OTIE
Oneida Total Integrated Enterprises

October 10, 2011

Mr. Leo Francendese
On-Scene Coordinator
U.S. Environmental Protection Agency, Region 4
61 Forsyth Street, SW, 11th Floor
Atlanta, Georgia 30303

Subject: **Perimeter Air Monitoring Work Plan, Rev.1**
US Finishing Cone Mills Removal
Greenville, Greenville County, South Carolina
Site ID: A4DD
TDD No.: TNA-05-001-0144
Contract No.: EP-W-05-053

Dear Mr. Francendese:

Oneida Total Integrated Enterprises (OTIE) in association with Aerostar Environmental Services, Inc. (AEROSTAR), Superfund Technical Assessment and Response Team (START) is submitting one copy of the Draft Permiter Air Monitoring Work Plan, Revision 1 for the US Finishing/Cone Mills Removal Site (the site) located in Greenville, Greenville County, South Carolina. This plan specifies air monitoring procedures to be conducted at the site during the removal action.

START appreciates the opportunity to provide you with this plan. Please contact me at (251) 583-1647 or Russell Henderson at (678) 355-5500, ext. 5707 with any questions or comments regarding this submittal.

Sincerely,

S. Adam Davis
Senior Scientist

Russell Henderson
Assistant START Program Manager

Enclosure

cc: Gary Stewart, SCDHEC Emergency/Time Critical Response
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START File

US FINISHING/CONE MILLS
GREENVILLE, GREENVILLE COUNTY, SOUTH CAROLINA
TDD No.: TNA-05-001-0144
CONTRACT No.: EP-W-05-053
CERCLIS ID: SCD003358744
U.S. EPA SITE ID: A4DD

Revision 1

Prepared for:

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Contract No.	:	EP-W-05-053
TDD Number	:	TNA-05-001-0144
Date Submitted	:	October 10, 2011
EPA OSC	:	Leo Francendese
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1.0 INTRODUCTION

The US Finishing/Cone Mills Removal Action consists of the demolition of several severely dilapidated on-site structures and the removal and disposal of large piles of burned debris generated by a fire which destroyed significant portions of the main production building. Asbestos containing materials (ACM) as well as lead based paint (LBP) exist throughout the dilapidated structures and within the fire damaged debris piles. The removal site consists primarily of the main production area which includes three, partially collapsed and interconnected buildings on the eastern portion of the site totaling approximately 130,000 square feet. Samples of building materials suspected of containing asbestos were collected in June 2010. Laboratory analysis of these samples determined that sheetrock type material and various thermal systems insulation were positive for asbestos on the main floor, second floor, and the basement of the main building. Sampling confirmed 2,450 square feet and 5,700 linear feet of ACM. In addition, approximately 427,000 square feet of material including the piles of burned debris located on the eastern side of the site is also suspected to contain asbestos. Additional information on the site conditions and history are included in the Removal Site Inspection and Incident Response Letter Report (Ref. 1 OTIE, August 2011).

This Perimeter Air Monitoring Work Plan (PAMWP) is being proposed for implementation during removal activities at the site. A separate On-site Air Monitoring Work Plan (OAMWP) is currently being developed to address on-site air monitoring for worker safety.

Previous investigations at the site have indicated the presence of elevated levels of compounds typically associated with historic industrial sites including ACM and LBP. Based on the assumed prevalence of these compounds in other un-tested portions of the site materials, and the general toxicity of these classes of compounds, asbestos and lead have been selected as the target analytes to be included in the ambient air quality monitoring program.

Real-time air quality monitoring, in conjunction with confirmatory air sampling and laboratory analysis, is to be performed at this location during removal activities in which building materials and debris are disturbed. The goal of real-time air monitoring and the aggressive response to exceedances of action levels are designed to be protective of individuals within the vicinity of the removal action. Real-time air monitoring will act as an early warning system to prevent off-site exposures to elevated levels of site contaminants and document conditions occurring during demolition and removal activities. Engineering controls such as dust and vapor suppression will be implemented during demolition and removal activities to prevent migration of fugitive contaminants off-site. If the action levels are exceeded, immediate and

aggressive actions will be taken to prevent further exposures, including implementation of additional engineering controls and alteration, or cessation of certain work activities.

2.0 PROJECT OBJECTIVES

The overall air monitoring objectives on this project are as follows:

- Minimize risk of off-site exposure to contaminants resulting from removal action work performed at the site;
- Provide an early warning of site conditions allowing site managers to proactively manage potential off-site ambient air impacts;
- Create a comprehensive, full-time database of perimeter air quality measurements, meteorological conditions, alarm notifications, equipment calibration and daily observations collected during the project.

2.1 PERIMETER AIR MONITORING OBJECTIVES

Perimeter air monitoring will be performed at upwind and downwind locations around the perimeter of the site before and during removal activities. The perimeter air monitoring system is designed to accomplish the objectives presented above as well as the following:

- Establish pre-removal baseline levels of target compounds in ambient air prior to initiation of removal activities;
- Monitor and document perimeter ambient air levels of target compounds during removal activities;
- Provide an early warning (visual indicator) system of potential elevated off-site exposures, allowing aggressive responses to exceedances of action levels ensuring that longer-term exposures at the perimeter are below acceptable levels;
- Evaluate ongoing effectiveness of, and need for additional vapor and/or dust suppression controls and/or alteration of work activities, to reduce airborne compounds to below acceptable risk levels;
- Use real-time perimeter monitoring results in conjunction with confirmatory air sampling to demonstrate that no significant human health exposures were caused by the work.
- Establish Data Quality Objectives (DQO) to define the quality of the data gathered in relation to the methods used to collect the data and the data's anticipated end use.

2.2 DATA QUALITY OBJECTIVES

Both real-time screening level and confirmatory data will be collected to evaluate contaminant levels in ambient air. The number of samples collected for field screening or laboratory

analysis depends on the level of data quality that can be expected from the testing method employed. Below is a discussion regarding Data Quality Objectives (DQOs) and the relative quality of the samples needed for types of data to be collected, either real-time or confirmatory.

The following DQO levels will be utilized during the performance of removal actions:

Real-time screening data: This screening data applies to all field screening using portable equipment, such as ambient dust (particulate) monitors. The data collected generally does not include QA/QC information. The real-time data will be used to document conditions occurring on the site during excavation activities and determine the need for more aggressive dust and/or vapor suppression activities or alteration of work activities. In addition, the real-time data will be used to demonstrate compliance with the health-protective action levels and will influence the frequency of confirmatory sample analysis.

Confirmatory data: This level applies to the analyses of samples collected on-site and is performed off-site at an EPA-accredited analytical laboratory. The analyses will be conducted in accordance with the appropriate US EPA air sampling methods. Data will include the QA/QC elements specified by the appropriate US EPA analytical methods. In general, the confirmatory samples will be collected on a baseline, start-up, and routine basis and analyzed using appropriate US EPA methods. Confirmatory data will be used to demonstrate compliance with the health-protective action levels and will influence the control measures being utilized during site removal activities.

2.3 SELECTION OF TARGET COMPOUNDS

The selection of target compounds and action levels for this project is based on guidance presented in Asbestos National Emission Standards for Hazardous Air Pollutants (NESHAP), 40 CFR, Subpart M (Attachment 1), the South Carolina Department of Health And Environmental Control (SCDHEC) Standards of Performance for Asbestos Projects Regulation 61-86.1 (Attachment 2), and the EPA Office of Solid Waste and Emergency Response (OSWER) Directives 9345.4-05 (Attachment 3) and 9200.0-68 (Attachment 4), as well as prior experience in conducting perimeter air monitoring projects at former industrial sites where demolition is included in removal activities and ACM and LBP may be present. Regulatory information related to the above-mentioned guidelines is included in Section 8 of this document.

The target compounds selected for the real-time component of this project include Particulate Matter in the form of respirable coarse particles (PM_{10}) as a surrogate for asbestos and lead exposure. Target compounds for the confirmatory sampling component of this project include asbestos and lead. Refer to Section 5 for a detailed discussion of the confirmatory sampling program.

2.4 ACTION LEVELS

As previously mentioned, the real-time component of this project includes PM_{10} as a surrogate for asbestos and lead exposure. The real-time monitoring action level selected for PM_{10} is 150 micrograms per cubic meter ($\mu g/m^3$) and is based on the National Ambient Air Quality Standard (NAAQS) provided in Title 40 of the Code of Federal Regulations (CFR) Part 50. The NAAQS for PM_{10} is averaged over a 24-hour period. The PM_{10} action level for the site is set at 150 $\mu g/m^3$ averaged over a one hour period.

Action Levels have also been selected for use with the supplemental confirmatory sampling for asbestos and lead. The action level for lead is 0.15 $\mu g/m^3$ averaged over a sampling period (work day) and is based on the NAAQS. The NAAQS for lead is measured as elemental lead with a maximum arithmetic mean averaged over a calendar quarter. The action level for asbestos is 0.001 fibers per cubic centimeter (f/cc) and is based on the EPA Air Action Level for Baseline Residential Asbestos Exposures (target risk level of $1x10^{-4}$) provided in OSWER Directive 9200.0-68.

2.6 WARNING LEVELS

In order to allow for mitigation activities to occur prior to a potential exceedance of an action level, warning levels that are lower than the action levels have been established for real time air monitoring. Additionally, warning levels have also been established for confirmatory air sampling so that site controls can be evaluated for efficacy. The proposed warning level for PM_{10} is set at 112.5 $\mu g/m^3$ averaged over a 1-hour period, or 75% of the action level of 150 $\mu g/m^3$. The proposed warning level for lead is 0.11 $\mu g/m^3$ averaged over a sampling period (work day), or 75% of the action level of 0.15 $\mu g/m^3$. The proposed warning level for asbestos is any detection above the laboratory method detection limit (MDL) or 0.001 f/cc.

The following table summarizes the selected action levels and warning levels to be used for the real-time monitoring system, and the supplemental confirmatory sampling.

Table 1 Warning and Action Levels

Compound	Warning Level	Action Level
Respirable Particulates (PM_{10})	112.5 $\mu g/m^3$	150 $\mu g/m^3$
Lead	0.11 $\mu g/m^3$	0.15 $\mu g/m^3$
Asbestos	0.001 f/cc or >MDL	0.001 f/cc or >MDL

$\mu g/m^3$- micrograms per cubic meter
f/cc- fibers per cubic centimeter
>MDL- Greater than the laboratory method detection limit. The maximum detection limit for asbestos is based on an approximate 2,300 liter sample volume (the maximum practicable sample volume for an 8-10 hour working period).

3.0 AIR MONITORING STRATEGY

The environmental monitoring required for the site will be conducted using real-time perimeter air monitoring equipment. Data collected through the real-time air monitoring will be supplemented with confirmatory air sampling using US EPA approved sampling and analytical methods. Perimeter air monitoring is intended to be protective of individuals within the vicinity of the removal action. Real-time perimeter air monitoring is designed to provide an immediate means to evaluate appropriate measures of control of short-term exposure levels for asbestos and lead, so that acceptable risks for acute and subchronic exposures are not exceeded. The data provided by real-time perimeter air monitoring may also be used to determine the appropriate control actions. While this data will be useful for such determinations, it may be considered supplementary data to the data required for determining employee time-weighted average exposures as required by specific OSHA regulations.

At the completion of the field work, an air monitoring report will be completed to document the results.

4.0 REAL-TIME AIR MONITORING

The perimeter air monitoring is designed to be protective of individuals within the vicinity of the removal action. Air monitoring stations will be established at selected locations surrounding the planned demolition and removal areas. Refer to Figure 1 for proposed sampling station locations. Spare equipment will be maintained in the event of failure so that downtime of the monitoring network is minimized.

4.1 AIR MONITORING DESIGN

Real-time methods for monitoring particle bound asbestos and lead do not exist, thus particle levels will be used as a surrogate for these compounds. The real-time air monitoring program consists of the monitoring for respirable particulates (PM_{10}). Detection levels are described in the following sections.

4.2 RESPIRABLE PARTICULATE MATTER (PM_{10}) PERIMETER AIR MONITORING

Real-time monitors for airborne lead and asbestos do not exist. Therefore, respirable dust (PM_{10}) will be measured as an indirect measure of ambient levels of these compounds.

4.2.1 PM_{10} MONITORS

Direct-reading, real-time particulate meters (E-BAM) are used to monitor for particulates (or dust). One of the types of monitors selected to continuously measure PM_{10} is the beta-attenuation monitors manufactured by Met One Instruments, Inc. (Met One). The Met One E-BAM will be used for continuous PM_{10} measurements. The instrument operates on the principle of beta attenuation. The beta attenuation process uses a small source of beta particles (carbon-14, 60 microcuries) is coupled to a sensitive detector that counts the emitted beta particles. The dust particles are collected on a filter tape that is placed between the beta source and the detector. Dust on the filter will intercept some of the beta particles. The reduction of beta particles is proportional to the amount of dust on the filter, which allows the mass of dust to be determined from the beta particle counts. The dust mass is combined with the air volume collected during the filter exposure time to determine the PM concentration.

The E-BAM monitors will be equipped with particle size selective inlets. The design of the inlets is such that particles larger than the desired size range will be removed from the air flow, based on the air flow rate. The units will be equipped with an inlet head to separate PM_{10}. Sampling flow rate is critical to maintain the proper particle size cut points of the inlets. Flow rates are maintained at 16.7 liters per minute (LPM) in the E-BAM monitors using an integral flow meter, pressure sensor, and ambient temperature sensor on board each monitor.

The data from the E-BAM units will be recorded by digital data loggers using the analog signal outputs of the monitors. The PM_{10} data from the E-BAM monitors will be recorded as hourly averages.

DataRAMs, such as the Thermo Scientific DataRAM 4, may also be used for PM_{10} monitoring to supplement data from the fixed E-BAM stations. The DataRAM 4 is a high-sensitivity, two-wavelength nephelometric monitor with a light scattering sensing configuration that has been optimized for the measurement of the fine particle fraction of airborne dust, smoke, fumes, and mists in ambient air. The DataRAM 4 provides direct and continuous readout as well as electronic recording of the information gathered.

For this project, all the particulate meters will be configured to measure PM_{10}. All air monitoring units will be operated in accordance with manufacturers' specifications.

