells on ABS-1 Total (DAB-1 to DAB-7)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	PIPE SPEC.	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	AVG. OPER. PRESSURE [1] (PSIG)	DESIGN TEMP.[2] (ºF)	MIN. TEST PRESSURE [3] (PSIG) Air	ESTIMATED OPER. TEMP [4] (ºF)
3/4	ABS	1201	Compressed Air to Well Pumps	Vapor	50	DAB-1	3/4" Header Line 1208	70	73	110	65
3/4	ABS	1202	Compressed Air to Well Pumps	Vapor	10	DAB-2	3/4" Header Line 1208	70	73	110	65
3/4	ABS	1203	Compressed Air to Well Pumps	Vapor	10	DAB-3	3/4" Header Line 1208	70	73	110	65
3/4	ABS	1204	Compressed Air to Well Pumps	Vapor	10	DAB-4	3/4" Header Line 1208	70	73	110	65
3/4	ABS	1205	Compressed Air to Well Pumps	Vapor	10	DAB-5	3/4" Header Line 1208	70	73	110	65
3/4	ABS	1206	Compressed Air to Well Pumps	Vapor	10	DAB-6	3/4" Header Line 1208	70	73	110	65
3/4	ABS	1207	Compressed Air to Well Pumps	Vapor	10	DAB-7	3/4" Header Line 1208	70	73	110	65
3/4	ABS	1208	Compressed Air to Well Pumps	Vapor	690	3/4" Branch Line 1201	Air Compressor	70	73	110	65

Notes:
1. Based on QED Long AP-4/BL Performance Curves: 3/4-inch I.D. Discharge, Revision 9 - July, 2004. Average is for Exposition A and B Zone pump.
2. Designed for a maximum continuous service pressure of 185 psi @ 73 ºF; any increase in working temperature above 73 ºF necessitates a corresponding reduction in pressure rating.
3. Minimum test pressure is 100% of average operating pressure.
4. Estimated operating temperature is based on annual average temperature 1921-1005 Long-Term Average in Downtown Los Angeles.
   Data source: National Oceanic & Atmospheric Administration (NOAA). http://www.wrh.noaa.gov/lox/climate/cvc.php

TABLE 15400-1
PIPELINE SUMMARY
WEST TRENCH COMPRESSED AIR LINE

15 Deep Wells on ABS-2 Total (DAB-8, DA/DB-1 TO DA/DB-7)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	PIPE SPEC.	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	AVG. OPER. PRESSURE [1] (PSIG)	DESIGN TEMP.[2] (ºF)	MIN. TEST PRESSURE [3] (PSIG) Air	ESTIMATED OPER. TEMP [4] (ºF)
3/4	ABS	1301	Compressed Air to Well Pumps	Vapor	120	DAB-8	3/4" Header Line 1315	70	73	110	65
3/4	ABS	1302	Compressed Air to Well Pumps	Vapor	5	DA-1	3/4" Header Line 1315	70	73	110	65
3/4	ABS	1303	Compressed Air to Well Pumps	Vapor	5	DB-1	3/4" Header Line 1315	70	73	110	65
3/4	ABS	1304	Compressed Air to Well Pumps	Vapor	10	DB-2	3/4" Branch Line 1308	70	73	110	65
3/4	ABS	1305	Compressed Air to Well Pumps	Vapor	10	DA-2	3/4" Branch Line 1308	70	73	110	65
3/4	ABS	1306	Compressed Air to Well Pumps	Vapor	5	DB-3	3/4" Branch Line 1308	70	73	110	65
3/4	ABS	1307	Compressed Air to Well Pumps	Vapor	5	DA-3	3/4" Branch Line 1308	70	73	110	65
3/4	ABS	1308	Compressed Air to Well Pumps	Vapor	132	3/4" Branch Line 1304	3/4" Header Line 1315	70	73	110	65
3/4	ABS	1309	Compressed Air to Well Pumps	Vapor	10	DA-4	3/4" Header Line 1315	70	73	110	65
3/4	ABS	1310	Compressed Air to Well Pumps	Vapor	10	DB-4	3/4" Header Line 1315	70	73	110	65
3/4	ABS	1311	Compressed Air to Well Pumps	Vapor	10	DA-5	3/4" Header Line 1315	70	73	110	65
3/4	ABS	1312	Compressed Air to Well Pumps	Vapor	10	DB-5	3/4" Header Line 1315	70	73	110	65
3/4	ABS	1313	Compressed Air to Well Pumps	Vapor	20	DA-6	3/4" Branch Line 1304	70	73	110	65
3/4	ABS	1314	Compressed Air to Well Pumps	Vapor	50	DB-6	3/4" Header Line 1315	70	73	110	65
3/4	ABS	1315	Compressed Air to Well Pumps	Vapor	560	3/4" Branch Line 1301	Air Compressor	70	73	110	65
3/4	ABS	1316	Compressed Air to Well Pumps	Vapor	10	DA-7	3/4" Branch Line 1318	70	73	110	65
3/4	ABS	1317	Compressed Air to Well Pumps	Vapor	10	DB-7	3/4" Branch Line 1318	70	73	110	65
3/4	ABS	1318	Compressed Air to Well Pumps	Vapor	130	3/4" Branch Line 1317	3/4" Header Line 1315	70	73	110	65

Notes:
1. Based on QED Long AP-4/BL Performance Curves: 3/4-inch I.D. Discharge, Revision 9 - July, 2004. Average is for Exposition A and B Zone pump.
2. Designed for a maximum continuous service pressure of 185 psi @ 73 ºF; any increase in working temperature above 73 ºF necessitates a corresponding reduction in pressure rating.
3. Minimum test pressure is 100% of average operating pressure.
4. Estimated operating temperature is based on annual average temperature 1921-1005 Long-Term Average in Downtown Los Angeles.
   Data source: National Oceanic & Atmospheric Administration (NOAA). http://www.wrh.noaa.gov/lox/climate/cvc.php

TABLE 15400-1
PIPELINE SUMMARY
EAST TRENCH COMPRESSED AIR LINE
10 Deep Wells and 1 Monitoring Well on ABS-3 Total (DA/DB-8 TO DA/DB-12, MW-24-140)

DESCRIPTION								DESIGN CONDITIONS			
DIAMETER (IN.)	PIPE SPEC.	LINE NO.	SERVICE	PHASE	APPROX. LENGTH (FT.)	FROM	TO	AVG. OPER. PRESSURE [1] (PSIG)	DESIGN TEMP.[2] (ºF)	MIN. TEST PRESSURE [3] (PSIG) Air	ESTIMATED OPER. TEMP [4] (ºF)
3/4	ABS	1401	Compressed Air to Well Pumps	Vapor	138	DA-9	3/4" Header Line 1413	100	73	110	65
3/4	ABS	1402	Compressed Air to Well Pumps	Vapor	10	DB-9	3/4" Header Line 1401	100	73	110	65
3/4	ABS	1405	Compressed Air to Well Pumps	Vapor	10	DA-10	3/4" Header Line 1413	100	73	110	65
3/4	ABS	1406	Compressed Air to Well Pumps	Vapor	10	DB-10	3/4" Header Line 1413	100	73	110	65
3/4	ABS	1407	Compressed Air to Well Pumps	Vapor	15	DA-11	3/4" Header Line 1413	100	73	110	65
3/4	ABS	1408	Compressed Air to Well Pumps	Vapor	15	DB-11	3/4" Header Line 1413	100	73	110	65
3/4	ABS	1409	Compressed Air to Well Pumps	Vapor	20	DA-12	3/4" Header Line 1413	100	73	110	65
3/4	ABS	1410	Compressed Air to Well Pumps	Vapor	20	DB-12	3/4" Header Line 1413	100	73	110	65
3/4	ABS	1411	Compressed Air to Well Pumps	Vapor	25	DA-8	3/4" Header Line 1413	100	73	110	65
3/4	ABS	1412	Compressed Air to Well Pumps	Vapor	25	DB-8	3/4" Header Line 1413	100	73	110	65
3/4	ABS	1413	Compressed Air to Well Pumps	Vapor	450	3/4" Header Line 1401	Air Compressor	100	73	110	65
3/4	ABS	1414	Compressed Air to Well Pumps	Vapor	41	MW-24-140	3/4" Header Line 1413	100	73	110	65

Notes:
1. The 100 psig air pressure is required for the QED Long AP-2/BL pump in well MW-24-140 (D Zone).
2. Designed for a maximum continuous service pressure of 185 psi @ 73 ºF; any increase in working temperature above 73 ºF necessitates a corresponding reduction in pressure rating.
3. Minimum test pressure is 100% of average operating pressure.
4. Estimated operating temperature is based on annual average temperature 1921-1005 Long-Term Average in Downtown Los Angeles.
Data source: National Oceanic & Atmospheric Administration (NOAA). http://www.wrh.noaa.gov/lox/climate/cvc.php

SECTION 16050N

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. This section applies to all sections of DIVISION 16 - ELECTRICAL of this project specification unless specified otherwise in the individual sections.