4.3 METEOROLOGICAL SYSTEM

On-site meteorological data will be collected to differentiate between upwind and downwind sample locations. The meteorological data will consist of wind speed and direction, temperature, and relative humidity. The meteorological data will be continuously recorded on a central on-site computer via telemetry links and will be used to assign an upwind, downwind, or crosswind designation to each air quality measurement.

4.4 ALARM SYSTEM

If a warning or action level is exceeded based on PM_{10} concentrations, a yellow (warning) or red (action level) visual alarm will be displayed and the field technician and the site supervisor will be alerted.

4.4.1 ALARM RESPONSE ACTIONS

Alarms from the automated system will be sent to various site personnel based on the type of alarm and the time of day. There are two general types of alarms generated by the system; air concentration exceedance alarms, and monitoring station parameter alarms. The air concentration exceedance alarms are based on the comparison of the measured air concentration to the established action levels. Alerts are generated for warning level exceedances (yellow) and action level exceedances (red). The monitoring station parameter alarms are generated based on two criteria; loss of communication to the station, and loss of battery power. During work hours, alarms will be sent to both the air monitoring technician and the removal site manager. The responses will include; investigating the cause of the alarm, notifying the site Task Monitor, or directly remediating the cause of the alarm, if possible. In the event of a warning level exceedance on a monitoring station downwind of the removal action, the air monitoring technician will collect a downwind confirmatory sample for analysis. Work activities will be temporarily halted until measured concentrations are less than the warning level. If the concentrations are less than the warning level, site work will continue. The air monitoring technician will directly respond to monitoring station parameter alarms (loss of power, loss of communication) and take necessary actions to resolve.

5.0 CONFIRMATORY AIR SAMPLING

Confirmatory air sampling will be conducted at the perimeter fence-line, upwind, and downwind locations in order to document ambient levels of target contaminants using US EPA approved sampling and analytical methods. Confirmatory samples will be co-located with a minimum of two real-time monitoring stations (one upwind and one downwind) on each day selected for sampling and in the event of an exceedance of a warning level. Analyses will be by an accredited off-site analytical laboratory demonstrating proficiency for the specific methods stated in this section. The laboratory will provide the analytical data in an eCVP (electronic Comprehensive validation package) data format. The eCVP is equivalent to a Level IV data package. In addition to the form one summary pages, this report also includes raw data, Spectral defense, if applicable, run logs, raw data of QC, including CAL and MDL information, also if applicable. Refer to section 6.0 for the occasion and frequency of sampling. The confirmatory sampling methodologies for the two target analyte classes are as follows.

5.1 LEAD

At a minimum, two lead samples, one upwind and one downwind will be collected during each day selected for sampling. One additional sample will be used as a field blank and will be submitted along with the field samples to the laboratory. The sampling location will be chosen based on actual and predicted wind conditions for the sampling day. Lead samples will be collected using programmable, constant flow (SKC or GilAir type) air sampling pumps with 0.8-micron pore size Mixed Cellulose Ester (MCE) filters enclosed in a 25 millimeter (mm) diameter cassette with a diffuser pad. Samples will be analyzed by NIOSH Method 7300, Inductively Coupled Argon Plasma, Atomic Emission Spectroscopy (ICP-AES). The lead samples will be analyzed by an off-site EPA accredited laboratory.

5.2 ASBESTOS

At a minimum, two asbestos samples, one upwind and one downwind will be collected during each day selected for sampling. One additional sample will be used as a field blank and will be submitted along with the field samples to the laboratory. The sampling locations will be chosen based on actual and predicted wind conditions for the sampling day. Samplers will be co-located with the lead sample locations and PM_{10} monitoring stations and will be collected for a minimum sampling period of at least 4 hours.

Samples will be collected using programmable, constant flow (SKC or GilAir type) high volume air sampling pumps using 0.8-micron pore size Mixed Cellulose Ester (MCE) filters enclosed in a 25

millimeter (mm) diameter cassette with a diffuser pad. Samples will be analyzed by Phase Contrast Microscopy (PCM), NIOSH Method 7400, to quantify airborne fiber concentrations. Sample pumps will be calibrated to flow rates between 2.31 liters per minute (lpm) and 10.25 lpm with the use of an onsite precision rotometer. Samples will be analyzed offsite by an EPA accredited laboratory.

Prior to and at the onset of building demolition activities, and at the discretion of the air monitoring technician, confirmatory asbestos samples will also be collected in accordance with NIOSH 7402, "Asbestos by TEM". For this method, asbestos analysis will be performed utilizing Transmission Electron Microscopy (TEM) analysis as specified in 40 CFR Part 763, Asbestos Hazard Emergency Response Act, (AHERA). Additionally, any positive results indicated by PCM above the warning level will be confirmed following NIOSH 7402. Prior to sample collection, each sampling pump will be calibrated according to the manufacturer's specifications.

6.0 SAMPLING PLAN

As presented in previous sections, sampling for respirable dust (as a surrogate for lead and asbestos) will occur on a real-time basis during site demolition and removal activities. Confirmatory air sampling for lead and asbestos will occur on a less frequent basis as follows:

6.1 BACKGROUND (PRE-REMOVAL) MONITORING

Prior to the initiation of demolition activities, background monitoring will be performed to quantify "background" levels of site-specific contaminants. The anticipated background sampling program involves collecting a minimum of at least two perimeter air samples (one upwind and one downwind location). The samples will be collected between 7:00 AM and 3:00 PM on two separate days preceding the planned removal action activities startup. The samples will be submitted to the laboratory for lead and asbestos analyses via NIOSH Methods 7300 and 7400, respectively. At the discretion of the air sampling technician, and, or in the event any positive results are indicated by PCM, samples may also be analyzed by NIOSH Method 7402.

6.2 ROUTINE MONITORING

During on-going demolition activities, confirmatory air sampling will be performed to quantify airborne levels of lead and asbestos. Following the background period, confirmatory samples will be collected daily from one upwind and two downwind locations at the onset of demolition until results of the analyses confirm no exceedances beyond the site action levels. These initial samples will be submitted daily for an expedited (48 hr.) analysis. Once airborne

concentrations of these compounds are shown to be below the site action limits, a minimum of one set of confirmatory air samples will be collected per week on a rotating day cycle (once per week, Monday on Week 1, Tuesday on Week 2, etc.) from one upwind and at least one downwind location. The schedule allows for samples to be collected on a rotating basis encompassing a different working day each week. The sampling times will be the same as previously described for the background sampling. The weekly samples will be submitted to the laboratory on a weekly basis for lead and asbestos analyses on a standard turnaround time.

6.3 SUPPLEMENTAL WALK-AROUND MONITORING

Supplemental perimeter walk-around monitoring will be performed on an as-needed basis in response to various site conditions such as real-time air monitoring system warnings, alerts, community complaints, or changes in site conditions. The supplemental monitoring will be initiated after consulting with site managers. The supplemental monitoring will consist of the deployment of the portable sampling pumps and sample materials as described in Section 5.

6.4 ALARM CONDITION MONITORING

During on-going site demolition and removal activities, confirmatory air sampling may be performed to quantify airborne levels of asbestos and/or lead if sustained "yellow" level alarm conditions are present. The determination of if alarm condition monitoring is required will be based on an evaluation of site conditions, such as site activities, wind direction, potential off-site impacts, etc. The confirmatory sampling will continue for the duration of the day to document the levels and/or the effectiveness of vapor or dust suppression actions.

6.5 SAMPLE ANALYSES

Asbestos samples will be collected according to NIOSH 7400 with a high volume sampler equipped with a 0.8-micron, 25mm MCE filter to collect ambient air samples. The collected air samples will be analyzed using PCM analysis. Additional asbestos samples will be collected in accordance with NIOSH 7402 and analyzed by TEM in the event that positive results above the warning level are indicated by PCM analysis, or at the discretion of the air sampling technician. Lead samples will be collected and analyzed in accordance with NIOSH Method 7300, ICP-AES.

Confirmatory air sample analysis during start-up phases of the work will be completed on an expedited schedule with the goal to receive data as soon as practicable. Once the adequacy of site controls in minimizing the potential contribution of site-related contaminants to the local environment off-site has been fully demonstrated,

the frequency of sample analyses may be reduced. Additionally, the requested turnaround times for results will likely be extended to the standard two to three weeks of the laboratory's receipt of the sample, depending on the appropriate holding times specified in the analytical methods. In the event of potential releases (e.g., if high levels are detected during real-time monitoring or confirmatory sampling), the sample collection frequency and turnaround time for sample analysis may be adjusted to expedite the assessment of the potential release. Analysis of field blanks will be completed within three weeks of the laboratory's receipt of the samples.

Sample number, collection, holding times, calibration procedures and handling will be performed in accordance with the requirements of the appropriate Method.

6.6 EQUIPMENT CALIBRATION

Equipment calibration will be performed in accordance with the manufacturer's instructions. Field checks using the appropriate reference standards will be made on-site at the minimum frequency of once per shift. The dust monitors will be zero checked once per shift (pre-sampling) and calibration will be performed according to the manufacturer's instructions for each instrument. A daily log of all instrument readings, as well as all field reference checks and calibration information will be maintained.

Additional spare monitoring instrumentation and sampling equipment will be maintained on the site and available for use as needed to minimize air monitoring system downtime. If monitoring or sampling equipment is determined not to be in proper working order, it will be removed from service, replaced with other equipment and sent to the appropriate manufacturer or supplier for service and calibration.

7.0 DATA EVALUATION

Air monitoring results will be generated in graphical form at the end of each monitoring day. These graphs will be reviewed each day and will be used in conjunction with daily field reports to generate summary reports. The summary reports will be prepared weekly and will summarize the previous weeks' data, any exceedances, who was notified of the exceedance, and any response actions taken, if appropriate. At the conclusion of the project, a perimeter air monitoring summary report will be prepared. The report will include all analytical data generated from the real time monitoring system, confirmatory analytical sampling results, meteorological monitoring, and a summary of any exceedances

of action levels, including the response to them. All data will be provided in an Excel spreadsheet and included on a DVD disk at the completion of the project

8.0 APPLICABLE REGULATIONS

According to the asbestos NESHAP (a work practice standard), the removal of all regulated asbestos-containing material (RACM) is required prior to demolition of a facility under most circumstances. Additionally, the asbestos NESHAP specifies emission control procedures [§61.145(c)] and waste disposal requirements [§61.150] that must be followed during demolition of a facility that contains asbestos above the threshold amount. Section §61.150 of the asbestos NESHAP requires owners to "discharge no visible emissions to the outside air" during demolition and renovation activities. However, the asbestos NESHAP Section § 61.145 specifies that if a facility is being demolished because it is structurally unsound and is in danger of imminent collapse, the RACM need not be removed prior to demolition, but must be kept adequately wet during demolition and disposed of properly. Due to the severe structural instability of the buildings onsite where removal activities will take place, it is anticipated that not all RACM will be removed from the site prior to the initiation of demolition activities. Accordingly, it is assumed that all of the contaminated debris will be kept adequately wet during and after demolition and until disposal; that no visible emissions to the outside air will be discharge; and all material known or suspected to contain ACM and will be disposed of as ACM.

9.0 REFERENCES

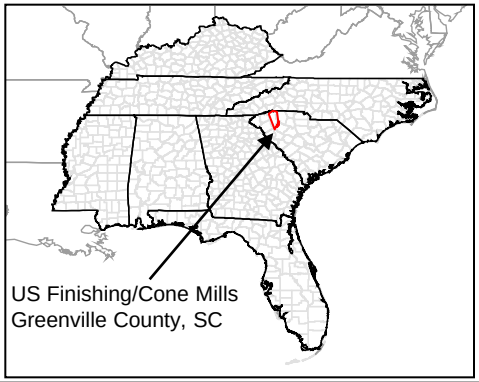
1. Oneida Total Integrated Enterprises (OTIE) Superfund Technical Assessment and Response Team (OTIE-START). Removal Site Inspection and Incident Response Letter Report. US Finishing/Cone Mills. August 22, 2011.

APPENDIX A
FIGURES

Legend

Site

Building Demolition Area



SOURCE: 2010 NAVTEQ
Pictometry Bird's Eye 2010
Pictometry International Corp.
Image Courtesy of USGS
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Disclaimer: This map is intended for visual orientation use only. In no way is this map to be used for precise locational use.

United States Environmental Protection Agency

EPA

FIGURE 1
SITE LOCATION MAP

US FINISHING/ CONE MILLS
GREENVILLE, GREENVILLE COUNTY,
SOUTH CAROLINA
TDD No. TNA-05-001-0144

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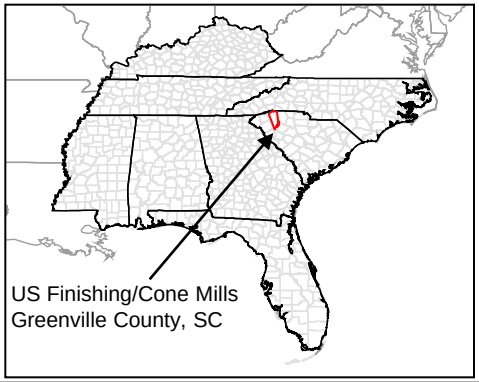
Legend

Removal Site

Air Monitoring Station

Predominant Wind Direction

Building Demolition Area



SOURCE: 2010 NAVTEQ
Pictometry Bird's Eye 2010
Pictometry International Corp.
Image Courtesy of USGS
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United States Environmental Protection Agency

FIGURE 2
AIR MONITORING STATIONS MAP

US FINISHING/ CONE MILLS
GREENVILLE, GREENVILLE COUNTY, SOUTH CAROLINA
TDD No. TNA-05-001-0144

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ATTACHMENT 1

Subpart M—National Emission Standard for Asbestos

top

Authority: 42 U.S.C. 7401, 7412, 7414, 7416, 7601.

Source: 49 FR 13661, Apr. 5, 1984, unless otherwise noted.

§ 61.140 Applicability.

top

The provisions of this subpart are applicable to those sources specified in §§61.142 through 61.151, 61.154, and 61.155.

[55 FR 48414, Nov. 20, 1990]

§ 61.141 Definitions.

top

All terms that are used in this subpart and are not defined below are given the same meaning as in the Act and in subpart A of this part.

Active waste disposal site means any disposal site other than an inactive site.

Adequately wet means sufficiently mix or penetrate with liquid to prevent the release of particulates. If visible emissions are observed coming from asbestos-containing material, then that material has not been adequately wetted. However, the absence of visible emissions is not sufficient evidence of being adequately wet.

Asbestos means the asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite, anthophyllite, and actinolite-tremolite.

Asbestos-containing waste materials means mill tailings or any waste that contains commercial asbestos and is generated by a source subject to the provisions of this subpart. This term includes filters from control devices, friable asbestos waste material, and bags or other similar packaging contaminated with commercial asbestos. As applied to demolition and renovation operations, this term also includes regulated asbestos-containing material waste and materials contaminated with asbestos including disposable equipment and clothing.

Asbestos mill means any facility engaged in converting, or in any intermediate step in converting, asbestos ore into commercial asbestos. Outside storage of asbestos material is not considered a part of the asbestos mill.

Asbestos tailings means any solid waste that contains asbestos and is a product of asbestos mining or milling operations.

Asbestos waste from control devices means any waste material that contains asbestos and is collected by a pollution control device.

Category I nonfriable asbestos-containing material (ACM) means asbestos-containing packings, gaskets, resilient floor covering, and asphalt roofing products containing more than 1 percent asbestos as determined using the method specified in appendix E, subpart E, 40 CFR part 763, section 1, Polarized Light Microscopy.

Category II nonfriable ACM means any material, excluding Category I nonfriable ACM, containing more than 1 percent asbestos as determined using the methods specified in appendix E, subpart E, 40 CFR part 763, section 1, Polarized Light Microscopy that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Commercial asbestos means any material containing asbestos that is extracted from ore and has value because of its asbestos content.

Cutting means to penetrate with a sharp-edged instrument and includes sawing, but does not include shearing, slicing, or punching.

Demolition means the wrecking or taking out of any load-supporting structural member of a facility together with any related handling operations or the intentional burning of any facility.

Emergency renovation operation means a renovation operation that was not planned but results from a sudden, unexpected event that, if not immediately attended to, presents a safety or public health hazard, is necessary to protect equipment from damage, or is necessary to avoid imposing an unreasonable financial burden. This term includes operations necessitated by nonroutine failures of equipment.

Fabricating means any processing (*e.g.,* cutting, sawing, drilling) of a manufactured product that contains commercial asbestos, with the exception of processing at temporary sites (field fabricating) for the construction or restoration of facilities. In the case of friction products, fabricating includes bonding, debonding, grinding, sawing, drilling, or other similar operations performed as part of fabricating.

Facility means any institutional, commercial, public, industrial, or residential structure, installation, or building (including any structure, installation, or building containing condominiums or individual dwelling units operated as a residential cooperative, but excluding residential buildings having four or fewer dwelling units); any ship; and any active or inactive waste disposal site. For purposes of this definition, any building, structure, or installation that contains a loft used as a dwelling is not considered a residential structure, installation, or building. Any structure, installation or building that

was previously subject to this subpart is not excluded, regardless of its current use or function.

Facility component means any part of a facility including equipment.

Friable asbestos material means any material containing more than 1 percent asbestos as determined using the method specified in appendix E, subpart E, 40 CFR part 763, section 1, Polarized Light Microscopy, that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure. If the asbestos content is less than 10 percent as determined by a method other than point counting by polarized light microscopy (PLM), verify the asbestos content by point counting using PLM.

Fugitive source means any source of emissions not controlled by an air pollution control device.

Glove bag means a sealed compartment with attached inner gloves used for the handling of asbestos-containing materials. Properly installed and used, glove bags provide a small work area enclosure typically used for small-scale asbestos stripping operations. Information on glove-bag installation, equipment and supplies, and work practices is contained in the Occupational Safety and Health Administration's (OSHA's) final rule on occupational exposure to asbestos (appendix G to 29 CFR 1926.58).

Grinding means to reduce to powder or small fragments and includes mechanical chipping or drilling.

In poor condition means the binding of the material is losing its integrity as indicated by peeling, cracking, or crumbling of the material.

Inactive waste disposal site means any disposal site or portion of it where additional asbestos-containing waste material has not been deposited within the past year.

Installation means any building or structure or any group of buildings or structures at a single demolition or renovation site that are under the control of the same owner or operator (or owner or operator under common control).

Leak-tight means that solids or liquids cannot escape or spill out. It also means dust-tight.

Malfunction means any sudden and unavoidable failure of air pollution control equipment or process equipment or of a process to operate in a normal or usual manner so that emissions of asbestos are increased. Failures of equipment shall not be considered malfunctions if they are caused in any way by poor maintenance, careless operation, or any other preventable upset conditions, equipment breakdown, or process failure.

Manufacturing means the combining of commercial asbestos—or, in the case of woven friction products, the combining of textiles containing commercial asbestos—with any

other material(s), including commercial asbestos, and the processing of this combination into a product. Chlorine production is considered a part of manufacturing.

Natural barrier means a natural object that effectively precludes or deters access. Natural barriers include physical obstacles such as cliffs, lakes or other large bodies of water, deep and wide ravines, and mountains. Remoteness by itself is not a natural barrier.

Nonfriable asbestos-containing material means any material containing more than 1 percent asbestos as determined using the method specified in appendix E, subpart E, 40 CFR part 763, section 1, Polarized Light Microscopy that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

Nonscheduled renovation operation means a renovation operation necessitated by the routine failure of equipment, which is expected to occur within a given period based on past operating experience, but for which an exact date cannot be predicted.

Outside air means the air outside buildings and structures, including, but not limited to, the air under a bridge or in an open air ferry dock.

Owner or operator of a demolition or renovation activity means any person who owns, leases, operates, controls, or supervises the facility being demolished or renovated or any person who owns, leases, operates, controls, or supervises the demolition or renovation operation, or both.

Particulate asbestos material means finely divided particles of asbestos or material containing asbestos.

Planned renovation operations means a renovation operation, or a number of such operations, in which some RACM will be removed or stripped within a given period of time and that can be predicted. Individual nonscheduled operations are included if a number of such operations can be predicted to occur during a given period of time based on operating experience.

Regulated asbestos-containing material (RACM) means (a) Friable asbestos material, (b) Category I nonfriable ACM that has become friable, (c) Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading, or (d) Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations regulated by this subpart.

Remove means to take out RACM or facility components that contain or are covered with RACM from any facility.

Renovation means altering a facility or one or more facility components in any way, including the stripping or removal of RACM from a facility component. Operations in which load-supporting structural members are wrecked or taken out are demolitions.

Resilient floor covering means asbestos-containing floor tile, including asphalt and vinyl floor tile, and sheet vinyl floor covering containing more than 1 percent asbestos as determined using polarized light microscopy according to the method specified in appendix E, subpart E, 40 CFR part 763, section 1, Polarized Light Microscopy.

Roadways means surfaces on which vehicles travel. This term includes public and private highways, roads, streets, parking areas, and driveways.

Strip means to take off RACM from any part of a facility or facility components.

Structural member means any load-supporting member of a facility, such as beams and load supporting walls; or any nonload-supporting member, such as ceilings and nonload-supporting walls.

Visible emissions means any emissions, which are visually detectable without the aid of instruments, coming from RACM or asbestos-containing waste material, or from any asbestos milling, manufacturing, or fabricating operation. This does not include condensed, uncombined water vapor.

Waste generator means any owner or operator of a source covered by this subpart whose act or process produces asbestos-containing waste material.

Waste shipment record means the shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of asbestos-containing waste material.

Working day means Monday through Friday and includes holidays that fall on any of the days Monday through Friday.

[49 FR 13661, Apr. 5, 1984; 49 FR 25453, June 21, 1984, as amended by 55 FR 48414, Nov. 20, 1990; 56 FR 1669, Jan. 16, 1991; 60 FR 31920, June 19, 1995]

§ 61.142 Standard for asbestos mills.

top

(a) Each owner or operator of an asbestos mill shall either discharge no visible emissions to the outside air from that asbestos mill, including fugitive sources, or use the methods specified by §61.152 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air.

(b) Each owner or operator of an asbestos mill shall meet the following requirements:

(1) Monitor each potential source of asbestos emissions from any part of the mill facility, including air cleaning devices, process equipment, and buildings that house equipment for material processing and handling, at least once each day, during daylight hours, for

visible emissions to the outside air during periods of operation. The monitoring shall be by visual observation of at least 15 seconds duration per source of emissions.

(2) Inspect each air cleaning device at least once each week for proper operation and for changes that signal the potential for malfunction, including, to the maximum extent possible without dismantling other than opening the device, the presence of tears, holes, and abrasions in filter bags and for dust deposits on the clean side of bags. For air cleaning devices that cannot be inspected on a weekly basis according to this paragraph, submit to the Administrator, and revise as necessary, a written maintenance plan to include, at a minimum, the following:

(i) Maintenance schedule.

(ii) Recordkeeping plan.

(3) Maintain records of the results of visible emissions monitoring and air cleaning device inspections using a format similar to that shown in Figures 1 and 2 and include the following:

(i) Date and time of each inspection.

(ii) Presence or absence of visible emissions.

(iii) Condition of fabric filters, including presence of any tears, holes, and abrasions.

(iv) Presence of dust deposits on clean side of fabric filters.

(v) Brief description of corrective actions taken, including date and time.

(vi) Daily hours of operation for each air cleaning device.

(4) Furnish upon request, and make available at the affected facility during normal business hours for inspection by the Administrator, all records required under this section.

(5) Retain a copy of all monitoring and inspection records for at least 2 years.

(6) Submit semiannually a copy of visible emission monitoring records to the Administrator if visible emissions occurred during the report period. Semiannual reports shall be postmarked by the 30th day following the end of the six-month period.

Date of inspection (mo/day/yr)	Time of inspection (a.m./p.m.)	Air cleaning device or fugitive source designation or number	Visible emissions observed (yes/no), corrective action taken	Daily operating hours	Inspector's initials

Figure 1. Record of Visible Emission Monitoring

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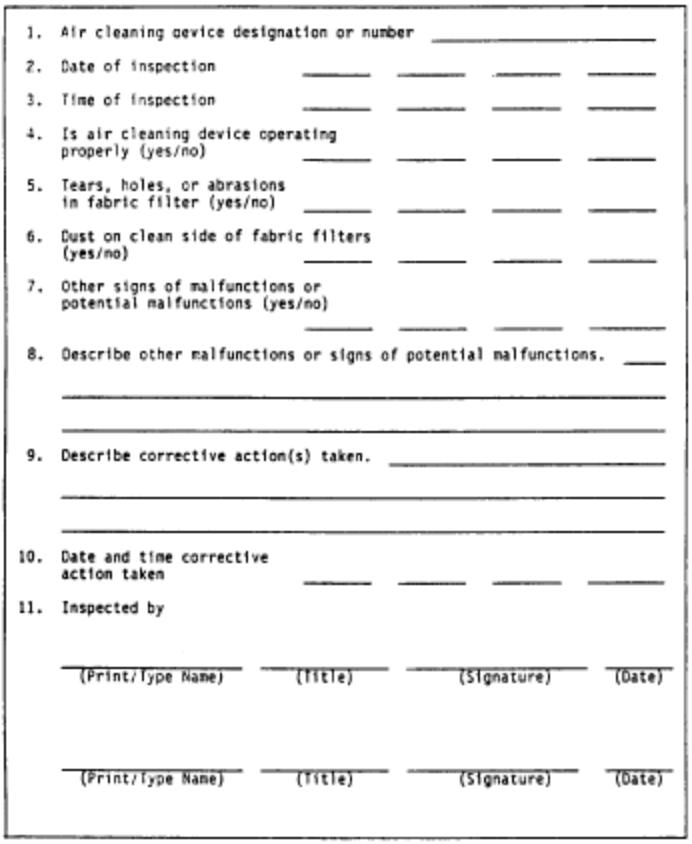

1. Air cleaning device designation or number _____
2. Date of inspection _____ _____ _____ _____
3. Time of inspection _____ _____ _____ _____
4. Is air cleaning device operating properly (yes/no) _____ _____ _____ _____
5. Tears, holes, or abrasions in fabric filter (yes/no) _____ _____ _____ _____
6. Dust on clean side of fabric filters (yes/no) _____ _____ _____ _____
7. Other signs of malfunctions or potential malfunctions (yes/no) _____ _____ _____ _____
8. Describe other malfunctions or signs of potential malfunctions. ____
   _____
   _____
9. Describe corrective action(s) taken. _____
   _____
   _____
10. Date and time corrective action taken _____ _____ _____ _____
11. Inspected by

(Print/Type Name)	(Title)	(Signature)	(Date)
(Print/Type Name)	(Title)	(Signature)	(Date)

Figure 2. Air Cleaning Device Inspection Checklist

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[55 FR 48416, Nov. 20, 1990, as amended at 64 FR 7467, Feb. 12, 1999]

§ 61.143 Standard for roadways.

top

No person may construct or maintain a roadway with asbestos tailings or asbestos-containing waste material on that roadway, unless, for asbestos tailings.

(a) It is a temporary roadway on an area of asbestos ore deposits (asbestos mine): or

(b) It is a temporary roadway at an active asbestos mill site and is encapsulated with a resinous or bituminous binder. The encapsulated road surface must be maintained at a minimum frequency of once per year to prevent dust emissions; or

(c) It is encapsulated in asphalt concrete meeting the specifications contained in section 401 of Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FP–85, 1985, or their equivalent.

[55 FR 48419, Nov. 20, 1990; 56 FR 1669, Jan. 16, 1991]

§ 61.144 Standard for manufacturing.

top

(a) *Applicability.* This section applies to the following manufacturing operations using commercial asbestos.

(1) The manufacture of cloth, cord, wicks, tubing, tape, twine, rope, thread, yarn, roving, lap, or other textile materials.

(2) The manufacture of cement products.

(3) The manufacture of fireproofing and insulating materials.

(4) The manufacture of friction products.

(5) The manufacture of paper, millboard, and felt.

(6) The manufacture of floor tile.

(7) The manufacture of paints, coatings, caulks, adhesives, and sealants.