ASTM INTERNATIONAL (ASTM)
ASTM D 709 (2001) Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)
TIA/EIA-606-A (2002) Administration Standard for the Telecommunications Infrastructure (ANSI/TIA/EIA-606-A)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
IEEE C2 (2002) National Electrical Safety Code
IEEE Std 100 (2000) IEEE Standard Dictionary of Electrical and Electronics Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA C57.12.28 (1999) Pad-Mounted Equipment - Enclosure Integrity
NEMA ICS 6 (1993; R 2001) Industrial Control and Systems: Enclosures
NEMA MG 1 (2003) Motors and Generators
NEMA MG 10 (2001) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11 (1977; R 1997; R 2001) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 70 (2002) National Electrical Code
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
29 CFR 1910.147 Control of Hazardous Energy (Lock Out/Tag Out)

1.2 SUBMITTALS

Submittals required in the sections which refer to this section must also conform to the following additional requirements. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and technical paragraph reference. Submittals shall also include applicable federal, military, industry, and technical society publication references, and years of satisfactory service, and other information necessary to establish contract compliance of each item to be provided.

1.2.1 Drawings

Submit drawings a minimum of 14 by 20 inches in size using a minimum scale of 1/8 inch per foot except as specified otherwise. Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.2.2 Instructions

Where installation procedures or part of the installation procedures are required to be in accordance with manufacturer's instructions, submit printed copies of those instructions prior to installation. Installation of the item shall not proceed until manufacturer's instructions are received. Failure to submit manufacturer's instructions shall be cause for rejection of the equipment or material.

1.2.3 Certificates

Submit manufacturer's certifications as required for products, materials, finishes, and equipment as specified in the technical sections. Certificates from material suppliers are not acceptable. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as"; "achieve the same end use and results as materials formulated in accordance with the referenced publications"; or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

1.2.3.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.2.3.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Project Engineer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.2.4 Operation and Maintenance Manuals

Submit text of posted operating instructions for each system and principal item of equipment as specified in the technical sections.

1.3 DEFINITIONS

A. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.

B. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

C. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project are indicated on Drawings E-1 through E-5. Final connections to the power distribution system at the existing substation shall be made in accordance with indicated specifications and State and Local standards and requirements.

1.4.1 Manufacturer's Catalog Data

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts. Handwritten and typed modifications and other notations not part of the manufacturer's preprinted data will result in the rejection of the submittal. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified for certificates of compliance.

1.5 QUALITY ASSURANCE

1.5.1 Material and Equipment Qualifications

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Manufacturers’ products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.5.2 Regulatory Requirements

Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70.

1.5.3 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6,000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.4 Service Support

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.5.5 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.5.6 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.7 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

A. When the enclosure integrity of such equipment is specified to be in accordance with NEMA C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2-inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPSO710D72 or approved equal.

B. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3-inch high white letters on a red and black field.

1.8 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, NFPA 70, and requirements specified herein.

1.8.1 Motors and Equipment

Provide electrical components of mechanical equipment, such as motors, motor starters, control or push-button stations, float or pressure switches, solenoid valves, and other devices functioning to control mechanical equipment, including control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors shall not be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, and the electrical power circuits shall be provided under DIVISION 16 - ELECTRICAL.

1.8.2 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment under SECTION 16402N - INTERIOR DISTRIBUTION SYSTEM. Power wiring and conduit shall conform to SECTION 16402N - INTERIOR DISTRIBUTION SYSTEM. Control wiring and conduit shall be provided under, and conform to the requirements of the section specifying the associated equipment.

1.9 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

1.10 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 PAINTING OF EQUIPMENT

3.1.1 Factory Applied

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test.

3.1.2 Field Applied

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in the section specifying the associated electrical equipment.

3.2 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

3.3 CABLE TAG INSTALLATION

Install cable tags in each manhole, handhole, and vault as specified, including each splice. Install cable tags over the fireproofing, if any, and locate the tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

END OF SECTION

SECTION 16070A

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM E 580 (2002) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint

U.S. ARMY CORPS OF ENGINEERS (USACE)

TI 809-04 (1998) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1570 (1995; Rev thru Nov 1999) Fluorescent Lighting Fixtures

UL 1571 (1995; Rev thru Nov 1999) Incandescent Lighting Fixtures

1.2 SUBMITTALS

Government approval is required for submittals having a "G" designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting Fixtures in Buildings;

Equipment Requirements;

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Lighting Fixtures in Buildings; G

Equipment Requirements; G

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G

Copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below. Structural requirements shall be in accordance with SECTION 13080 - SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

1.3.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Control Panels	Air Handling Units
Pumps with Motors	Switchgear
Light Fixtures	Unit Substations
Motor Control Centers	Transformers
Switchboards (Floor Mounted)	Storage Racks
	Solar Heating Units

1.3.3 Electrical Systems

Electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with City, State, or Local regulations.

1.3.4 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with TI 809-04 and additional data furnished by the Project Engineer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. TI 809-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using TI 809-04 are based on strength design; therefore, the AISC LRFP specifications shall be used for the design.

1.3.5 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 2-1/2 inches trade size. All other interior conduit, shall be seismically protected as specified or as directed by the Project Engineer.

1.4 EQUIPMENT REQUIREMENTS

1.4.1 Rigidly Mounted Equipment

Specific items of equipment (as selected by the Project Manager) furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in TI 809-04, Chapter 10. Each item of rigid electrical equipment (see following list), shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Engine-Generators
Substations
Transformers
Switch Boards and Switch Gears

Motor Control Centers
Free Standing Electric Motors

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1570 or UL 1571 as applicable.

2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in SECTION 13080 - SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the standards listed in the following subsections.

3.2.1 Pendant Fixtures

Pendant fixtures shall conform to the requirements of TI 809-04, Chapter 10.

3.2.2 Ceiling Attached Fixtures

3.2.2.1 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system built in accordance with ASTM E 580. Seismic protection for the fixtures shall conform to the requirements of TI 809-04, Chapter 10. Recessed lighting fixtures not over 56 pounds in weight may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic design. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw attachments.

3.2.2.2 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system built in accordance with ASTM E 580. Seismic protection for the fixtures shall conform to the requirements of TI 809-04, Chapter 10.

3.2.3 Assembly Mounted on Outlet Box

A supporting assembly, that is intended to be mounted on an outlet box, shall be designed to accommodate mounting features on 3 or 4 inch boxes, plaster rings, and fixture studs.

3.2.4 Wall-Mounted Emergency Light Unit

Attachments for wall-mounted emergency light units shall be designed and secured for the worst expected seismic disturbance at the site.

3.2.5 Lateral Force

Structural requirements for light fixture bracing shall be in accordance with SECTION 13080 - SEISMIC PROTECTION FOR MISCELLANIOUS EQUIPMENT.

END OF SECTION

SECTION 16081N

APPARATUS INSPECTION AND TESTING

PART 1 GENERAL

1.1 REFERENCES
The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. SECTION 16050N BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
NETA ATS (2003) Acceptance Testing Specifications

1.2 SUBMITTALS
Government approval is required for submittals having a "G" designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-06 Test Reports
Acceptance tests and inspections; G

SD-07 Certificates
Qualifications of organization, and lead engineering technician; G

Acceptance test and inspections procedure; G

1.3 QUALITY ASSURANCE

1.3.1 Qualifications
Electrical distribution system shall be inspected, tested, calibrated, and adjusted in accordance with the paragraph entitled "Acceptance Tests and Inspections." Submit name and qualifications of inspection organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.3.2 Acceptance Tests and Inspections Reports
Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.3.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results has been completed. The Project Engineer shall be notified at least 14 days in advance of when tests will be conducted. Perform acceptance tests and inspections on applicable equipment and systems specified in SECTION 16302N -UNDERGROUND TRANSMISSION AND DISTRIBUTION.

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

END OF SECTION

SECTION 16120A

INSULATED WIRE AND CABLE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5 (1994; CS5a-1995) Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV

AEIC CS6 (1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 69 kV

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 383 (1974; R 1992) Type Test of Class 1E Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WC 7 (1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NEMA WC 8 (1988; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

1.2 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 - SUBMITTAL PROCEDURES:

SD-03 Product Data
 Installation Instructions
The Contractor shall submit cable manufacturing data as requested.

SD-06 Test Reports
 Tests, Inspections, and Verifications
3 certified copies of test reports shall be submitted by the contractor.

1.3 DELIVERY, STORAGE, AND HANDLING

Furnish cables on reels or coils. Each cable and the outside of each reel or coil, shall be plainly marked or tagged to indicate the cable length, voltage rating, conductor size, and manufacturer's lot number and reel number. Each coil or reel of cable shall contain only one continuous cable without splices. Cables for exclusively dc applications, as specified in paragraph HIGH VOLTAGE TEST SOURCE, shall be identified as such. Shielded cables rated 2,001 volts and above and shall be reeled and marked in accordance with Section I of AEIC CS5 or AEIC CS6, as applicable.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Wire Table

Wire and cable shall be furnished in accordance with the requirements of the wire table appended to these specifications, and shall conform to the detailed requirements specified herein.

2.1.2 Rated Circuit Voltages

All wire and cable shall have minimum rated circuit voltages in accordance with Table 3-1 of NEMA WC 7 or NEMA WC 8.

2.1.3 Conductors

2.1.3.1 Material

Conductors shall conform to all the applicable requirements of Section 2 of NEMA WC 7 or Part 2 of NEMA WC 8 as applicable and shall be annealed copper. Copper conductors may be bare, or tin- or lead-alloy-coated, if required by the type of insulation used.