(8) The manufacture of plastics and rubber materials.

(9) The manufacture of chlorine utilizing asbestos diaphragm technology.

(10) The manufacture of shotgun shell wads.

(11) The manufacture of asphalt concrete.

(b) *Standard.* Each owner or operator of any of the manufacturing operations to which this section applies shall either:

(1) Discharge no visible emissions to the outside air from these operations or from any building or structure in which they are conducted or from any other fugitive sources; or

(2) Use the methods specified by §61.152 to clean emissions from these operations containing particulate asbestos material before they escape to, or are vented to, the outside air.

(3) Monitor each potential source of asbestos emissions from any part of the manufacturing facility, including air cleaning devices, process equipment, and buildings housing material processing and handling equipment, at least once each day during daylight hours for visible emissions to the outside air during periods of operation. The

monitoring shall be by visual observation of at least 15 seconds duration per source of emissions.

(4) Inspect each air cleaning device at least once each week for proper operation and for changes that signal the potential for malfunctions, including, to the maximum extent possible without dismantling other than opening the device, the presence of tears, holes, and abrasions in filter bags and for dust deposits on the clean side of bags. For air cleaning devices that cannot be inspected on a weekly basis according to this paragraph, submit to the Administrator, and revise as necessary, a written maintenance plan to include, at a minimum, the following:

(i) Maintenance schedule.

(ii) Recordkeeping plan.

(5) Maintain records of the results of visible emission monitoring and air cleaning device inspections using a format similar to that shown in Figures 1 and 2 and include the following.

(i) Date and time of each inspection.

(ii) Presence or absence of visible emissions.

(iii) Condition of fabric filters, including presence of any tears, holes and abrasions.

(iv) Presence of dust deposits on clean side of fabric filters.

(v) Brief description of corrective actions taken, including date and time.

(vi) Daily hours of operation for each air cleaning device.

(6) Furnish upon request, and make available at the affected facility during normal business hours for inspection by the Administrator, all records required under this section.

(7) Retain a copy of all monitoring and inspection records for at least 2 years.

(8) Submit semiannually a copy of the visible emission monitoring records to the Administrator if visible emission occurred during the report period. Semiannual reports shall be postmarked by the 30th day following the end of the six-month period.

[49 FR 13661, Apr. 5, 1984, as amended at 55 FR 48419, Nov. 20, 1990; 56 FR 1669, Jan. 16, 1991; 64 FR 7467, Feb. 12, 1999]

§ 61.145 Standard for demolition and renovation.

top

(a) *Applicability.* To determine which requirements of paragraphs (a), (b), and (c) of this section apply to the owner or operator of a demolition or renovation activity and prior to the commencement of the demolition or renovation, thoroughly inspect the affected facility or part of the facility where the demolition or renovation operation will occur for the presence of asbestos, including Category I and Category II nonfriable ACM. The requirements of paragraphs (b) and (c) of this section apply to each owner or operator of a demolition or renovation activity, including the removal of RACM as follows:

(1) In a facility being demolished, all the requirements of paragraphs (b) and (c) of this section apply, except as provided in paragraph (a)(3) of this section, if the combined amount of RACM is

(i) At least 80 linear meters (260 linear feet) on pipes or at least 15 square meters (160 square feet) on other facility components, or

(ii) At least 1 cubic meter (35 cubic feet) off facility components where the length or area could not be measured previously.

(2) In a facility being demolished, only the notification requirements of paragraphs (b)(1), (2), (3)(i) and (iv), and (4)(i) through (vii) and (4)(ix) and (xvi) of this section apply, if the combined amount of RACM is

(i) Less than 80 linear meters (260 linear feet) on pipes and less than 15 square meters (160 square feet) on other facility components, and

(ii) Less than one cubic meter (35 cubic feet) off facility components where the length or area could not be measured previously or there is no asbestos.

(3) If the facility is being demolished under an order of a State or local government agency, issued because the facility is structurally unsound and in danger of imminent collapse, only the requirements of paragraphs (b)(1), (b)(2), (b)(3)(iii), (b)(4) (except (b)(4)(viii)), (b)(5), and (c)(4) through (c)(9) of this section apply.

(4) In a facility being renovated, including any individual nonscheduled renovation operation, all the requirements of paragraphs (b) and (c) of this section apply if the combined amount of RACM to be stripped, removed, dislodged, cut, drilled, or similarly disturbed is

(i) At least 80 linear meters (260 linear feet) on pipes or at least 15 square meters (160 square feet) on other facility components, or

(ii) At least 1 cubic meter (35 cubic feet) off facility components where the length or area could not be measured previously.

(iii) To determine whether paragraph (a)(4) of this section applies to planned renovation operations involving individual nonscheduled operations, predict the combined additive amount of RACM to be removed or stripped during a calendar year of January 1 through December 31.

(iv) To determine whether paragraph (a)(4) of this section applies to emergency renovation operations, estimate the combined amount of RACM to be removed or stripped as a result of the sudden, unexpected event that necessitated the renovation.

(5) Owners or operators of demolition and renovation operations are exempt from the requirements of §§61.05(a), 61.07, and 61.09.

(b) *Notification requirements.* Each owner or operator of a demolition or renovation activity to which this section applies shall:

(1) Provide the Administrator with written notice of intention to demolish or renovate. Delivery of the notice by U.S. Postal Service, commercial delivery service, or hand delivery is acceptable.

(2) Update notice, as necessary, including when the amount of asbestos affected changes by at least 20 percent.

(3) Postmark or deliver the notice as follows:

(i) At least 10 working days before asbestos stripping or removal work or any other activity begins (such as site preparation that would break up, dislodge or similarly disturb asbestos material), if the operation is described in paragraphs (a) (1) and (4) (except (a)(4)(iii) and (a)(4)(iv)) of this section. If the operation is as described in paragraph (a)(2) of this section, notification is required 10 working days before demolition begins.

(ii) At least 10 working days before the end of the calendar year preceding the year for which notice is being given for renovations described in paragraph (a)(4)(iii) of this section.

(iii) As early as possible before, but not later than, the following working day if the operation is a demolition ordered according to paragraph (a)(3) of this section or, if the operation is a renovation described in paragraph (a)(4)(iv) of this section.

(iv) For asbestos stripping or removal work in a demolition or renovation operation, described in paragraphs (a) (1) and (4) (except (a)(4)(iii) and (a)(4)(iv)) of this section, and for a demolition described in paragraph (a)(2) of this section, that will begin on a date other than the one contained in the original notice, notice of the new start date must be provided to the Administrator as follows:

(A) When the asbestos stripping or removal operation or demolition operation covered by this paragraph will begin after the date contained in the notice,

(*1*) Notify the Administrator of the new start date by telephone as soon as possible before the original start date, and

(*2*) Provide the Administrator with a written notice of the new start date as soon as possible before, and no later than, the original start date. Delivery of the updated notice by the U.S. Postal Service, commercial delivery service, or hand delivery is acceptable.

(B) When the asbestos stripping or removal operation or demolition operation covered by this paragraph will begin on a date earlier than the original start date,

(*1*) Provide the Administrator with a written notice of the new start date at least 10 working days before asbestos stripping or removal work begins.

(*2*) For demolitions covered by paragraph (a)(2) of this section, provide the Administrator written notice of a new start date at least 10 working days before commencement of demolition. Delivery of updated notice by U.S. Postal Service, commercial delivery service, or hand delivery is acceptable.

(C) In no event shall an operation covered by this paragraph begin on a date other than the date contained in the written notice of the new start date.

(4) Include the following in the notice:

(i) An indication of whether the notice is the original or a revised notification.

(ii) Name, address, and telephone number of both the facility owner and operator and the asbestos removal contractor owner or operator.

(iii) Type of operation: demolition or renovation.

(iv) Description of the facility or affected part of the facility including the size (square meters [square feet] and number of floors), age, and present and prior use of the facility.

(v) Procedure, including analytical methods, employed to detect the presence of RACM and Category I and Category II nonfriable ACM.

(vi) Estimate of the approximate amount of RACM to be removed from the facility in terms of length of pipe in linear meters (linear feet), surface area in square meters (square feet) on other facility components, or volume in cubic meters (cubic feet) if off the facility components. Also, estimate the approximate amount of Category I and Category II nonfriable ACM in the affected part of the facility that will not be removed before demolition.

(vii) Location and street address (including building number or name and floor or room number, if appropriate), city, county, and state, of the facility being demolished or renovated.

(viii) Scheduled starting and completion dates of asbestos removal work (or any other activity, such as site preparation that would break up, dislodge, or similarly disturb asbestos material) in a demolition or renovation; planned renovation operations involving individual nonscheduled operations shall only include the beginning and ending dates of the report period as described in paragraph (a)(4)(iii) of this section.

(ix) Scheduled starting and completion dates of demolition or renovation.

(x) Description of planned demolition or renovation work to be performed and method(s) to be employed, including demolition or renovation techniques to be used and description of affected facility components.

(xi) Description of work practices and engineering controls to be used to comply with the requirements of this subpart, including asbestos removal and waste-handling emission control procedures.

(xii) Name and location of the waste disposal site where the asbestos-containing waste material will be deposited.

(xiii) A certification that at least one person trained as required by paragraph (c)(8) of this section will supervise the stripping and removal described by this notification. This requirement shall become effective 1 year after promulgation of this regulation.

(xiv) For facilities described in paragraph (a)(3) of this section, the name, title, and authority of the State or local government representative who has ordered the demolition, the date that the order was issued, and the date on which the demolition was ordered to begin. A copy of the order shall be attached to the notification.

(xv) For emergency renovations described in paragraph (a)(4)(iv) of this section, the date and hour that the emergency occurred, a description of the sudden, unexpected event, and an explanation of how the event caused an unsafe condition, or would cause equipment damage or an unreasonable financial burden.

(xvi) Description of procedures to be followed in the event that unexpected RACM is found or Category II nonfriable ACM becomes crumbled, pulverized, or reduced to powder.

(xvii) Name, address, and telephone number of the waste transporter.

(5) The information required in paragraph (b)(4) of this section must be reported using a form similiar to that shown in Figure 3.

(c) *Procedures for asbestos emission control.* Each owner or operator of a demolition or renovation activity to whom this paragraph applies, according to paragraph (a) of this section, shall comply with the following procedures:

(1) Remove all RACM from a facility being demolished or renovated before any activity begins that would break up, dislodge, or similarly disturb the material or preclude access to the material for subsequent removal. RACM need not be removed before demolition if:

(i) It is Category I nonfriable ACM that is not in poor condition and is not friable.

(ii) It is on a facility component that is encased in concrete or other similarly hard material and is adequately wet whenever exposed during demolition; or

(iii) It was not accessible for testing and was, therefore, not discovered until after demolition began and, as a result of the demolition, the material cannot be safely removed. If not removed for safety reasons, the exposed RACM and any asbestos-contaminated debris must be treated as asbestos-containing waste material and adequately wet at all times until disposed of.

(iv) They are Category II nonfriable ACM and the probability is low that the materials will become crumbled, pulverized, or reduced to powder during demolition.

(2) When a facility component that contains, is covered with, or is coated with RACM is being taken out of the facility as a unit or in sections:

(i) Adequately wet all RACM exposed during cutting or disjoining operations; and

(ii) Carefully lower each unit or section to the floor and to ground level, not dropping, throwing, sliding, or otherwise damaging or disturbing the RACM.

(3) When RACM is stripped from a facility component while it remains in place in the facility, adequately wet the RACM during the stripping operation.

(i) In renovation operations, wetting is not required if:

(A) The owner or operator has obtained prior written approval from the Administrator based on a written application that wetting to comply with this paragraph would unavoidably damage equipment or present a safety hazard; and

(B) The owner or operator uses of the following emission control methods:

(*1*) A local exhaust ventilation and collection system designed and operated to capture the particulate asbestos material produced by the stripping and removal of the asbestos materials. The system must exhibit no visible emissions to the outside air or be designed and operated in accordance with the requirements in §61.152.

(*2*) A glove-bag system designed and operated to contain the particulate asbestos material produced by the stripping of the asbestos materials.

(*3*) Leak-tight wrapping to contain all RACM prior to dismantlement.

(ii) In renovation operations where wetting would result in equipment damage or a safety hazard, and the methods allowed in paragraph (c)(3)(i) of this section cannot be used, another method may be used after obtaining written approval from the Administrator based upon a determination that it is equivalent to wetting in controlling emissions or to the methods allowed in paragraph (c)(3)(i) of this section.

(iii) A copy of the Administrator's written approval shall be kept at the worksite and made available for inspection.

(4) After a facility component covered with, coated with, or containing RACM has been taken out of the facility as a unit or in sections pursuant to paragraph (c)(2) of this section, it shall be stripped or contained in leak-tight wrapping, except as described in paragraph (c)(5) of this section. If stripped, either:

(i) Adequately wet the RACM during stripping; or

(ii) Use a local exhaust ventilation and collection system designed and operated to capture the particulate asbestos material produced by the stripping. The system must exhibit no visible emissions to the outside air or be designed and operated in accordance with the requirements in §61.152.

(5) For large facility components such as reactor vessels, large tanks, and steam generators, but not beams (which must be handled in accordance with paragraphs (c)(2), (3), and (4) of this section), the RACM is not required to be stripped if the following requirements are met:

(i) The component is removed, transported, stored, disposed of, or reused without disturbing or damaging the RACM.

(ii) The component is encased in a leak-tight wrapping.

(iii) The leak-tight wrapping is labeled according to §61.149(d)(1)(i), (ii), and (iii) during all loading and unloading operations and during storage.

(6) For all RACM, including material that has been removed or stripped:

(i) Adequately wet the material and ensure that it remains wet until collected and contained or treated in preparation for disposal in accordance with §61.150; and

(ii) Carefully lower the material to the ground and floor, not dropping, throwing, sliding, or otherwise damaging or disturbing the material.

(iii) Transport the material to the ground via leak-tight chutes or containers if it has been removed or stripped more than 50 feet above ground level and was not removed as units or in sections.

(iv) RACM contained in leak-tight wrapping that has been removed in accordance with paragraphs (c)(4) and (c)(3)(i)(B)(*3*) of this section need not be wetted.