2.1.3.2 Size

Minimum wire size shall be No. 12 AWG for power and lighting circuits; No. 10 AWG for current transformer secondary circuits; No. 14 AWG for potential transformer, relaying, and control circuits; No. 16 AWG for annunciator circuits; and No. 19 AWG for alarm circuits. Minimum wire sizes for rated circuit voltages of 2,001 volts and above shall not be less than those listed for the applicable voltage in Table 3-1 of Section 3 of NEMA WC 7 or Part 3 of NEMA WC 8, as applicable.

2.1.3.3 Stranding

Conductor stranding classes cited herein shall be as defined in Appendix L of NEMA WC 7 or NEMA WC 8, as applicable. Lighting conductors No. 10 AWG and smaller shall be solid or have Class B stranding. Any conductors used between stationary and moving devices, such as hinged doors or panels, shall have Class H or K stranding. All other conductors shall have Class B or C stranding, except that conductors shown on the drawings, or in the schedule, as No. 12 AWG may be 19 strands of No. 25 AWG, and conductors shown as No. 10 AWG may be 19 strands of No. 22 AWG.

2.1.3.4 Conductor Shielding

Conductor shielding conforming to paragraph 2.7 of NEMA WC 7 or NEMA WC 8, as applicable, shall be used on power cables having a rated circuit voltage above 2,000 volts. In addition, conductor shielding for shielded cables shall also comply with Section C of AEIC CS5 or AEIC CS6. Strict precautions shall be taken after application of the conductor shielding to prevent the inclusion of voids or contamination between the conductor shielding and the subsequently applied insulation.

2.1.3.5 Separator Tape

Where conductor shielding, strand filling, or other special conductor treatment is not required, a separator tape between conductor and insulation is permitted.

2.1.4 Insulation

2.1.4.1 Insulation Material
Insulation shall be cross-linked thermosetting polyethylene (XLPE) type, meeting the requirements of Section 3 or paragraph 7.7 of NEMA WC 7 as applicable, or an ethylene-propylene rubber (EPR) type meeting the requirements of Part 3 of NEMA WC 8. For shielded cables of rated circuit voltages above 2,000 volts, the following provisions shall also apply: XLPE, if used, shall be tree-retardant. Insulation shall be chemically bonded to conductor shielding. The insulation material and its manufacturing, handling, extrusion and vulcanizing processes, shall all be subject to strict procedures to prevent the inclusion of voids, contamination, or other irregularities on or in the insulation. Insulation material shall be inspected for voids and contaminants. Inspection methods, and maximum allowable void and contaminant content shall be in accordance with Section B of AEIC CS5 or AEIC CS6, as applicable. Cables with repaired insulation defects discovered during factory testing, or with splices or insulation joints, are not acceptable

2.1.4.2 Insulation Thickness
The insulation thickness for each conductor shall be based on its rated circuit voltage. Power Cables/Single-Conductor Control Cables, 2,000 Volts and Below - The insulation thickness for single-conductor cables rated 2,000 volts and below shall be as required by Table 3-1, Section 3 of NEMA WC 7 or Table 3-1, Part 3, of NEMA WC 8, as applicable. Column "A" thickness of Table 3-1 of NEMA WC 7will be permitted only for single-conductor cross-linked thermosetting polyethylene insulated cables without a jacket. NEMA WC 8 ethylene-propylene rubber-insulated conductors shall have a jacket. Column "B" thickness shall apply to single-conductor cables that require a jacket and to individual conductors of multiple-conductor cables with an overall jacket. Power Cables, Rated 2,001 Volts and Above - Thickness of insulation for power cables rated 2,001 volts and above shall be in accordance with the following:

1) Non-shielded cables, 2,001 to 5,000 volts, shall comply with Note 3 to Table 3-1, of either NEMA WC 7 or NEMA WC 8, as applicable.

2) Shielded cables rated 2,001 volts and above shall comply with Column B of Table B1, of AEIC CS5 or AEIC CS6, as applicable.

Multiple-Conductor Control Cables - The insulation thickness of multiple-conductor cables used for control and related purposes shall be as required by Table 7-32 of NEMA WC 7 or Table 7.5.1 of NEMA WC 8 as applicable.

2.1.4.3 Insulation Shielding
Unless otherwise specified, insulation shielding shall be provided for conductors having rated circuit voltages of 2,001 volts and above. The voltage limits above which insulation shielding is required, and the material requirements, are given in Section 4 of NEMA WC 7 or Part 4 of NEMA WC 8, as applicable. The material, if thermosetting, shall meet the wafer boil test requirements as described in Section D of AEIC CS5 or AEIC CS6, as applicable. The method of shielding shall be in accordance with the current practice of the industry; however, the application process shall include strict precautions to prevent voids or contamination between the insulation and the nonmetallic component. Voids, protrusions, and indentations of the shield shall not exceed the maximum allowances specified in Section C of AEIC CS5 or AEIC CS6, as applicable. The cable shall be capable of operating without damage or excessive temperature when the shield is grounded at both ends of each conductor. All components of the shielding system shall remain tightly applied to the components they enclose after handling and

installation in accordance with the manufacturer's recommendations. Shielding systems which require heat to remove will not be permitted unless specifically approved.

2.1.5 Jackets

All cables shall have jackets meeting the requirements of Section 4 of NEMA WC 7, or Part 4 of NEMA WC 8, as applicable, and as specified herein. Individual conductors of multiple-conductor cables shall be required to have jackets only if they are necessary for the conductor to meet other specifications herein. Jackets of single-conductor cables and of individual conductors of multiple-conductor cables, except for shielded cables, shall be in direct contact and adhere or be vulcanized to the conductor insulation. Multiple-conductor cables and shielded single-conductor cables shall be provided with a common overall jacket, which shall be tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.1.5.1 Jacket Material

The jacket shall be one of the materials listed below. Variations from the materials required below will be permitted only if approved for each specific use, upon submittal of sufficient data to prove that they exceed all specified requirements for the particular application.

General Use

1) Heavy-duty black neoprene (NEMA WC 8, paragraph 4.4.3).

2) Heavy-duty chlorosulfonated polyethylene (NEMA WC 8, paragraph 4.4.10).

3) Heavy-duty cross-linked (thermoset) chlorinated polyethylene (NEMA WC 8, paragraph 4.4.11).

Accessible Use Only, 2,000 Volts or Less - Cables installed where they are entirely accessible, such as cable trays and raceways with removable covers, or where they pass through less than 10 feet of exposed conduit only, shall have jackets of one of the materials specified in above paragraph GENERAL USE, or the jackets may be of one of the following:

1) General-purpose neoprene (NEMA WC 8, paragraph 4.4.4).

2) Black polyethylene (NEMA WC 8, paragraph 4.4.6).

3) Thermoplastic chlorinated polyethylene (NEMA WC 8, paragraph 4.4.7).

2.1.5.2 Jacket Thickness

The minimum thickness of the jackets at any point shall be not less than 80 percent of the respective nominal thicknesses specified below. Multiple-Conductor Cables - Thickness of the jackets of the individual conductors of multiple-conductor cables shall be as required by Section 4, Table 4-6 of NEMA WC 7 or Part 4, Table 4-4 of NEMA WC 8, and shall be in addition to the conductor insulation thickness required by Column B of Table 3-1 of the applicable NEMA publication for the insulation used. Thickness of the outer jackets or sheaths of the assembled multiple-conductor cables shall be as required by Section 4, Table 4-7, of NEMA WC 7 or Part 4, Table 4-5, of NEMA WC 8. Single-Conductor Cables - Single-conductor cables, if nonshielded, shall have a jacket thickness as specified in Section 4, Table 4-4 of NEMA WC 7 or Part 4, Table 4-2 of NEMA WC 8. If shielded, the jacket thickness shall be in accordance with the requirements of Section 4, Table 4-5 of NEMA WC 7 or Part 4, Table 4-3 of NEMA WC 8.

2.1.6 Metal-Clad Cable

2.1.6.1 General

The metallic covering shall be interlocked steel tape or corrugated metal, conforming to the applicable requirements of section 4.5 of NEMA WC 7. If the covering is of ferrous metal, it shall be galvanized. Copper grounding conductor(s) conforming to Section 7.8 of NEMA WC 7 shall be furnished for each multiple-conductor metal-clad cable. Assembly and cabling shall be as specified in paragraph CABLING. The metallic covering shall be applied over an inner jacket or filler tape. The cable shall be assembled so that the metallic covering will be tightly bound over a firm core.

2.1.6.2 Jackets

Metal-clad cables may have a jacket under the armor, and shall have a jacket over the armor. Jackets shall comply with the requirements of Section 4.5 of NEMA WC 7. The outer jacket for the metal-clad cable may be of polyvinyl chloride only if specifically approved.

2.1.7 Identification

2.1.7.1 Color-coding

Insulation of individual conductors of multiple-conductor cables shall be color-coded in accordance with paragraph 5.3 of NEMA WC 8, except that colored braids will not be permitted. Only one color-code method shall be used for each cable construction type. Control cable color-coding shall be in accordance with Table 5-2 of NEMA WC 8. Power cable color-coding shall be black for Phase A, red for Phase B, blue for Phase C, white for grounded neutral, and green for an insulated grounding conductor, if included.

2.1.7.2 Shielded Cables Rated 2,001 Volts and Above

Marking shall be in accordance with Section H of AEIC CS5 or AEIC CS6, as applicable.