(7) When the temperature at the point of wetting is below 0 °C (32 °F):

(i) The owner or operator need not comply with paragraph (c)(2)(i) and the wetting provisions of paragraph (c)(3) of this section.

(ii) The owner or operator shall remove facility components containing, coated with, or covered with RACM as units or in sections to the maximum extent possible.

(iii) During periods when wetting operations are suspended due to freezing temperatures, the owner or operator must record the temperature in the area containing the facility components at the beginning, middle, and end of each workday and keep daily temperature records available for inspection by the Administrator during normal business hours at the demolition or renovation site. The owner or operator shall retain the temperature records for at least 2 years.

(8) Effective 1 year after promulgation of this regulation, no RACM shall be stripped, removed, or otherwise handled or disturbed at a facility regulated by this section unless at least one on-site representative, such as a foreman or management-level person or other authorized representative, trained in the provisions of this regulation and the means of complying with them, is present. Every 2 years, the trained on-site individual shall receive refresher training in the provisions of this regulation. The required training shall include as a minimum: applicability; notifications; material identification; control procedures for removals including, at least, wetting, local exhaust ventilation, negative pressure enclosures, glove-bag procedures, and High Efficiency Particulate Air (HEPA) filters; waste disposal work practices; reporting and recordkeeping; and asbestos hazards and worker protection. Evidence that the required training has been completed shall be posted and made available for inspection by the Administrator at the demolition or renovation site.

(9) For facilities described in paragraph (a)(3) of this section, adequately wet the portion of the facility that contains RACM during the wrecking operation.

(10) If a facility is demolished by intentional burning, all RACM including Category I and Category II nonfriable ACM must be removed in accordance with the NESHAP before burning.

NOTIFICATION OF DEMOLITION AND RENOVATION

Operator Project #	Postmark	Date Received	Notification #

I. TYPE OF NOTIFICATION (O=Original R=Revised C=Cancelled):

II. FACILITY INFORMATION (Identify owner, removal contractor, and other operator)

OWNER NAME:

Address:

City: | State: | Zip:

Contact: | Tel:

REMOVAL CONTRACTOR:

Address:

City: | State: | Zip:

Contact: | Tel:

OTHER OPERATOR:

Address:

City: | State: | Zip:

Contact: | Tel:

III. TYPE OF OPERATION (D=Demo O=Ordered Demo R=Renovation E=Emer.Renovation):

IV. IS ASBESTOS PRESENT? (Yes/No):

V. FACILITY DESCRIPTION (Include building name, number and floor or room number)

Bldg Name:

Address:

City: | State: | County:

Site Location:

Building Size: | # of Floors: | Age in Years:

Present Use: | Prior Use:

VI. PROCEDURE, INCLUDING ANALYTICAL METHOD, IF APPROPRIATE, USED TO DETECT THE PRESENCE OF ASBESTOS MATERIAL:

VII. APPROXIMATE AMOUNT OF ASBESTOS, INCLUDING: 1. Regulated ACM to be removed 2. Category I ACM Not Removed 3. Category II ACM Not Removed	RACM To Be Removed	Friable Asbestos Material Not To Be Removed		Indicate Unit of Measurement Below	
		Cat I	Cat II	UNIT	
Pipes				Lnft:	Ln m:
Surface Area				SqFt:	Sq m:
Vol RACM Off Facility Component				Cuft:	Cu m:

VIII. SCHEDULED DATES ASBESTOS REMOVAL (MM/DD/YY) Start: Complete:

IX. SCHEDULED DATES DEMO/RENOVATION (MM/DD/YY) Start: Complete:

Continued on page two

Figure 3. Notification of Demolition and Renovation

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NOTIFICATION OF DEMOLITION AND RENOVATION (continued)

X. DESCRIPTION OF PLANNED DEMOLITION OR RENOVATION WORK, AND METHOD(S) TO BE USED:

XI. DESCRIPTION OF WORK PRACTICES AND ENGINEERING CONTROLS TO BE USED TO PREVENT EMISSIONS OF ASBESTOS AT THE DEMOLITION AND RENOVATION SITE:

XII. WASTE TRANSPORTER #1

Name:

Address

City: | State: | Zip:

Contact Person: | Telephone:

WASTE TRANSPORTER #2

Name:

Address:

City: | State: | Zip:

Contact Person: | Telephone:

XIII. WASTE DISPOSAL SITE

Name:

Location:

City: | State: | Zip:

Telephone:

XIV. IF DEMOLITION ORDERED BY A GOVERNMENT AGENCY, PLEASE IDENTIFY THE AGENCY BELOW:

Name: | Title:

Authority:

Date of Order (MM/DD/YY): | Date Ordered to Begin (MM/DD/YY):

XV. FOR EMERGENCY RENOVATIONS

Date and Hour of Emergency (MM/DD/YY):

Description of the sudden, unexpected event:

Explanation of how the event caused unsafe conditions or would cause equipment damage or an unreasonable financial burden:

XVI. DESCRIPTION OF PROCEDURES TO BE FOLLOWED IN THE EVENT THAT UNEXPECTED ASBESTOS IS FOUND OR PREVIOUSLY NONFRIABLE ASBESTOS MATERIAL BECOMES CRUMBLED, PULVERIZED, OR REDUCED TO POWDER.

XVI. I CERTIFY THAT AN INDIVIDUAL TRAINED IN THE PROVISIONS OF THIS REGULATION (40 CFR PART 61, SUBPART M) WILL BE ON-SITE DURING THE DEMOLITION OR RENOVATION AND EVIDENCE THAT THE REQUIRED TRAINING HAS BEEN ACCOMPLISHED BY THIS PERSON WILL BE AVAILABLE FOR INSPECTION DURING NORMAL BUSINESS HOURS. (Required 1 year after promulgation)

(Signature of Owner/Operator) (Date)

XVII. I CERTIFY THAT THE ABOVE INFORMATION IS CORRECT.

(Signature of Owner/Operator) (Date)

Figure 3. Notification of Demolition and Renovation

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[55 FR 48419, Nov. 20, 1990; 56 FR 1669, Jan. 16, 1991]

§ 61.146 Standard for spraying.

top

The owner or operator of an operation in which asbestos-containing materials are spray applied shall comply with the following requirements:

(a) For spray-on application on buildings, structures, pipes, and conduits, do not use material containing more than 1 percent asbestos as determined using the method specified in appendix E, subpart E, 40 CFR part 763, section 1, Polarized Light Microscopy, except as provided in paragraph (c) of this section.

(b) For spray-on application of materials that contain more than 1 percent asbestos as determined using the method specified in appendix E, subpart E, 40 CFR part 763, section 1, Polarized Light Microscopy, on equipment and machinery, except as provided in paragraph (c) of this section:

(1) Notify the Administrator at least 20 days before beginning the spraying operation. Include the following information in the notice:

(i) Name and address of owner or operator.

(ii) Location of spraying operation.

(iii) Procedures to be followed to meet the requirements of this paragraph.

(2) Discharge no visible emissions to the outside air from spray-on application of the asbestos-containing material or use the methods specified by §61.152 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air.

(c) The requirements of paragraphs (a) and (b) of this section do not apply to the spray-on application of materials where the asbestos fibers in the materials are encapsulated with a bituminous or resinous binder during spraying and the materials are not friable after drying.

(d) Owners or operators of sources subject to this paragraph are exempt from the requirements of §§61.05(a), 61.07 and 61.09.

[49 FR 13661, Apr. 5, 1984. Redesignated and amended at 55 FR 48424, Nov. 20, 1990; 60 FR 31920, June 19, 1995]

§ 61.147 Standard for fabricating.

top

(a) *Applicability.* This section applies to the following fabricating operations using commercial asbestos:

(1) The fabrication of cement building products.

(2) The fabrication of friction products, except those operations that primarily install asbestos friction materials on motor vehicles.

(3) The fabrication of cement or silicate board for ventilation hoods; ovens; electrical panels; laboratory furniture, bulkheads, partitions, and ceilings for marine construction; and flow control devices for the molten metal industry.

(b) *Standard.* Each owner or operator of any of the fabricating operations to which this section applies shall either:

(1) Discharge no visible emissions to the outside air from any of the operations or from any building or structure in which they are conducted or from any other fugitive sources; or

(2) Use the methods specified by §61.152 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air.

(3) Monitor each potential source of asbestos emissions from any part of the fabricating facility, including air cleaning devices, process equipment, and buildings that house equipment for material processing and handling, at least once each day, during daylight hours, for visible emissions to the outside air during periods of operation. The monitoring shall be by visual observation of at least 15 seconds duration per source of emissions.

(4) Inspect each air cleaning device at least once each week for proper operation and for changes that signal the potential for malfunctions, including, to the maximum extent possible without dismantling other than opening the device, the presence of tears, holes, and abrasions in filter bags and for dust deposits on the clean side of bags. For air cleaning devices that cannot be inspected on a weekly basis according to this paragraph, submit to the Administrator, and revise as necessary, a written maintenance plan to include, at a minimum, the following:

(i) Maintenance schedule.

(ii) Recordkeeping plan.

(5) Maintain records of the results of visible emission monitoring and air cleaning device inspections using a format similar to that shown in Figures 1 and 2 and include the following:

(i) Date and time of each inspection.

(ii) Presence or absence of visible emissions.

(iii) Condition of fabric filters, including presence of any tears, holes, and abrasions.

(iv) Presence of dust deposits on clean side of fabric filters.

(v) Brief description of corrective actions taken, including date and time.

(vi) Daily hours of operation for each air cleaning device.

(6) Furnish upon request and make available at the affected facility during normal business hours for inspection by the Administrator, all records required under this section.

(7) Retain a copy of all monitoring and inspection records for at least 2 years.

(8) Submit semiannually a copy of the visible emission monitoring records to the Administrator if visible emission occurred during the report period. Semiannual reports shall be postmarked by the 30th day following the end of the six-month period.

[49 FR 13661, Apr. 5, 1984. Redesignated and amended at 55 FR 48424, Nov. 20, 1991; 64 FR 7467, Feb. 12, 1999]

§ 61.148 Standard for insulating materials.

top

No owner or operator of a facility may install or reinstall on a facility component any insulating materials that contain commercial asbestos if the materials are either molded and friable or wet-applied and friable after drying. The provisions of this section do not apply to spray-applied insulating materials regulated under §61.146.

[55 FR 48424, Nov. 20, 1990]

§ 61.149 Standard for waste disposal for asbestos mills.

top

Each owner or operator of any source covered under the provisions of §61.142 shall:

(a) Deposit all asbestos-containing waste material at a waste disposal site operated in accordance with the provisions of §61.154; and

(b) Discharge no visible emissions to the outside air from the transfer of control device asbestos waste to the tailings conveyor, or use the methods specified by §61.152 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air. Dispose of the asbestos waste from control devices in accordance with §61.150(a) or paragraph (c) of this section; and

(c) Discharge no visible emissions to the outside air during the collection, processing, packaging, or on-site transporting of any asbestos-containing waste material, or use one of the disposal methods specified in paragraphs (c) (1) or (2) of this section, as follows:

(1) Use a wetting agent as follows:

(i) Adequately mix all asbestos-containing waste material with a wetting agent recommended by the manufacturer of the agent to effectively wet dust and tailings, before depositing the material at a waste disposal site. Use the agent as recommended for the particular dust by the manufacturer of the agent.

(ii) Discharge no visible emissions to the outside air from the wetting operation or use the methods specified by §61.152 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air.

(iii) Wetting may be suspended when the ambient temperature at the waste disposal site is less than −9.5 °C (15 °F), as determined by an appropriate measurement method with an accuracy of ±1 °C (±2 °F). During periods when wetting operations are suspended, the temperature must be recorded at least at hourly intervals, and records must be retained for at least 2 years in a form suitable for inspection.

(2) Use an alternative emission control and waste treatment method that has received prior written approval by the Administrator. To obtain approval for an alternative method, a written application must be submitted to the Administrator demonstrating that the following criteria are met:

(i) The alternative method will control asbestos emissions equivalent to currently required methods.

(ii) The suitability of the alternative method for the intended application.

(iii) The alternative method will not violate other regulations.

(iv) The alternative method will not result in increased water pollution, land pollution, or occupational hazards.

(d) When waste is transported by vehicle to a disposal site:

(1) Mark vehicles used to transport asbestos-containing waste material during the loading and unloading of the waste so that the signs are visible. The markings must:

(i) Be displayed in such a manner and location that a person can easily read the legend.

(ii) Conform to the requirements for 51 cm × 36 cm (20 in × 14 in) upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and

(iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

Legend

DANGER

ASBESTOS DUST HAZARD

CANCER AND LUNG DISEASE HAZARD

Authorized Personnel Only

Notation

2.5 cm (1 inch) Sans Serif, Gothic or Block

2.5 cm (1 inch) Sans Serif, Gothic or Block

1.9 cm (3/4inch) Sans Serif, Gothic or Block

14 Point Gothic

Spacing between any two lines must be a least equal to the height of the upper of the two lines.

(2) For off-site disposal, provide a copy of the waste shipment record, described in paragraph (e)(1) of this section, to the disposal site owner or operator at the same time as the asbestos-containing waste material is delivered to the disposal site.

(e) For all asbestos-containing waste material transported off the facility site:

(1) Maintain asbestos waste shipment records, using a form similar to that shown in Figure 4, and include the following information:

(i) The name, address, and telephone number of the waste generator.

(ii) The name and address of the local, State, or EPA Regional agency responsible for administering the asbestos NESHAP program.

(iii) The quantity of the asbestos-containing waste material in cubic meters (cubic yards).

(iv) The name and telephone number of the disposal site operator.

(v) The name and physical site location of the disposal site.

(vi) The date transported.

(vii) The name, address, and telephone number of the transporter(s).

(viii) A certification that the contents of this consignment are fully and accurately described by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.

(2) For waste shipments where a copy of the waste shipment record, signed by the owner or operator of the designated disposal site, is not received by the waste generator within

35 days of the date the waste was accepted by the initial transporter, contact the transporter and/or the owner or operator of the designated disposal site to determine the status of the waste shipment.

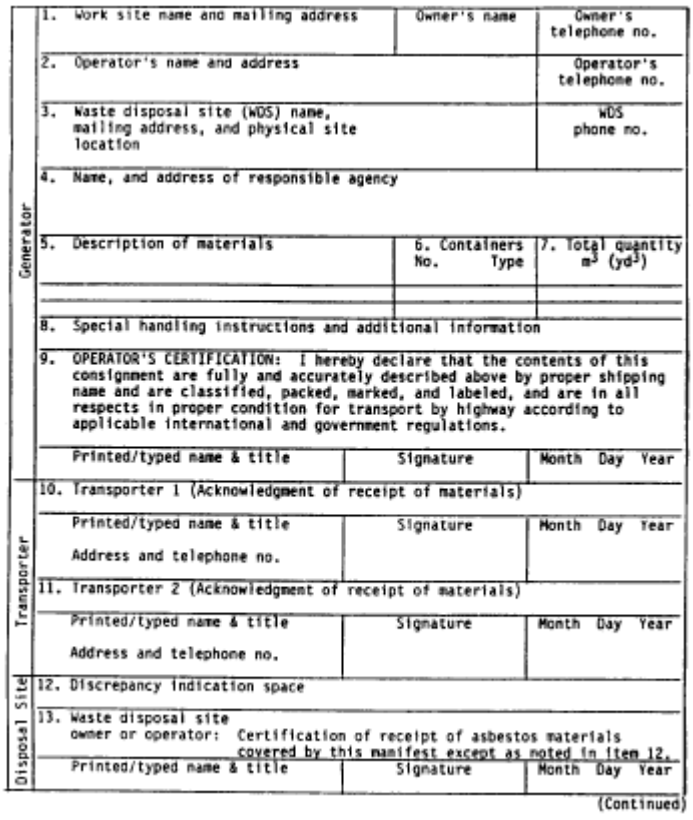
(3) Report in writing to the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program for the waste generator if a copy of the waste shipment record, signed by the owner or operator of the designated waste disposal site, is not received by the waste generator within 45 days of the date the waste was accepted by the initial transporter. Include in the report the following information:

(i) A copy of the waste shipment record for which a confirmation of delivery was not received, and

(ii) A cover letter signed by the waste generator explaining the efforts taken to locate the asbestos waste shipment and the results of those efforts.

(4) Retain a copy of all waste shipment records, including a copy of the waste shipment record signed by the owner or operator of the designated waste disposal site, for at least 2 years.

(f) Furnish upon request, and make available for inspection by the Administrator, all records required under this section.



Generator	1. Work site name and mailing address	Owner's name	Owner's telephone no.
	2. Operator's name and address		Operator's telephone no.
	3. Waste disposal site (WDS) name, mailing address, and physical site location		WDS phone no.
	4. Name, and address of responsible agency		
	5. Description of materials	6. Containers No. Type	7. Total quantity m^3 (yd^3)
	8. Special handling instructions and additional information		
	9. OPERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.		
	Printed/typed name & title	Signature	Month Day Year
Transporter	10. Transporter 1 (Acknowledgment of receipt of materials)		
	Printed/typed name & title Address and telephone no.	Signature	Month Day Year
	11. Transporter 2 (Acknowledgment of receipt of materials)		
	Printed/typed name & title Address and telephone no.	Signature	Month Day Year
Disposal Site	12. Discrepancy indication space		
	13. Waste disposal site owner or operator: Certification of receipt of asbestos materials covered by this manifest except as noted in item 12.		
	Printed/typed name & title	Signature	Month Day Year

(Continued)

Figure 4. Waste Shipment Record

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INSTRUCTIONS

Waste Generator Section (Items 1-9)

1. Enter the name of the facility at which asbestos waste is generated and the address where the facility is located. In the appropriate spaces, also enter the name of the owner of the facility and the owner's phone number.

2. If a demolition or renovation, enter the name and address of the company and authorized agent responsible for performing the asbestos removal. In the appropriate spaces, also enter the phone number of the operator.

3. Enter the name, address, and physical site location of the waste disposal site (WDS) that will be receiving the asbestos materials. In the appropriate spaces, also enter the phone number of the WDS. Enter "on-site" if the waste will be disposed of on the generator's property.

4. Provide the name and address of the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program.

5. Indicate the types of asbestos waste materials generated. If from a demolition or renovation, indicate the amount of asbestos that is

   - Friable asbestos material
   - Nonfriable asbestos material

6. Enter the number of containers used to transport the asbestos materials listed in Item 5. Also enter one of the following container codes used in transporting each type of asbestos material (specify any other type of container used if not listed below):

   DM - Metal drums, barrels
   DP - Plastic drums, barrels
   BA - 6 mil plastic bags or wrapping

7. Enter the quantities of each type of asbestos material removed in units of cubic meters (cubic yards).

8. Use this space to indicate special transportation, treatment, storage or disposal or Bill of Lading information. If an alternate waste disposal site is designated, note it here. Emergency response telephone numbers or similar information may be included here.

9. The authorized agent of the waste generator must read and then sign and date this certification. The date is the date of receipt by transporter.

NOTE: The waste generator must retain a copy of this form.

(continued)

Figure 4. Waste Shipment Record

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Transporter Section (Items 10 & 11)

10. & 11. Enter name, address, and telephone number of each transporter used, if applicable. Print or type the full name and title of person accepting responsibility and acknowledging receipt of materials as listed on this waste shipment record for transport. Enter date of receipt and signature.

NOTE: The transporter must retain a copy of this form.

Disposal Site Section (Items 12 & 13)

12. The authorized representative of the WDS must note in this space any discrepancy between waste described on this manifest and waste actually received as well as any improperly enclosed or contained waste. Any rejected materials should be listed and destination of those materials provided. A site that converts asbestos-containing waste material to nonasbestos material is considered a WDS.

13. The signature (by hand) of the authorized WDS agent indicates acceptance and agreement with statements on this manifest except as noted in item 12. The date is the date of signature and receipt of shipment.

NOTE: The WDS must retain a completed copy of this form. The WDS must also send a completed copy to the operator listed in item 2.

Figure 4. Waste Shipment Record

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§ 61.150 Standard for waste disposal for manufacturing, fabricating, demolition, renovation, and spraying operations.

top

Each owner or operator of any source covered under the provisions of §§61.144, 61.145, 61.146, and 61.147 shall comply with the following provisions:

(a) Discharge no visible emissions to the outside air during the collection, processing (including incineration), packaging, or transporting of any asbestos-containing waste material generated by the source, or use one of the emission control and waste treatment methods specified in paragraphs (a) (1) through (4) of this section.

(1) Adequately wet asbestos-containing waste material as follows:

(i) Mix control device asbestos waste to form a slurry; adequately wet other asbestos-containing waste material; and

(ii) Discharge no visible emissions to the outside air from collection, mixing, wetting, and handling operations, or use the methods specified by §61.152 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air; and

(iii) After wetting, seal all asbestos-containing waste material in leak-tight containers while wet; or, for materials that will not fit into containers without additional breaking, put materials into leak-tight wrapping; and

(iv) Label the containers or wrapped materials specified in paragraph (a)(1)(iii) of this section using warning labels specified by Occupational Safety and Health Standards of the Department of Labor, Occupational Safety and Health Administration (OSHA) under 29 CFR 1910.1001(j)(4) or 1926.1101(k)(8). The labels shall be printed in letters of sufficient size and contrast so as to be readily visible and legible.

(v) For asbestos-containing waste material to be transported off the facility site, label containers or wrapped materials with the name of the waste generator and the location at which the waste was generated.

(2) Process asbestos-containing waste material into nonfriable forms as follows:

(i) Form all asbestos-containing waste material into nonfriable pellets or other shapes;

(ii) Discharge no visible emissions to the outside air from collection and processing operations, including incineration, or use the method specified by §61.152 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air.

(3) For facilities demolished where the RACM is not removed prior to demolition according to §§61.145(c)(1) (i), (ii), (iii), and (iv) or for facilities demolished according to §61.145(c)(9), adequately wet asbestos-containing waste material at all times after demolition and keep wet during handling and loading for transport to a disposal site. Asbestos-containing waste materials covered by this paragraph do not have to be sealed in leak-tight containers or wrapping but may be transported and disposed of in bulk.

(4) Use an alternative emission control and waste treatment method that has received prior approval by the Administrator according to the procedure described in §61.149(c)(2).

(5) As applied to demolition and renovation, the requirements of paragraph (a) of this section do not apply to Category I nonfriable ACM waste and Category II nonfriable ACM waste that did not become crumbled, pulverized, or reduced to powder.

(b) All asbestos-containing waste material shall be deposited as soon as is practical by the waste generator at:

(1) A waste disposal site operated in accordance with the provisions of §61.154, or

(2) An EPA-approved site that converts RACM and asbestos-containing waste material into nonasbestos (asbestos-free) material according to the provisions of §61.155.

(3) The requirements of paragraph (b) of this section do not apply to Category I nonfriable ACM that is not RACM.

(c) Mark vehicles used to transport asbestos-containing waste material during the loading and unloading of waste so that the signs are visible. The markings must conform to the requirements of §§61.149(d)(1) (i), (ii), and (iii).

(d) For all asbestos-containing waste material transported off the facility site:

(1) Maintain waste shipment records, using a form similar to that shown in Figure 4, and include the following information:

(i) The name, address, and telephone number of the waste generator.

(ii) The name and address of the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program.

(iii) The approximate quantity in cubic meters (cubic yards).

(iv) The name and telephone number of the disposal site operator.

(v) The name and physical site location of the disposal site.

(vi) The date transported.

(vii) The name, address, and telephone number of the transporter(s).

(viii) A certification that the contents of this consignment are fully and accurately described by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and government regulations.

(2) Provide a copy of the waste shipment record, described in paragraph (d)(1) of this section, to the disposal site owners or operators at the same time as the asbestos-containing waste material is delivered to the disposal site.

(3) For waste shipments where a copy of the waste shipment record, signed by the owner or operator of the designated disposal site, is not received by the waste generator within 35 days of the date the waste was accepted by the initial transporter, contact the transporter and/or the owner or operator of the designated disposal site to determine the status of the waste shipment.

(4) Report in writing to the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program for the waste generator if a copy of the waste shipment record, signed by the owner or operator of the designated waste disposal site, is not received by the waste generator within 45 days of the date the waste was accepted by the initial transporter. Include in the report the following information:

(i) A copy of the waste shipment record for which a confirmation of delivery was not received, and

(ii) A cover letter signed by the waste generator explaining the efforts taken to locate the asbestos waste shipment and the results of those efforts.

(5) Retain a copy of all waste shipment records, including a copy of the waste shipment record signed by the owner or operator of the designated waste disposal site, for at least 2 years.

(e) Furnish upon request, and make available for inspection by the Administrator, all records required under this section.

[55 FR 48429, Nov. 20, 1990; 56 FR 1669, Jan. 16, 1991, as amended at 68 FR 54793, Sept. 18, 2003]

§ 61.151 Standard for inactive waste disposal sites for asbestos mills and manufacturing and fabricating operations.


top

Each owner or operator of any inactive waste disposal site that was operated by sources covered under §61.142, 61.144, or 61.147 and received deposits of asbestos-containing waste material generated by the sources, shall:

(a) Comply with one of the following:

(1) Either discharge no visible emissions to the outside air from an inactive waste disposal site subject to this paragraph; or

(2) Cover the asbestos-containing waste material with at least 15 centimeters (6 inches) of compacted nonasbestos-containing material, and grow and maintain a cover of vegetation on the area adequate to prevent exposure of the asbestos-containing waste material. In desert areas where vegetation would be difficult to maintain, at least 8 additional centimeters (3 inches) of well-graded, nonasbestos crushed rock may be placed on top of the final cover instead of vegetation and maintained to prevent emissions; or

(3) Cover the asbestos-containing waste material with at least 60 centimeters (2 feet) of compacted nonasbestos-containing material, and maintain it to prevent exposure of the asbestos-containing waste; or

(4) For inactive waste disposal sites for asbestos tailings, a resinous or petroleum-based dust suppression agent that effectively binds dust to control surface air emissions may be used instead of the methods in paragraphs (a) (1), (2), and (3) of this section. Use the agent in the manner and frequency recommended for the particular asbestos tailings by the manufacturer of the dust suppression agent to achieve and maintain dust control. Obtain prior written approval of the Administrator to use other equally effective dust suppression agents. For purposes of this paragraph, any used, spent, or other waste oil is not considered a dust suppression agent.

(b) Unless a natural barrier adequately deters access by the general public, install and maintain warning signs and fencing as follows, or comply with paragraph (a)(2) or (a)(3) of this section.

(1) Display warning signs at all entrances and at intervals of 100 m (328 ft) or less along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material was deposited. The warning signs must:

(i) Be posted in such a manner and location that a person can easily read the legend; and

(ii) Conform to the requirements for 51 cm×36 cm (20&inch;×14&inch;) upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and

(iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

Legend	Notation

Asbestos Waste Disposal Site	2.5 cm (1 inch) Sans Serif, Gothic or Block
Do Not Create Dust	1.9 cm (3/4 inch) Sans Serif, Gothic or Block
Breathing Asbestos is Hazardous to Your Health	14 Point Gothic.

Spacing between any two lines must be at least equal to the height of the upper of the two lines.

(2) Fence the perimeter of the site in a manner adequate to deter access by the general public.

(3) When requesting a determination on whether a natural barrier adequately deters public access, supply information enabling the Administrator to determine whether a fence or a natural barrier adequately deters access by the general public.

(c) The owner or operator may use an alternative control method that has received prior approval of the Administrator rather than comply with the requirements of paragraph (a) or (b) of this section.

(d) Notify the Administrator in writing at least 45 days prior to excavating or otherwise disturbing any asbestos-containing waste material that has been deposited at a waste disposal site under this section, and follow the procedures specified in the notification. If the excavation will begin on a date other than the one contained in the original notice, notice of the new start date must be provided to the Administrator at least 10 working days before excavation begins and in no event shall excavation begin earlier than the date specified in the original notification. Include the following information in the notice:

(1) Scheduled starting and completion dates.

(2) Reason for disturbing the waste.

(3) Procedures to be used to control emissions during the excavation, storage, transport, and ultimate disposal of the excavated asbestos-containing waste material. If deemed necessary, the Administrator may require changes in the emission control procedures to be used.