2.1.8 Cabling

Individual conductors of multiple-conductor cables shall be assembled with flame-and moisture-resistant fillers, binders, and a lay conforming to Part 5 of NEMA WC 8, except that flat twin cables will not be permitted. Fillers shall be used in the interstices of multiple-conductor round cables with a common covering where necessary to give the completed cable a substantially circular cross section. Fillers shall be non-hygroscopic material, compatible with the cable insulation, jacket, and other components of the cable. The rubber-filled or other approved type of binding tape shall consist of a material that is compatible with the other components of the cable and shall be lapped at least 10 percent of its width.

2.1.9 Dimensional Tolerance

The outside diameters of single-conductor cables and of multiple-conductor cables shall not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

2.2 INSTALLATION INSTRUCTIONS

The following information shall be provided by the cable manufacturer for each size, conductor quantity, and type of cable furnished: Minimum bending radius, in inches - For multiple-conductor cables, this information shall be provided for both the individual conductors and the multiple-conductor cable. Pulling tension and sidewall pressure limits, in pounds. Instructions for stripping semi-conducting insulation shields, if furnished, with minimum effort without damaging the insulation. Upon request, compatibility of cable materials and construction with specific materials and hardware manufactured by others shall be stated. Also, if requested, recommendations shall be provided for various cable operations, including installing, splicing, terminating, etc.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Cable Data

Manufacture of the wire and cable shall not be started until all materials to be used in the fabrication of the finished wire or cable have been approved by the RPM. Cable data shall be submitted for approval including dimensioned sketches showing cable construction, and sufficient additional data to show that these specifications will be satisfied.

2.3.2 Inspection and Tests

Inspection and tests of wire and cable furnished under these specifications shall be made by and at the plant of the manufacturer, and shall be witnessed by the Project Engineer, QC Engineer, or other authorized or qualified representative. The Government may perform further tests before or after installation. Testing in general shall comply with Section 6 of NEMA WC 7 or Part 6 of NEMA WC 8. Specific tests required for particular materials, components, and completed cables shall be as specified in the sections of the above standards applicable to those materials, components, and cable types. Tests shall also be performed in accordance with the additional requirements specified below.

2.3.2.1 High-Voltage Test Source

Where the applicable standards allow a choice, high-voltage tests for cables to be used exclusively on dc circuits shall be made with dc test voltages. Cables to be used exclusively on ac circuits shall be tested with ac test voltages. If both ac and dc will be present, on either the same or separate conductors of the cable, ac test voltages shall be used.

2.3.2.2 Shielded Cables Rated 2,001 Volts or Greater

The following tests shall be performed in addition to those specified above. Section or paragraph references are to AEIC CS5 or AEIC CS6 as applicable, unless otherwise stated. High potential test voltages shall be as required by Table B1 of AEIC CS5 or AEIC CS6 as applicable, rather than by Table 3-1 of NEMA WC 7 or NEMA WC 8. If high potential testing is done with an ac test voltage as specified in paragraph HIGH-VOLTAGE TEST SOURCE, an additional test shall be made using a dc test voltage rated at 75 percent of the specified full dc test voltage, for 5 consecutive minutes. Production sampling tests shall be performed in accordance with Section D. Sampling frequency and failure contingencies shall be in accordance with paragraph G.3. Unless otherwise approved, samples shall not be taken from the middle of extruder runs of insulation or shielding made only for one continuous shipping length of cable, if such sampling will result in the need to repair the sampled area. Partial discharge tests shall be performed in accordance with Section E, paragraph E.2, and Section F.

2.3.2.3 Flame Tests

All multiple-conductor and single-conductor cable assemblies shall pass IEEE Std 383 flame tests, paragraph 2.5, using the ribbon gas burner. Single-conductor cables and individual conductors of multiple-conductor cables shall pass the flame test of NEMA WC 7, paragraph 7.7.3.1.3. If such tests, however, have previously been made on identical cables, these tests need not be repeated. Instead, certified reports of the original qualifying tests shall be submitted. In this case the reports furnished under paragraph REPORTS, shall verify that all of each cable's materials, construction, and dimensions are the same as those in the qualifying tests.

2.3.2.4 Independent Tests

The Government may at any time make visual inspections, continuity or resistance checks, insulation resistance readings, power factor tests, or dc high-potential tests at field test values. A cable's failure to pass these tests and inspections, or failure to produce readings consistent with acceptable values for the application, will be grounds for rejection of the cable.

2.3.2.5 Reports

Results of tests made shall be furnished. No wire or cable shall be shipped until authorized. Lot number and reel or coil number of wire and cable tested shall be indicated on the test reports.

PART 3 EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 16302N

UNDERGROUND TRANSMISSION AND DISTRIBUTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
ANSI C119.1 (2002) Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI C2 (1997) National Electrical Safety Code

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
AEIC CS1 (1990) Impregnated-Paper-Insulated, Metallic Sheathed Cable, Solid Type
AEIC CS5 (1994; CS5a-1995) Cross-Linked Polyethylene Insulated Shielded Power Cables Rated 5 through 46 kV
AEIC CS6 (1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 69 kV

ASTM INTERNATIONAL (ASTM)
ASTM B 1 (2001) Hard-Drawn Copper Wire
ASTM B 8 (1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM C 260 (2001) Air-Entraining Admixtures for Concrete
ASTM F 512 (1995; R 2001e1) Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
IEEE Std 404 (2000) Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V Through 500 000 V
IEEE Std 48 (1996; R 2003) Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
NETA ATS (2003) Acceptance Testing Specifications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA RN 1 (1998) Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2 (2003) Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
NEMA TC 3 (2004) Polyvinyl Chloride PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TC 6 (1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 8 (1990) Extra-Strength PVC Plastic Utilities Duct for Underground Installation
NEMA TC 9 (2004) Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation
NEMA WC 7 (1988; Rev 3 1996) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8 (1988; Rev 3 1996) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 70 (2002) National Electrical Code
NFPA 70B (2002) Electrical Equipment Maintenance

UNDERWRITERS LABORATORIES (UL)
UL 1242 (2000; Rev thru May 2003) Electrical Intermediate Metal Conduit -- Steel
UL 467 (1993; Rev thru Feb 2001) Grounding and Bonding Equipment
UL 486A (1997; Rev thru May 2001) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B (1997; Rev thru May 2001) Wire Connectors for Use with Aluminum Conductors
UL 510 (1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A (2004) Metallic Outlet Boxes
UL 514B (2004) Conduit, Tubing and Cable Fittings
UL 6 (2000; Rev thru May 2003) Rigid Metal Conduit
UL 651 (1995; Rev thru Oct 2002) Schedule 40 and 80 Rigid PVC Conduit
UL 83 (2003; Rev thru Mar 2004) Thermoplastic-Insulated Wires and Cables
UL 854 (1999; Rev thru Nov 2002) Service-Entrance Cables

1.2 RELATED REQUIREMENTS

SECTION 16050N - BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.2.1 Underground Service

Terminate underground service into building at a point 5 feet outside the building and projections thereof, except that service conductors shall be continuous to the interior terminating point indicated. Connections of the service to the service switch, panelboard, or load center is included in SECTION 16402N - INTERIOR DISTRIBUTION SYSTEM. Protect ends of underground conduit with threaded metal caps or plastic plugs as applicable until connections are made.

1.3 DEFINITIONS

a. In the text of this section, the words conduit and duct are used interchangeably and have the same meaning.

b. In the text of this section, "medium voltage cable splices," and "medium voltage cable joints" are used interchangeably and have the same meaning.

1.4 SUBMITTALS

Government approval is required for submittals having a “G” designation; all other submittals are for Contractor Quality Control Engineer approval. The following shall be submitted in accordance with SECTION 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings
Proposed precast sectional underground duct bank; G

SD-03 Product Data
Medium voltage cable; G

Medium voltage cable joints; G

Medium voltage cable terminations; G

600 volt wires and cables

SD-06 Test Reports
Acceptance checks and tests; G
Identify each cable for 600-volt, and medium voltage cable tests. When testing grounding electrodes and systems, identify each electrode and system for each test, as well as the resistance and soil conditions at the time the measurement were made.

SD-07 Certificates
Cable splicer/terminator; G

Thirty calendar days before making splices or terminations, submit names of the cable splicers to be employed, together with proof that splicer has at least 3 years experience in splicing the type and rating of cables specified. Submit certification for each splicer by the cable joint kit manufacturer in the use of manufacturer's kits.

SD-08 Manufacturer's Instructions
Ground megger

"UL listed" kit

Termination kit

Medium-voltage joints

SD-09 Manufacturer's Field Reports
Medium voltage cable tests; G
Factory engineered heat shrinkable joint kit

1.5 QUALITY ASSURANCE

Each cable splicer may be required to make an approved dummy splice in the presence of the Contracting Officer in accordance with cable manufacturer's instructions. The Contractor shall furnish the material for dummy splices.

1.5.1 Cable Splicer Qualifications

a. In order to establish the cable workman's competency, the Contractor shall be required to submit the following within 30 calendar days prior to commencement of the splice/termination:

   (1) Documentation to verify that the individual has completed a splice/termination of the type to be installed under this contract. The test splice-termination shall be performed at the job site for this contract under the supervision of the cable accessory manufacturer or his representative and witnessed by the Government.

   (2) Documentation that said splice/termination has undergone and passed the following tests by the splice-termination manufacturer or an independent testing laboratory.

	MINIMUM VALUE		
TEST	5 kV	15 kV	35 kV
Discharge Ext. Value with 3 pC or less	13 kV	20 kV	35 kV
AC withstand, 1 minute	35 kV	50 kV	75 kV
DC withstand, 15 minutes	65 kV	70 kV	100 kV

These results shall be attached for review

   (3) A statement of the number of years in which the individual has been splicing/terminating medium voltage cable.

b. Criteria for waiver: Items a.1 and a.2 above may be waived on subsequent jobs provided the following criteria is satisfied:

(1) Documentation of prior completion of items a.1 and a.2 be submitted.

(2) A list of the last three jobs where the specific splices/terminations were installed within the past 12 consecutive months. The tabulation shall include splice/termination manufacturer, catalog number, and the number of splice/terminations installed.

c. Requalifications: Requalification to items a.1 and a.2 in above paragraph may be required if the splice installer can not demonstrate a prior history of splice/termination installation during the previous 12 consecutive months. The contractor shall furnish the material for splices and terminations.

1.5.2 Test Instrument and Procedure
Submit for use of ground megger with proposed method indicated.

1.5.3 Manufacturer's Test
Submit the manufacturer's test report indicating that performance of the heat shrinkable joint kit is equivalent to the cable rating, in accordance with the applicable sections of IEEE Std 48, IEEE Std 404, and AEIC CS1.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Conduit

2.1.1.1 Rigid Metal Conduit
UL 6, galvanized steel, threaded type.

2.1.1.2 Rigid Metal Conduit, PVC Coated
UL 6, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.1.1.3 Intermediate Metal Conduit
UL 1242, galvanized steel, threaded type.

2.1.1.4 Intermediate Metal conduit, PVC Coated
UL 1242, galvanized steel, threaded type, coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3500 psi, and aging shall be minimum 1000 hours in an Atlas Weatherometer.

2.1.1.5 Plastic Conduit for Direct Burial
NEMA TC 2, EPC-40-PVC

2.1.1.6 Plastic Utilities Duct for Concrete Encasement
NEMA TC 6, Type EB

2.1.2 Fittings

2.1.2.1 Metal Fittings
UL 514B, threaded type.

2.1.2.2 PVC Conduit Fittings
NEMA TC 3 UL 514B; UL 651

2.1.2.3 PVC Duct Fittings
NEMA TC 9.

2.1.2.4 Outlet Boxes for Steel Conduit
Outlet boxes for use with rigid or flexible steel conduit shall be cast-metal cadmium or zinc-coated if of ferrous metal with gasketed closures and shall conform to UL 514A.

2.1.3 Conductors Rated 600 Volts and Less
Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout the cable length. Wires and cables manufactured more than 24 months prior to date of delivery to the site shall not be used.

2.1.3.1 600 Volt Wires and Cables
Service entrance and direct buried conductors shall conform to UL 854, Type USE. Conductors in conduit other than service entrance shall conform to UL 83, Type THWN. Conductor size and number of conductors in each cable shall be as indicated. Conductors shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, or heat shrink type sleeves. Control circuit terminations shall be properly identified. Conductors No.10 AWG and smaller shall be solid copper. Conductors No. 8 AWG and larger shall be stranded copper. All conductors shall be copper.

Colors for coding conductors shall be:

208-VOLT SYSTEM	480-VOLT SYSTEM
Neutral – White	Neutral – White
Phase A – Black	Phase A – Brown
Phase B – Red	Phase B – Orange
Phase C – Blue	Phase C – Yellow
Grounding conductor – Green	Grounding conductor – Green

2.1.4 600 Volt Wire Connector and Terminals
Shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on stranded conductors.

For use with copper conductors: UL 486A.

2.1.5 600 Volt Splices
Provide splices with a compression connector on the conductor and by insulating and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply ANSI C119.1.

a. Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or by a pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package.

b. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold.

c. Provide heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which shall be applied by a clean burning propane gas torch.

d. Provide a cold-shrink rubber splice which consists of EPDM rubber tube which has been factory stretched onto a spiraled core which is removed during splice installation. The installation shall not require heat or flame, or any additional materials such as covering or adhesive. It shall be designed for use with inline compression type connectors, or indoor, outdoor, direct-burial or submerged locations.

2.1.6 Medium Voltage Cable

Cable (conductor) sizes are designated by American Wire Gauge (AWG) and Thousand Circular Mils (Kcmil). Conductor and conduit sizes indicated are for copper conductors unless otherwise noted. Insulated conductors shall have the date of manufacture and other identification imprinted on the outer surface of each cable at regular intervals throughout cable length. Wires and cables manufactured more than 24 months prior to date of delivery to the site shall not be accepted.

Cable for 4.16 kV underground distribution system shall be ozone resistant ethylene-propylene-rubber-insulated (EPR) cable conforming to NEMA WC 8, as applicable, and AEIC CS6 or cross-linked-thermosetting-insulated (XLP) cable conforming to NEMA WC 7, as applicable, and AEIC CS5. Cable shall be single conductor, employing compact round stranded copper conductors. Cable shall have conductor and insulation shielding. Insulation shielding shall be metal tape or wire type consisting of a concentric serving of tape or wires according to NEMA WC 8 or NEMA WC 7. Cable shall be rated 5 kV with insulation and jacket thickness of 115 and 60 mils, respectively. Cable shall have a polyvinyl chloride jacket.

2.1.7 Medium Voltage Cable Terminations

IEEE Std 48 Class 1. Provide terminations including stress control terminator, ground clamp, connectors, and lugs. Terminator shall be the product of one manufacturer, suitable for the type and materials of the cable terminated. Furnish components in the form of a "UL listed" kit, including complete instructions which shall be followed for assembly and installation. Provide terminator as specified herein for terminating single conductor, or the single conductor of multiconductor, solid insulated, nonmetallic jacketed type cables for service voltage up to 35 KV indoor and outdoor. Do not use separate parts of copper or copper alloy in contact with aluminum alloy parts in the construction or installation of the terminator.

2.1.7.1 Termination; Separable Insulated Connector Type

Provide as specified in SECTION 16272N PAD-MOUNTED TRANSFORMERS

2.1.8 Tape

2.1.8.1 Insulating Tape

UL 510 plastic insulating tape.

2.1.8.2 Buried Warning and Identification Tape

Provide detectable aluminum foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried cable and conduit. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 2-inch minimum width, color coded for the utility involved with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be CAUTION BURIED ELECTRIC CABLE BELOW or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.1.9 Pull Rope
Shall be plastic having a minimum tensile strength of 200 pounds.

2.1.10 Grounding and Bonding Equipment
UL 467. Ground rods shall be copper clad steel with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter and 10 feet long unless otherwise indicated.

2.1.11 Cable Tags
Provide as specified in SECTION 16050N BASIC ELECTRICAL MATERIALS AND METHODS.

2.2 SOURCE QUALITY CONTROL

2.2.1 Medium Voltage Cable Tests
Results of AEIC C5 and/or AEIC CS6 qualification and production tests as applicable for each type of medium voltage cable.

PART 3 EXECUTION

3.1 INSTALLATION
NFPA 70 and ANSI C2 and CALPUC G.O.128.

3.1.1 Concrete
Concrete work for electrical requirements shall be 3000 psi minimum ultimate 28-day compressive strength with one inch minimum aggregate.

3.1.2 Underground Duct with Concrete Encasement
Construct underground duct lines of individual conduits encased in concrete. Except where rigid galvanized steel conduit is indicated or specified, the conduit shall be PVC Type EB-35. Do not mix different kinds of conduit in any one duct bank. Ducts shall not be smaller than 2 inches in diameter unless otherwise indicated. Concrete encasement surrounding the bank shall be rectangular in cross-section and shall provide at least 3 inches of concrete cover for ducts. Separate conduits by a minimum concrete thickness of 2 1/2 inches, except separate light and power conduits from control, signal, and telephone conduits by a minimum concrete thickness of 3 inches. Provide color, type and depth of warning tape as specified in SECTION 02300 EARTHWORK.

3.1.2.1 Depth of Encasement
Top of the concrete encasement shall not be less than 18 inches below grade except that under roads and pavement concrete be a minimum of 24 inches below grade and under railroad tracks a minimum of 50 inches below top of rails.

3.1.2.2 Slope of Encasement
Duct banks shall have a continuous slope downward toward underground structures and away from buildings with a minimum pitch of 3 inches in 100 feet. Except at conduit risers, accomplish changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, by long sweep bends having a minimum radius of curvature of 25 feet; sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger. Excavate trenches along straight lines from structure to structure before ducts are laid or structure constructed so the elevation can be adjusted, if necessary, to avoid unseen obstruction.

3.1.2.3 Conduits
Terminate conduits in end-bells where duct lines enter underground structures. Stagger conduit joints by rows and layers to strengthen the duct bank. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked-in duct bank. Install spacers per manufacture's instructions, but provide a minimum of two spacer assemblies per 10 feet of duct bank. Before pouring concrete, anchor duct bank assemblies to prevent the assemblies from floating during concrete pouring. Anchoring shall be done by driving reinforcing rods adjacent to every other duct spacer assembly and attaching the rod to the spacer assembly.