(4) Location of any temporary storage site and the final disposal site.

(e) Within 60 days of a site becoming inactive and after the effective date of this subpart, record, in accordance with State law, a notation on the deed to the facility property and on any other instrument that would normally be examined during a title search; this notation will in perpetuity notify any potential purchaser of the property that:

(1) The land has been used for the disposal of asbestos-containing waste material;

(2) The survey plot and record of the location and quantity of asbestos-containing waste disposed of within the disposal site required in §61.154(f) have been filed with the Administrator; and

(3) The site is subject to 40 CFR part 61, subpart M.

[49 FR 13661, Apr. 5, 1984, as amended at 53 FR 36972, Sept. 23, 1988. Redesignated and amended at 55 FR 48429, Nov. 20, 1990]

§ 61.152 Air-cleaning.

top

(a) The owner or operator who uses air cleaning, as specified in §§61.142(a), 61.144(b)(2), 61.145(c)(3)(i)(B)(*1*), 61.145(c)(4)(ii), 61.145(c)(11)(i), 61.146(b)(2), 61.147(b)(2), 61.149(b), 61.149(c)(1)(ii), 61.150(a)(1)(ii), 61.150(a)(2)(ii), and 61.155(e) shall:

(1) Use fabric filter collection devices, except as noted in paragraph (b) of this section, doing all of the following:

(i) Ensuring that the airflow permeability, as determined by ASTM Method D737–75, does not exceed 9 m^3 /min/m^2 (30 ft^3 /min/ft^2) for woven fabrics or 11^3 /min/m^2 (35 ft^3 /min/ft^2) for felted fabrics, except that 12 m^3 /min/m^2 (40 ft^3 min/ft^2) for woven and 14 m^3 /min/m^2 (45 ft^3 min/ft^2) for felted fabrics is allowed for filtering air from asbestos ore dryers; and

(ii) Ensuring that felted fabric weighs at least 475 grams per square meter (14 ounces per square yard) and is at least 1.6 millimeters (one-sixteenth inch) thick throughout; and

(iii) Avoiding the use of synthetic fabrics that contain fill yarn other than that which is spun.

(2) Properly install, use, operate, and maintain all air-cleaning equipment authorized by this section. Bypass devices may be used only during upset or emergency conditions and then only for so long as it takes to shut down the operation generating the particulate asbestos material.

(3) For fabric filter collection devices installed after January 10, 1989, provide for easy inspection for faulty bags.

(b) There are the following exceptions to paragraph (a)(1):

(1) After January 10, 1989, if the use of fabric creates a fire or explosion hazard, or the Administrator determines that a fabric filter is not feasible, the Administrator may

authorize as a substitute the use of wet collectors designed to operate with a unit contacting energy of at least 9.95 kilopascals (40 inches water gage pressure).

(2) Use a HEPA filter that is certified to be at least 99.97 percent efficient for 0.3 micron particles.

(3) The Administrator may authorize the use of filtering equipment other than described in paragraphs (a)(1) and (b)(1) and (2) of this section if the owner or operator demonstrates to the Administrator's satisfaction that it is equivalent to the described equipment in filtering particulate asbestos material.

[49 FR 13661, Apr. 5, 1984; 49 FR 25453, June 21, 1984, as amended at 51 FR 8199, Mar. 10, 1986. Redesignated and amended at 55 FR 48430, Nov. 20, 1990]

§ 61.153 Reporting.

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(a) Any new source to which this subpart applies (with the exception of sources subject to §§61.143, 61.145, 61.146, and 61.148), which has an initial startup date preceding the effective date of this revision, shall provide the following information to the Administrator postmarked or delivered within 90 days of the effective date. In the case of a new source that does not have an initial startup date preceding the effective date, the information shall be provided, postmarked or delivered, within 90 days of the initial startup date. Any owner or operator of an existing source shall provide the following information to the Administrator within 90 days of the effective date of this subpart unless the owner or operator of the existing source has previously provided this information to the Administrator. Any changes in the information provided by any existing source shall be provided to the Administrator, postmarked or delivered, within 30 days after the change.

(1) A description of the emission control equipment used for each process; and

(i) If the fabric device uses a woven fabric, the airflow permeability in m^3 /min/m^2 and; if the fabric is synthetic, whether the fill yarn is spun or not spun; and

(ii) If the fabric filter device uses a felted fabric, the density in g/m^2 , the minimum thickness in inches, and the airflow permeability in m^3 /min/m^2 .

(2) If a fabric filter device is used to control emissions,

(i) The airflow permeability in m^3 /min/m^2 (ft^3 /min/ft^2) if the fabric filter device uses a woven fabric, and, if the fabric is synthetic, whether the fill yarn is spun or not spun; and

(ii) If the fabric filter device uses a felted fabric, the density in g/m^2 (oz/yd^2), the minimum thickness in millimeters (inches), and the airflow permeability in $m^3/min/m^2$ ($ft^3/min/ft^2$).

(3) If a HEPA filter is used to control emissions, the certified efficiency.

(4) For sources subject to §§61.149 and 61.150:

(i) A brief description of each process that generates asbestos-containing waste material; and

(ii) The average volume of asbestos-containing waste material disposed of, measured in m^3/day (yd^3/day); and

(iii) The emission control methods used in all stages of waste disposal; and

(iv) The type of disposal site or incineration site used for ultimate disposal, the name of the site operator, and the name and location of the disposal site.

(5) For sources subject to §§61.151 and 61.154:

(i) A brief description of the site; and

(ii) The method or methods used to comply with the standard, or alternative procedures to be used.

(b) The information required by paragraph (a) of this section must accompany the information required by §61.10. Active waste disposal sites subject to §61.154 shall also comply with this provision. Roadways, demolition and renovation, spraying, and insulating materials are exempted from the requirements of §61.10(a). The information described in this section must be reported using the format of appendix A of this part as a guide.

(Sec. 114. Clean Air Act as amended (42 U.S.C. 7414))

[49 FR 13661, Apr. 5, 1984. Redesignated and amended at 55 FR 48430, Nov. 20, 1990; 56 FR 1669, Jan. 16, 1991]

§ 61.154 Standard for active waste disposal sites.

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Each owner or operator of an active waste disposal site that receives asbestos-containing waste material from a source covered under §61.149, 61.150, or 61.155 shall meet the requirements of this section:

(a) Either there must be no visible emissions to the outside air from any active waste disposal site where asbestos-containing waste material has been deposited, or the requirements of paragraph (c) or (d) of this section must be met.

(b) Unless a natural barrier adequately deters access by the general public, either warning signs and fencing must be installed and maintained as follows, or the requirements of paragraph (c)(1) of this section must be met.

(1) Warning signs must be displayed at all entrances and at intervals of 100 m (330 ft) or less along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material is deposited. The warning signs must:

(i) Be posted in such a manner and location that a person can easily read the legend; and

(ii) Conform to the requirements of 51 cm × 36 cm (20&inch;×14&inch;) upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph; and

(iii) Display the following legend in the lower panel with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

Legend	Notation
Asbestos Waste Disposal Site	2.5 cm (1 inch) Sans Serif, Gothic or Block.
Do Not Create Dust	1.9 cm (3/4 inch) Sans Serif, Gothic or Block.
Breathing Asbestos is Hazardous to Your Health	14 Point Gothic.

Spacing between any two lines must be at least equal to the height of the upper of the two lines.

(2) The perimeter of the disposal site must be fenced in a manner adequate to deter access by the general public.

(3) Upon request and supply of appropriate information, the Administrator will determine whether a fence or a natural barrier adequately deters access by the general public.

(c) Rather than meet the no visible emission requirement of paragraph (a) of this section, at the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material that has been deposited at the site during the operating day or previous 24-hour period shall:

(1) Be covered with at least 15 centimeters (6 inches) of compacted nonasbestos-containing material, or

(2) Be covered with a resinous or petroleum-based dust suppression agent that effectively binds dust and controls wind erosion. Such an agent shall be used in the manner and frequency recommended for the particular dust by the dust suppression agent manufacturer to achieve and maintain dust control. Other equally effective dust suppression agents may be used upon prior approval by the Administrator. For purposes of this paragraph, any used, spent, or other waste oil is not considered a dust suppression agent.

(d) Rather than meet the no visible emission requirement of paragraph (a) of this section, use an alternative emissions control method that has received prior written approval by the Administrator according to the procedures described in §61.149(c)(2).

(e) For all asbestos-containing waste material received, the owner or operator of the active waste disposal site shall:

(1) Maintain waste shipment records, using a form similar to that shown in Figure 4, and include the following information:

(i) The name, address, and telephone number of the waste generator.

(ii) The name, address, and telephone number of the transporter(s).

(iii) The quantity of the asbestos-containing waste material in cubic meters (cubic yards).

(iv) The presence of improperly enclosed or uncovered waste, or any asbestos-containing waste material not sealed in leak-tight containers. Report in writing to the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program for the waste generator (identified in the waste shipment record), and, if different, the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program for the disposal site, by the following working day, the presence of a significant amount of improperly enclosed or uncovered waste. Submit a copy of the waste shipment record along with the report.

(v) The date of the receipt.

(2) As soon as possible and no longer than 30 days after receipt of the waste, send a copy of the signed waste shipment record to the waste generator.

(3) Upon discovering a discrepancy between the quantity of waste designated on the waste shipment records and the quantity actually received, attempt to reconcile the discrepancy with the waste generator. If the discrepancy is not resolved within 15 days after receiving the waste, immediately report in writing to the local, State, or EPA Regional office responsible for administering the asbestos NESHAP program for the waste generator (identified in the waste shipment record), and, if different, the local, State, or EPA Regional office responsible for administering the asbestos NESHAP

program for the disposal site. Describe the discrepancy and attempts to reconcile it, and submit a copy of the waste shipment record along with the report.

(4) Retain a copy of all records and reports required by this paragraph for at least 2 years.

(f) Maintain, until closure, records of the location, depth and area, and quantity in cubic meters (cubic yards) of asbestos-containing waste material within the disposal site on a map or diagram of the disposal area.

(g) Upon closure, comply with all the provisions of §61.151.

(h) Submit to the Administrator, upon closure of the facility, a copy of records of asbestos waste disposal locations and quantities.

(i) Furnish upon request, and make available during normal business hours for inspection by the Administrator, all records required under this section.

(j) Notify the Administrator in writing at least 45 days prior to excavating or otherwise disturbing any asbestos-containing waste material that has been deposited at a waste disposal site and is covered. If the excavation will begin on a date other than the one contained in the original notice, notice of the new start date must be provided to the Administrator at least 10 working days before excavation begins and in no event shall excavation begin earlier than the date specified in the original notification. Include the following information in the notice:

(1) Scheduled starting and completion dates.

(2) Reason for disturbing the waste.

(3) Procedures to be used to control emissions during the excavation, storage, transport, and ultimate disposal of the excavated asbestos-containing waste material. If deemed necessary, the Administrator may require changes in the emission control procedures to be used.

(4) Location of any temporary storage site and the final disposal site.

(Secs. 112 and 301(a) of the Clean Air Act as amended (42 U.S.C. 7412, 7601(a))

[49 FR 13661, Apr. 5, 1990. Redesignated and amended at 55 FR 48431, Nov. 20, 1990; 56 FR 1669, Jan. 16, 1991]

§ 61.155 Standard for operations that convert asbestos-containing waste material into nonasbestos (asbestos-free) material.

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Each owner or operator of an operation that converts RACM and asbestos-containing waste material into nonasbestos (asbestos-free) material shall:

(a) Obtain the prior written approval of the Administrator to construct the facility. To obtain approval, the owner or operator shall provide the Administrator with the following information:

(1) Application to construct pursuant to §61.07.

(2) In addition to the information requirements of §61.07(b)(3), a

(i) Description of waste feed handling and temporary storage.

(ii) Description of process operating conditions.

(iii) Description of the handling and temporary storage of the end product.

(iv) Description of the protocol to be followed when analyzing output materials by transmission electron microscopy.

(3) Performance test protocol, including provisions for obtaining information required under paragraph (b) of this section.

(4) The Administrator may require that a demonstration of the process be performed prior to approval of the application to construct.

(b) Conduct a start-up performance test. Test results shall include:

(1) A detailed description of the types and quantities of nonasbestos material, RACM, and asbestos-containing waste material processed, *e.g.,* asbestos cement products, friable asbestos insulation, plaster, wood, plastic, wire, etc. Test feed is to include the full range of materials that will be encountered in actual operation of the process.

(2) Results of analyses, using polarized light microscopy, that document the asbestos content of the wastes processed.

(3) Results of analyses, using transmission electron microscopy, that document that the output materials are free of asbestos. Samples for analysis are to be collected as 8-hour composite samples (one 200-gram (7-ounce) sample per hour), beginning with the initial introduction of RACM or asbestos-containing waste material and continuing until the end of the performance test.

(4) A description of operating parameters, such as temperature and residence time, defining the full range over which the process is expected to operate to produce nonasbestos (asbestos-free) materials. Specify the limits for each operating parameter within which the process will produce nonasbestos (asbestos-free) materials.

(5) The length of the test.

(c) During the initial 90 days of operation,

(1) Continuously monitor and log the operating parameters identified during start-up performance tests that are intended to ensure the production of nonasbestos (asbestos-free) output material.

(2) Monitor input materials to ensure that they are consistent with the test feed materials described during start-up performance tests in paragraph (b)(1) of this section.

(3) Collect and analyze samples, taken as 10-day composite samples (one 200-gram (7-ounce) sample collected every 8 hours of operation) of all output material for the presence of asbestos. Composite samples may be for fewer than 10 days. Transmission electron microscopy (TEM) shall be used to analyze the output material for the presence of asbestos. During the initial 90-day period, all output materials must be stored on-site until analysis shows the material to be asbestos-free or disposed of as asbestos-containing waste material according to §61.150.

(d) After the initial 90 days of operation,

(1) Continuously monitor and record the operating parameters identified during start-up performance testing and any subsequent performance testing. Any output produced during a period of deviation from the range of operating conditions established to ensure the production of nonasbestos (asbestos-free) output materials shall be:

(i) Disposed of as asbestos-containing waste material according to §61.150, or

(ii) Recycled as waste feed during process operation within the established range of operating conditions, or

(iii) Stored temporarily on-site in a leak-tight container until analyzed for asbestos content. Any product material that is not asbestos-free shall be either disposed of as asbestos-containing waste material or recycled as waste feed to the process.