3.1.2.4 Connections to Manholes
Duct bank envelopes connecting to underground structures shall be flared to have enlarged cross-section at the manhole entrance to provide additional shear strength. Dimensions of the flared cross-section shall be larger than the corresponding manhole opening dimensions by no less than 12 inches in each direction. Perimeter of the duct bank opening in the underground structure shall be flared toward the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Use vibrators when this portion of the encasement is poured to assure a seal between the envelope and the wall of the structure.

3.1.3 Underground Conduit for Service Feeders Into Buildings
The duct from the bed mount transformer to the switchboard in the electrical equipment room shall be galvanized rigid steel or steel IMC. The conduit shall not penetrate the floor of the compound but shall be routed to penetrate the compound above the curb. Protect the ends of the conduit by threaded metal caps or bushings; coat the threads with graphite grease or other coating. Clean and plug conduit until conductors are installed. Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

3.1.4 Conduit Protection at Concrete Penetrations
Galvanized conduits which penetrate concrete (slabs, pavement, and walls) in wet locations shall be PVC coated and shall extend from at least 2 inches within the concrete to the first coupling or fitting outside the concrete (minimum of 6 inches from penetration).

3.1.5 Buried Warning and Identification Tape
Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the sub-grade under pavements.

3.1.6 Cable Pulling
Pull cables down grade with the feed-in point at the manhole or buildings of the highest elevation. Use flexible cable feeds to convey cables through manhole opening and into duct runs. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape or wire shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. If basket-grip type cable-pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.

3.1.6.1 Cable Lubricants
Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic jacketed cables. Lubricant shall not be deleterious to the cable sheath, jacket, or outer coverings.

3.1.6.2 Cable Pulling Tensions
Tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer.

3.1.6.3 Secondary Cable Runs, 600 Volts and Less
Provide insulated copper equipment grounding conductor, sized as required by the rating of the overcurrent device supplying the phase conductors.

3.1.6.4 Conductors Installed in Parallel
Conductors shall be grouped such that each conduit of a parallel run contains 1 Phase A conductor, 1 Phase B conductor, 1 Phase C conductor, and 1 neutral conductor.

3.1.7 600 Volt Cable Splicing and Terminating
Protect terminations of insulated power and lighting cables from accidental contact, deterioration of coverings and moisture by providing terminating devices and materials. Install terminations of insulated power and lighting cables in accordance with the manufacturer's requirements. Make terminations with materials and methods as indicated or specified herein or as designated by the written instructions of the cable manufacturer and termination kit manufacturer.

3.1.8 Connections to Utility Lines
The Contractor shall coordinate the work with the Contracting Officer and shall provide for final connections to the utility electric lines.

3.1.8.1 Connections Between Aerial and Underground Systems
Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in guards or conduit to cable terminations. Conduits shall be secured to poles by two-hole galvanized steel pipe straps spaced not more than 10 feet apart and with one support not more than 12 inches from any bend or termination. Cables shall be supported by devices separate from the conduit or guard, near their point of exit from the riser conduit or guard. Cable guards shall be secured in accordance with the manufacturer’s published procedure. Risers shall be equipped with bushings to protect cables.

3.1.9 Grounding Systems
Shall be as indicated, and as required by NFPA 70 and ANSI C2.

3.1.9.1 Grounding Electrodes
Provide cone pointed driven ground rods driven full depth plus 6 inches, installed to provide an earth ground of the appropriate value for the particular equipment being grounded.

3.1.9.2 Grounding Connections
Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.9.3 Grounding Conductors
Grounding conductors shall be stranded-bare copper conforming to ASTM B 8, Class B, for sizes No. 6 AWG and larger, and shall be solid-bare copper conforming to ASTM B 1 for sizes No. 8 and smaller. Cable sheaths, cable shields, conduit, and equipment shall be grounded with No. 6 AWG.

3.1.9.4 Ground Cable Crossing Expansion Joints
Protect ground cables crossing expansion joints or similar separations in structures and pavements by use of approved devices or methods of installation which provide the necessary slack in the cable across the joint to permit movement. Use stranded or other approved flexible copper cable across such separations.

3.1.10 Special Conditions
During the construction of duct banks and underground structures located in streets, the streets shall remain open to traffic. Plan and execute the work to meet this condition. At locations where duct banks cross railroad tracks and the work requires closing of the tracks, secure permission from the Contracting Officer for each track closure.

3.1.11 Earthwork for Utilities
See SECTION 02300 - EARTHWORK.

3.1.12 Reconditioning of Surfaces

3.1.12.1 Unpaved Surfaces
Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct [or direct burial cable]. Preserve sod and topsoil removed during excavation and reinstall after backfilling is completed. Replace sod that is damaged by sod of quality equal to that removed. When the surface is disturbed in a newly seeded area, re-seed the restored surface with the same quantity and formula of seed as that used in the original seeding.

3.1.12.2 Paving Repairs
Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.1.13 Certificate of Competency for Cable Splicer/Terminator
Certification of the qualification of the cable splicer/terminator shall be submitted, for approval, 30 days before splices or terminations are to be made in medium voltage (5 kV to 35 kV) cables. The certification shall include the training, and experience of the individual on the specific type and classification of cable to be provided under this contract. The certification shall indicate that the individual has had three or more years recent experience splicing and terminating medium voltage cables. The certification shall also list a minimum of three splices/terminations that have been in operation for more than one year. In addition, the individual may be required to perform a dummy or practice splice/termination in the presence of the Contracting Officer, before being approved as a qualified cable splicer. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice/termination kit, and detailed manufacturer's instructions for the cable to be spliced. The Contracting Officer reserves the right to require additional proof of competency or to reject the individual and call for certification of an alternate cable splicer.

3.2 FIELD QUALITY CONTROL
As an exception to requirements that may be stated elsewhere in the contract, notify the Project Engineer 5 working days prior to each test. Furnish labor, equipment, and incidentals required for testing, except that the Government will provide electric power required for the tests. Correct defects in the work provided by the Contractor and repeat tests until the work is in compliance with contract requirements.

3.2.1 Performance of Acceptance Checks and Tests
Perform in accordance with the manufacturer's recommendations, NFPA 70B, NETA ATS, and referenced ANSI standards. Include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.2.1.1 600 Volt Cable Tests
Perform tests after wiring is completed, connected, and ready for operation, but prior to placing system in service and before any branch circuit breaker is closed.

a. Visual and Mechanical Inspection

(1) Inspect cables for physical damage and proper connection in accordance with contract plans and specifications.

(2) Test cable mechanical connections to manufacturer's recommended values using a calibrated torque wrench. In the absence of manufacturer's data use NETA recommended values.

(3) Check cable color coding for compliance with contract specifications.

b. Electrical Tests

(1) Perform insulation-resistance test on each conductor with respect to ground and adjacent conductor; applied potential shall be 1000 volts DC for 1 minute; minimum insulation-resistance values shall not be less than 2 megohms.

(2) Perform continuity test to insure proper cable connection.

3.2.1.2 Medium Voltage Cables

Perform tests after installation of cable, splices, and terminators and before terminating to equipment.

a. Visual and Mechanical Inspection

(1) Inspect exposed cable sections for physical damage.

(2) Verify that cable is supplied and connected in accordance with contract plans and specifications.

(3) Inspect for proper shield grounding, cable support, and cable termination.

(4) Verify that cable bends are not less than ICEA or manufacturer's minimum allowable bending radius.

(5) Inspect for proper fireproofing.

(6) If cables are terminated through window-type CT's, make an inspection to verify that neutrals and grounds are properly terminated for proper operation of protective devices.]

(7) Visually inspect jacket and insulation condition.

(8) Inspect for proper phase identification and arrangement.

b. Electrical Tests

(1) Perform a shield continuity test on each power cable by ohmmeter method. Record ohmic value, resistance values in excess of 10 ohms per 1000 feet of cable must be investigated and justified.

(2) Perform a DC high-potential test on all cables. Adhere to precautions and limits as specified in the applicable NEMA/ICEA Standard for the specific cable. Test procedure shall be as follows, and the results for each cable test shall be recorded as specified herein. Field acceptance test voltage shall be as follows:

*Use lower value when insulated connectors are connected to the cable being tested.

a. Current-sensing circuits in test equipment shall measure only the leakage current associated with the cable under test and shall not include internal leakage of the test equipment.

b. Record wet- and dry-bulb temperatures or relative humidity and temperature.

c. Test each section of cable individually.

d. Individually test each conductor with all other conductors grounded; Ground all shields.

e. Terminations shall be properly corona-suppressed by guard ring, field reduction sphere, or other suitable methods as necessary.

f. Ensure that the maximum test voltage does not exceed the limits for terminators specified in IEEE standard 48 or manufacturer's specifications.

g. Apply the DC high-potential test in at least five equal increments until maximum test voltage is reached. No increment shall exceed the voltage rating of the cable. Record DC leakage current at each step after a constant stabilization time consistent with system charging current.

h. Raise the conductor to the specified maximum test voltage and hold for fifteen (15) minutes. Record readings of leakage current at 30 seconds and one minute and at one-minute intervals thereafter. Provide a graphic plot of readings with leakage current (X axis) versus voltage (Y axis) at each increment.

i. Reduce the conductor test potential to zero and measure residual voltage at discrete intervals.

j. Apply grounds for a time period adequate to drain all insulation stored charge.

k. When new cables are spliced into existing cables, the DC high-potential test shall be performed on the new cable prior to splicing. After test results are approved for new cable and the splice is completed, an insulation-resistance test and a shield-continuity test shall be performed on the length of new and existing cable including the splice. After a satisfactory insulation-resistance test, a DC high-potential test shall be performed on the completed cable system utilizing a test voltage 75 percent of new cable tested value.

3.2.1.3 Ground Rods

Perform ground resistance tests for ground rods before any wire is connected. Take measurements in normally dry weather, not less than 48 hours after rainfall. Ground resistance shall also be measured for each piece of equipment and medium voltage cable splice to the ground electrode. Use a portable ground testing megger in accordance with manufacturer's instructions to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground electrode under test.

END OF SECTION

SECTION 16402N

INTERIOR DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. Section 16050N BASIC ELECTRICAL MATERIALS AND METHODS, applies to this section with additions and modifications specified herein.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
ANSI C80.5 (1994) Aluminum Rigid Conduit (ARC)

ASTM INTERNATIONAL (ASTM)
ASTM B 1 (2001) Hard-Drawn Copper Wire
ASTM B 8 (1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
IEEE C12.7 (1993; R 1999) Requirements for Watthour Meter Sockets

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
NETA ATS (2003) Acceptance Testing Specifications

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
NEMA BU 1 (1999) Busways
NEMA C12.1 (2001) Code for Electricity Metering
NEMA C80.1 (1994) Rigid Steel Conduit - Zinc Coated (GRC)
NEMA C80.3 (1994) Electrical Metallic Tubing - Zinc Coated (EMT)
NEMA FU 1 (2002) Low Voltage Cartridge Fuses
NEMA ICS 1 (2000) Industrial Control and Systems: General Requirements
NEMA ICS 2 (2000) Industrial Controls and Systems: Controllers, Contactors, and Overload Relays Rated Not More than 2000 Volts AC or 750 Volts DC
NEMA ICS 3 (1993; R 2000) Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 Volts AC
NEMA ICS 4 (2000) Industrial Control and Systems: Terminal Blocks
NEMA ICS 6 (1993; R 2001) Industrial Control and Systems: Enclosures
NEMA KS 1 (2001) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA MG 1 (2003) Motors and Generators
NEMA MG 10 (2001) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11 (1977; R 1997; R 2001) Energy Management Guide for Selection and Use of Single Phase Motors
NEMA RN 1 (1998) Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20 (1992; R 1997) Dry-Type Transformers for General Applications
NEMA TC 14 (2002) Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
NEMA TC 2 (2003) Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

NEMA TC 3 (2004) Polyvinyl Chloride PVC Fittings for Use with Rigid PVC Conduit and Tubing
NEMA TP 1 (2002) Guide for Determining Energy Efficiency for Distribution Transformers
NEMA VE 1 (2002) Metal Cable Tray Systems
NEMA WD 1 (1999) General Color Requirements for Wiring Devices
NEMA WD 6 (2002) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 70 (2002) National Electrical Code
NFPA 780 (2000) Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)
UL 1 (2000; Rev thru Mar 2004) Flexible Metal Conduit
UL 1010 (1995; Rev thru Mar 1999) Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1242 (2000; Rev thru May 2003) Electrical Intermediate Metal Conduit -- Steel
UL 1449 (1996; Rev thru Jul 2002) Transient Voltage Surge Suppressors
UL 1561 (1999; Rev thru Feb 2004) Dry-Type General Purpose and Power Transformers
UL 1569 (1999; Rev thru Mar 2004) Metal-Clad Cables
UL 1660 (2004) Liquid-Tight Flexible Nonmetallic Conduit
UL 1699 (1999; Rev thru May 2003) Arc-Fault Circuit-Interrupters
UL 198C (1986; Rev thru Feb 1998)High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198E (1988; Rev Jul 1988) Class R Fuses
UL 198H (1988; Rev thru Nov 1993) Class T Fuses
UL 20 (2000; Rev thru Jun 2002) General-Use Snap Switches
UL 360 (2003) Liquid-Tight Flexible Steel Conduits
UL 4 (2004) Armored Cable
UL 44 (1999; Rev thru May 2002) Thermoset-Insulated Wires and Cables
UL 467 (1993; Rev thru Feb 2001) Grounding and Bonding Equipment
UL 486A (1997; Rev thru May 2001) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B (1997; Rev thru May 2001) Wire Connectors for Use with Aluminum Conductors
UL 486C (2000; Rev thru Oct 2002) Splicing Wire Connectors
UL 489 (2002; Rev thru May 2003) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498 (2001; Rev thru Oct 2002) Attachment Plugs and Receptacles
UL 5 (2004) Surface Metal Raceways and Fittings
UL 50 (1995; Rev thru Sep 2003) Enclosures for Electrical Equipment
UL 506 (2000; Rev thru Feb 2004) Specialty Transformers
UL 508 (1999; Rev thru Dec 2003) Industrial Control Equipment
UL 510 (1994; Rev thru Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 514A (2004) Metallic Outlet Boxes
UL 514B (2004) Conduit, Tubing and Cable Fittings
UL 514C (1996; Rev thru Nov 2002) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 5A (2003) Nonmetallic Surface Raceways and Fittings
UL 6 (2000; Rev thru May 2003) Rigid Metal Conduit
UL 651 (1995; Rev thru Oct 2002) Schedule 40 and 80 Rigid PVC Conduit
UL 67 (1993; Rev thru Nov 2003) Panelboards
UL 6A (2000; Rev thru Jan 2004) Electrical Rigid Metal Conduit - Aluminum, Bronze, and Stainless Steel
UL 719 (2002; Rev thru May 2003) Nonmetallic-Sheathed Cables

UL 797 (2000; Rev thru May 2003) Electrical Metallic Tubing -- Steel
UL 83 (2003; Rev thru Mar 2004) Thermoplastic-Insulated Wires and Cables
UL 845 (1995; Rev thru Apr 2004) Motor Control Centers
UL 854 (1999; Rev thru Nov 2002) Service-Entrance Cables
UL 857 (2001; Rev thru Nov 2002) Busways
UL 869A (1998) Reference Standard for Service Equipment
UL 870 (1995; Rev thru Jul 2003) Wireways, Auxiliary Gutters, and Associated Fittings
UL 886 (1994; Rev thru Apr 1999) Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 943 (1993; Rev thru Feb 2004) Ground-Fault Circuit-Interrupters
UL 984 (1996) Hermetic Refrigerant Motor-Compressors

1.2 SUBMITTALS

SD-02 Shop Drawings
Panelboards; G

SD-03 Product Data
Receptacles; G

Circuit breakers; G

Switches; G

Transformers; G

Enclosed circuit breakers; G

Motor controllers; G

Combination motor controllers; G

Manual motor starters; G

Residential load centers; G

Metering; G

Meter base only; G

Grounding Block; G

Surge protective devices; G

SD-06 Test Reports
600-volt wiring test; G

Grounding system test; G

Transformer tests; G

Ground-fault receptacle test; G

SD-07 Certificates
Fuses; G

SD-09 Manufacturer's Field Reports
Transformer factory tests

1.3 QUALITY ASSURANCE

1.3.1 Fuses

Submit coordination data as specified in article entitled, "FUSES" of this section.

1.4 MAINTENANCE

1.4.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70.

2.2 CONDUIT AND FITTINGS

Shall conform to the standards indicated in the following subsections.

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

NEMA C80.1, UL 6.

2.2.1.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6A.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40 and EPC-80 in accordance with NEMA TC 2,UL 651, or fiberglass conduit, in accordance with NEMA TC 14.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)
UL 797, NEMA C80.3.

2.2.5 Plastic-Coated Rigid Steel and IMC Conduit
NEMA RN 1, Type 40 (one millimeter(40 mils) thick).

2.2.6 Flexible Metal Conduit
UL 1.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel
UL 360.

2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit
UL 514B. Ferrous fittings shall be cadmium- or zinc-coated in accordance with UL 514B.

2.2.7.1 Fittings for Rigid Metal Conduit and IMC
Threaded-type. Split couplings unacceptable.

2.2.7.2 Fittings for EMT
Die cast compression type.

2.2.8 Fittings for Rigid Nonmetallic Conduit
NEMA TC 3, UL 514B.

2.3 OUTLET BOXES AND COVERS
UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES
Volume greater than 100 cubic inches, UL 50, hot-dip, zinc-coated, if sheet steel.

2.5 WIRES AND CABLES
Wires and cables shall meet applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Wires and cables manufactured more than 12 months prior to date of delivery to site shall not be used.

2.5.1 Conductors
Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.5.1.1 Minimum Conductor Sizes
Minimum size for branch circuits shall be No. 12 AWG; for Class 1 remote-control and signal circuits, No. 14 AWG; for Class 2 low-energy, remote-control and signal circuits, No. 16 AWG; and for Class 3 low-energy, remote-control, alarm and signal circuits, No. 22 AWG.

2.5.2 Color Coding
Provide for service, feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one

system are installed in same raceway or box, other neutral shall be white with colored (not green) stripe. Color of ungrounded conductors in different voltage systems shall be as follows:

a. 208/120 volt, three-phase

    (1) Phase A – black

    (2) Phase B – red

    (3) Phase C – blue

b. 480/277 volt, three-phase

    (1) Phase A – brown

    (2) Phase B – orange

    (3) Phase C – yellow

c. 120/240 volt, single phase: Black and red

2.5.3 Insulation
Unless specified or indicated otherwise or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN/THHN conforming to UL 83 conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.5.4 Bonding Conductors
ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.5.5 Armored Cable
UL 4; NFPA 70, Type AC cable.

2.6 SPLICES AND TERMINATION COMPONENTS
UL 486A for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires shall be insulated, pressure-type in accordance with UL 486A or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES
Provide UL listed, one-piece device plates for outlets to suit the devices installed. For metal outlet boxes, plates on unfinished walls shall be of zinc-coated sheet steel or cast metal having round or beveled edges. For nonmetallic boxes and fittings, other suitable plates may be provided. Plates on finished walls shall be nylon or lexan, minimum 0.03-inch wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted. Screws shall be machine-type with countersunk heads in color to match finish of plate. Sectional type device plates will not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

2.8 SWITCHES

2.8.1 Toggle Switches

NEMA WD 1, UL 20, single pole, double pole, three-way, and four-way, totally enclosed with bodies of thermoplastic and/or thermoset plastic and mounting strap with grounding screw. Handles shall be ivory thermoplastic. Wiring terminals shall be screw-type, side-wired. Contacts shall be silver-cadmium and contact arm shall be one-piece copper alloy. Switches shall be rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.8.2 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Fused switches shall utilize Class R fuseholders and fuses, unless indicated otherwise. Switches serving as motor-disconnect means shall be horsepower rated. Provide switches in NEMA 3R, enclosure per NEMA ICS 6.

2.8.3 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.9 RECEPTACLES

UL 498, hard use, heavy-duty, grounding-type. Ratings and configurations shall be as indicated. Bodies shall be of ivory as per NEMA WD 1. Face and body shall be thermoplastic supported on a metal mounting strap. Dimensional requirements shall be per NEMA WD 6. Provide screw-type, side-wired wiring terminals. Connect grounding pole to mounting strap. The receptacle shall contain triple-wipe power contacts and double or triple-wipe ground contacts.

2.10 PANELBOARDS

UL 67 and UL 50. Panelboards for use as service disconnecting means shall additionally conform to UL 869A. Panelboards shall be circuit breaker-equipped. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated. Panelboard locks shall be keyed same. Directories shall indicate load served by each circuit of panelboard. Directories shall also indicate source of service (upstream panel, switchboard, motor control center, etc.) to panelboard. Type directories and mount in holder behind transparent protective covering.

2.10.1 Panelboard Buses

Support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide isolated neutral bus in each panel for connection of circuit neutral conductors. Provide separate ground bus identified as equipment grounding bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2.10.2 Circuit Breakers

UL 489, thermal magnetic-type or solid state-type having a minimum short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker shall be mounted. Breaker terminals shall be UL listed as suitable for type of conductor provided. Series rated circuit breakers and plug-in circuit breakers without a self-contained bracket and not secured by a positive locking device requiring mechanical release for removal are unacceptable.

2.10.2.1 Multipole Breakers
Provide common trip-type with single operating handle. Breaker design shall be such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.11 TRANSFORMERS
NEMA ST 20, general purpose, dry-type, self-cooled, ventilated. Provide transformers in NEMA 3R enclosure. Transformer shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation for transformers rated 10 kVA and less, with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformer of 115 degrees C temperature rise shall be capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

2.12 MOTORS

2.12.1 Motor Sizes
Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided.

2.13 MOTOR CONTROLLERS
UL 508, NEMA ICS 1, and NEMA ICS 2.
Controllers shall have thermal overload protection in each phase and shall have one spare normally open and one spare normally closed auxiliary contact. Magnetic-type motor controllers shall have undervoltage protection when used with momentary-contact pushbutton stations or switches and shall have undervoltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller shall have hand/off/automatic selector switch. Connections to selector switch shall be such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices, shall be connected in motor control circuit in "hand" and "automatic" positions. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device shall be made in accordance with indicated or manufacturer's approved wiring diagram. For each motor not in sight of controller or where controller disconnecting means is not in sight of motor location and driven machinery location, controller disconnecting means shall be capable of being locked in open position. As an alternative, provide a manually operated, lockable, nonfused switch which disconnects motor from supply source within sight of motor. Overload protective devices shall provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case. Cover of combination motor controller and manual switch or circuit breaker shall be interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

2.13.1 Control Circuits

Control circuits shall have maximum voltage of 120 volts derived from a separate control source. Provide terminals and terminal boards. Provide separate control disconnect switch within controller. One secondary lead shall be fused; others shall be grounded.

2.13.2 Enclosures for Motor Controllers

NEMA ICS 6. Enclosures shall be minimum NEMA 1 gasketed.

2.13.3 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers shall have compelling relays and shall be multiple-button, station-type with pilot lights for each speed.

2.13.4 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations shall be heavy duty, oil-tight design.

2.13.5 Pilot and Indicating Lights

Provide LED cluster lamps.

2.13.6 Terminal Blocks

NEMA ICS 4.

2.14 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

2.14.1 Pilot Lights

Provide yoke-mounted, seven element LED cluster light module. Color shall be in accordance with NEMA ICS 2.

2.15 NAMEPLATES

Provide as specified in Section 16050N - BASIC ELECTRICAL MATERIALS AND METHODS.

2.16 SOURCE QUALITY CONTROL

2.16.1 Transformer Factory Tests

Submittal shall include routine NEMA ST 20 transformer test results on each transformer and also contain the results of NEMA "design" and "prototype" tests that were made on transformers electrically and mechanically equal to those specified.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to requirements of NFPA 70 and to requirements specified herein.

3.1.1 Underground Service

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph entitled "Nameplates." Use lettering of at least 0.25 inches in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by NFPA 70.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Shared neutral, or multi-wire branch circuits, are not permitted with arc-fault circuit interrupters. Minimum conduit size shall be 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches.

3.1.3.1 Restrictions Applicable to Aluminum Conduit

Do not install underground or encase in concrete or masonry. Do not use brass or bronze fittings.

3.1.3.2 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to severe physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

3.1.3.3 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40 and PVC Schedule 80

   (1) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in fire pump rooms.

(4) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

(5) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

b. Electrical Nonmetallic Tubing

(1) Do not install underground.

(2) Do not encase in concrete except when provided with fittings identified for this purpose are used for connections.

(3) Do not use in areas where subject to severe physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, hospitals, power plants, missile magazines, and other such areas.

(4) Do not use in hazardous areas.

(5) Do not use outdoors.

(6) Do not use in sizes larger than 2 inches.

(7) Do not run exposed in buildings exceeding three floors above grade, where "first floor" is as defined in NFPA 70.

3.1.3.4 Restrictions Applicable to Flexible Conduit
Use only as specified in paragraph entitled "Flexible Connections."

3.1.3.5 Service Entrance Conduit, Overhead
Rigid steel or IMC from service entrance to service entrance fitting or weatherhead outside building.

3.1.3.6 Service Entrance Conduit, Underground
PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.3.7 Conduit in Floor Slabs
Rigid steel; steel IMC; fiberglass, or PVC, Type EPC-40.

3.1.4 Conduit Installation
Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inches in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.4.2 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.3 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 890-N (200-lb) tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4.4 Conduit Installed in Concrete Floor Slabs

Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum one-inch cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway. Conduit larger than one-inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab.

3.1.4.5 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.4.6 Flexible Connections
Provide flexible steel conduit between 3 and 6 feet in length for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 1/2 inch diameter. Provide liquid-tight flexible nonmetallic conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.5 Boxes, Outlets, and Supports
Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, and when specifically indicated. Boxes in other locations shall be sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic sheathed cable conduit system. Each box shall have volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.5.1 Boxes
Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2-inch boxes may be used where only one raceway enters outlet.

3.1.5.2 Pull Boxes
Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through a common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.5.3 Extension Rings
Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.6 Mounting Heights

Mount panel boards, circuit breakers, motor controller, and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches 48 inches above finished floor, receptacles 18 inches above finished floor, and other devices. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.7 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with manufacturer's recommendations.

3.1.8 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.9 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates is not permitted. Provide gasket for plates installed in wet locations.

3.1.10 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings.

3.1.11 Grounding and Bonding

NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telephone system grounds, and neutral conductor of wiring systems. Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include lightning protection, electrical service, telephone system grounds, as well as underground metallic piping systems. Interconnection to the gas line shall be made on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.12 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.13 Repair of Existing Work

3.1.13.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.13.2 Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.14 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible.

3.2 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results.

3.2.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.2.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.2.3 Transformer Tests

Perform the standard, not optional, tests in accordance with the Inspection and Test Procedures for transformers, dry type, air-cooled, 600 volt and below; as specified in NETA ATS. Measure primary and secondary voltages for proper tap settings. Tests need not be performed by a recognized independent testing firm or independent electrical consulting firm.

3.2.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Submit written results of each test to Project Engineer, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

3.2.5 Watthour Meter

Visual and mechanical inspection Examine for broken parts, shipping damage, and tightness of connections. Verify that meter type, scales, and connections are in accordance with approved shop drawings. Electrical tests Determine accuracy of meter. Calibrate watthour meters to one-half percent. Verify that correct multiplier has been placed on face of meter, where applicable.

END OF SECTION