(2) Collect and analyze monthly composite samples (one 200-gram (7-ounce) sample collected every 8 hours of operation) of the output material. Transmission electron microscopy shall be used to analyze the output material for the presence of asbestos.

(e) Discharge no visible emissions to the outside air from any part of the operation, or use the methods specified by §61.152 to clean emissions containing particulate asbestos material before they escape to, or are vented to, the outside air.

(f) Maintain records on-site and include the following information:

(1) Results of start-up performance testing and all subsequent performance testing, including operating parameters, feed characteristic, and analyses of output materials.

(2) Results of the composite analyses required during the initial 90 days of operation under §61.155(c).

(3) Results of the monthly composite analyses required under §61.155(d).

(4) Results of continuous monitoring and logs of process operating parameters required under §61.155 (c) and (d).

(5) The information on waste shipments received as required in §61.154(e).

(6) For output materials where no analyses were performed to determine the presence of asbestos, record the name and location of the purchaser or disposal site to which the output materials were sold or deposited, and the date of sale or disposal.

(7) Retain records required by paragraph (f) of this section for at least 2 years.

(g) Submit the following reports to the Administrator:

(1) A report for each analysis of product composite samples performed during the initial 90 days of operation.

(2) A quarterly report, including the following information concerning activities duringeachconsecutive 3-month period:

(i) Results of analyses of monthly product composite samples.

(ii) A description of any deviation from the operating parameters established during performance testing, the duration of the deviation, and steps taken to correct the deviation.

(iii) Disposition of any product produced during a period of deviation, including whether it was recycled, disposed of as asbestos-containing waste material, or stored temporarily on-site until analyzed for asbestos content.

(iv) The information on waste disposal activities as required in §61.154(f).

(h) Nonasbestos (asbestos-free) output material is not subject to any of the provisions of this subpart. Output materials in which asbestos is detected, or output materials produced when the operating parameters deviated from those established during the start-up performance testing, unless shown by TEM analysis to be asbestos-free, shall be considered to be asbestos-containing waste and shall be handled and disposed of according to §§61.150 and 61.154 or reprocessed while all of the established operating parameters are being met.

[55 FR 48431, Nov. 20, 1990]

§ 61.156 Cross-reference to other asbestos regulations.

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In addition to this subpart, the regulations referenced in Table 1 also apply to asbestos and may be applicable to those sources specified in §§61.142 through 61.151, 61.154, and 61.155 of this subpart. These cross-references are presented for the reader's information and to promote compliance with the cited regulations.

Table 1—Cross-Reference to Other Asbestos Regulations

Agency	CFR citation	Comment
EPA	40 CFR part 763, subpart E	Requires schools to inspect for asbestos and implement response actions and submit asbestos management plans to States. Specifies use of accredited inspectors, air sampling methods, and waste disposal procedures.
	40 CFR part 427	Effluent standards for asbestos manufacturing source categories.
	40 CFR part 763, subpart G	Protects public employees performing asbestos abatement work in States not covered by OSHA asbestos standard.
OSHA	29 CFR 1910.1001	Worker protection measures-engineering controls, worker training, labeling, respiratory protection, bagging of waste, permissible exposure level.
	29 CFR 1926.1101	Worker protection measures for all construction work involving asbestos, including demolition and renovation-work practices, worker training, bagging of waste, permissible exposure level.
MSHA	30 CFR part 56, subpart D	Specifies exposure limits, engineering controls, and respiratory protection measures for workers in surface mines.
	30 CFR part 57, subpart D	Specifies exposure limits, engineering controls, and respiratory protection measures for workers in underground mines.
DOT	49 CFR parts 171 and 172	Regulates the transportation of asbestos-containing waste material. Requires waste containment and shipping papers.

[55 FR 48432, Nov. 20, 1990, as amended at 60 FR 31920, June 19, 1995; 68 FR 54793, Sept. 18, 2003; 69 FR 43324, July 20, 2004]

§ 61.157 Delegation of authority.

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(a) In delegating implementation and enforcement authority to a State under section 112(d) of the Act, the authorities contained in paragraph (b) of this section shall be retained by the Administrator and not transferred to a State.

(b) Authorities that will not be delegated to States:

(1) Section 61.149(c)(2)

(2) Section 61.150(a)(4)

(3) Section 61.151(c)

(4) Section 61.152(b)(3)

(5) Section 61.154(d)

(6) Section 61.155(a).

[55 FR 48433, Nov. 20, 1990]

Appendix A to Subpart M of Part 61—Interpretive Rule Governing Roof Removal Operations

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I. Applicability of the Asbestos NESHAP

1.1. Asbestos-containing material (ACM) is material containing more than one percent asbestos as determined using the methods specified in appendix E, subpart E, 40 CFR part 763, section 1, Polarized Light Microscopy. The NESHAP classifies ACM as either “friable” or “nonfriable”. Friable ACM is ACM that, when dry, can be crumbled, pulverized or reduced to powder by hand pressure. Nonfriable ACM is ACM that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure.

1.2. Nonfriable ACM is further classified as either Category I ACM or Category II ACM. Category I ACM and Category II ACM are distinguished from each other by their potential to release fibers when damaged. Category I ACM includes asbestos-containing gaskets, packings, resilient floor coverings, resilient floor covering mastic, and asphalt roofing products containing more than one percent asbestos. Asphalt roofing products which may contain asbestos include built-up roofing; asphalt-containing single ply membrane systems; asphalt shingles; asphalt-containing underlayment felts; asphalt-containing roof coatings and mastics; and asphalt-containing base flashings. ACM roofing products that use other bituminous or resinous binders (such as coal tars or pitches) are also considered to be Category I ACM. Category II ACM includes all other nonfriable ACM, for example, asbestos-cement (A/C) shingles, A/C tiles, and transite boards or panels containing more than one percent asbestos. Generally speaking,

Category II ACM is more likely to become friable when damaged than is Category I ACM. The applicability of the NESHAP to Category I and II ACM depends on: (1) the condition of the material at the time of demolition or renovation, (2) the nature of the operation to which the material will be subjected, (3) the amount of ACM involved.

1.3. Asbestos-containing material regulated under the NESHAP is referred to as "regulated asbestos-containing material" (RACM). RACM is defined in §61.141 of the NESHAP and includes: (1) friable asbestos-containing material; (2) Category I nonfriable ACM that has become friable; (3) Category I nonfriable ACM that has been or will be sanded, ground, cut, or abraded; or (4) Category II nonfriable ACM that has already been or is likely to become crumbled, pulverized, or reduced to powder. If the coverage threshold for RACM is met or exceeded in a renovation or demolition operation, then all friable ACM in the operation, and in certain situations, nonfriable ACM in the operation, are subject to the NESHAP.

A. Threshold Amounts of Asbestos-Containing Roofing Material

1.A.1. The NESHAP does not cover roofing projects on single family homes or on residential buildings containing four or fewer dwelling units. 40 CFR 61.141. For other roofing renovation projects, if the total asbestos-containing roof area undergoing renovation is less than 160 ft^2 , the NESHAP does not apply, regardless of the removal method to be used, the type of material (Category I or II), or its condition (friable versus nonfriable). 40 CFR 61.145(a)(4). However, EPA would recommend the use of methods that damage asbestos-containing roofing material as little as possible. EPA has determined that where a rotating blade (RB) roof cutter or equipment that similarly damages the roofing material is used to remove Category I nonfriable asbestos-containing roofing material, the removal of 5580 ft^2 of that material will create 160 ft^2 of RACM. For the purposes of this interpretive rule, "RB roof cutter" means an engine-powered roof cutting machine with one or more rotating cutting blades the edges of which are blunt. (Equipment with blades having sharp or tapered edges, and/or which does not use a rotating blade, is used for "slicing" rather than "cutting" the roofing material; such equipment is not included in the term "RB roof cutter".) Therefore, it is EPA's interpretation that when an RB roof cutter or equipment that similarly damages the roofing material is used to remove Category I nonfriable asbestos-containing roofing material, any project that is 5580 ft^2 or greater is subject to the NESHAP; conversely, it is EPA's interpretation that when an RB roof cutter or equipment that similarly damages the roofing material is used to remove Category I nonfriable asbestos-containing roofing material in a roof removal project that is less than 5580 ft^2 , the project is not subject to the NESHAP, except that notification is always required for demolitions. EPA further construes the NESHAP to mean that if slicing or other methods that do not sand, grind, cut or abrade will be used on Category I nonfriable ACM, the NESHAP does not apply, regardless of the area of roof to be removed.

1.A.2. For asbestos cement (A/C) shingles (or other Category II roofing material), if the area of the roofing material to be removed is at least 160 ft^2 and the removal methods will crumble, pulverize, reduce to powder, or contaminate with RACM (from other ACM that

has been crumbled, pulverized or reduced to powder) 160 ft^2 or more of such roofing material, the removal is subject to the NESHAP. Conversely, if the area of the A/C shingles (or other Category II roofing materials) to be removed is less than 160 ft^2 , the removal is not subject to the NESHAP regardless of the removal method used, except that notification is always required for demolitions. 40 CFR 61.145(a). However, EPA would recommend the use of methods that damage asbestos-containing roofing material as little as possible. If A/C shingles (or other Category II roofing materials) are removed without 160 ft^2 or more of such roofing material being crumbled, pulverized, reduced to powder, or contaminated with RACM (from other ACM that has been crumbled, pulverized or reduced to powder), the operation is not subject to the NESHAP, even where the total area of the roofing material to be removed exceeds 160 ft^2 ; provided, however, that if the renovation includes other operations involving RACM, the roof removal operation is covered if the total area of RACM from all renovation activities exceeds 160 ft^2 . *See* the definition of regulated asbestos-containing material (RACM), 40 CFR 61.141.

1.A.3. Only roofing material that meets the definition of ACM can qualify as RACM subject to the NESHAP. Therefore, to determine if a removal operation that meets or exceeds the coverage threshold is subject to the NESHAP, any suspect roofing material (*i.e.* roofing material that may be ACM) should be tested for asbestos. If any such roofing material contains more than one percent asbestos and if the removal operation is covered by the NESHAP, then EPA must be notified and the work practices in §61.145(c) must be followed. In EPA's view, if a removal operation involves at least the threshold level of suspect material, a roofing contractor may choose not to test for asbestos if the contractor follows the notification and work practice requirements of the NESHAP.

B. A/C Shingle Removal (Category II ACM Removal)

1.B.1. A/C shingles, which are Category II nonfriable ACM, become regulated ACM if the material has a high probability of becoming or has become crumbled, pulverized or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations. 40 CFR 61.141. However, merely breaking an A/C shingle (or any other category II ACM) that is not friable may not necessarily cause the material to become RACM. A/C shingles are typically nailed to buildings on which they are attached. EPA believes that the extent of breakage that will normally result from carefully removing A/C shingles and lowering the shingles to the ground will not result in crumbling, pulverizing or reducing the shingles to powder. Conversely, the extent of breakage that will normally occur if the A/C shingles are dropped from a building or scraped off of a building with heavy machinery would cause the shingles to become RACM. EPA therefore construes the NESHAP to mean that the removal of A/C shingles that are not friable, using methods that do not crumble, pulverize, or reduce the A/C shingles to powder (such as pry bars, spud bars and shovels to carefully pry the material), is not subject to the NESHAP provided that the A/C shingles are properly handled during and after removal, as discussed in this paragraph and the asbestos NESHAP. This interpretation also applies to other Category II nonfriable asbestos-containing roofing materials.

C. Cutting vs. Slicing and Manual Methods for Removal of Category I ACM

1.C.1. Because of damage to the roofing material, and the potential for fiber release, roof removal operations using rotating blade (RB) roof cutters or other equipment that sand, grind, cut or abrade the roof material are subject to the NESHAP. As EPA interprets the NESHAP, the use of certain manual methods (using equipment such as axes, hatchets, or knives, spud bars, pry bars, and shovels, but not saws) or methods that slice, shear, or punch (using equipment such as a power slicer or power plow) does not constitute "cutting, sanding, grinding or abrading." This is because these methods do not destroy the structural matrix or integrity of the material such that the material is crumbled, pulverized or reduced to powder. Hence, it is EPA's interpretation that when such methods are used, assuming the roof material is not friable, the removal operation is not subject to the regulation.

1.C.2. Power removers or power tear-off machines are typically used to pry the roofing material up from the deck after the roof membrane has been cut. It is EPA's interpretation that when these machines are used to pry roofing material up, their use is not regulated by the NESHAP.

1.C.3. As noted previously, the NESHAP only applies to the removal of asbestos-containing roofing materials. Thus, the NESHAP does not apply to the use of RB cutters to remove non-asbestos built up roofing (BUR). On roofs containing some asbestos-containing and some non-asbestos-containing materials, coverage under the NESHAP depends on the methods used to remove each type of material in addition to other coverage thresholds specified above. For example, it is not uncommon for existing roofs to be made of non-asbestos BUR and base flashings that do contain asbestos. In that situation, EPA construes the NESHAP to be inapplicable to the removal of the non-asbestos BUR using an RB cutter so long as the RB cutter is not used to cut 5580 ft^2 or more of the asbestos-containing base flashing or other asbestos-containing material into sections. In addition, the use of methods that slice, shear, punch or pry could then be used to remove the asbestos flashings and not trigger coverage under the NESHAP.

II. Notification

2.1. Notification for a demolition is always required under the NESHAP. However, EPA believes that few roof removal jobs constitute "demolitions" as defined in the NESHAP (§61.141). In particular, it is EPA's view that the removal of roofing systems (i.e., the roof membrane, insulation, surfacing, coatings, flashings, mastic, shingles, and felt underlayment), when such removal is not a part of a demolition project, constitutes a "renovation" under the NESHAP. If the operation is a renovation, and Category I roofing material is being removed using either manual methods or slicing, notification is not required by the NESHAP. If Category II material is not friable and will be removed without crumbling, pulverizing, or reducing it to powder, no notification is required. Also, if the renovation involves less than the threshold area for applicability as discussed above, then no notification is required. However, if a roof removal meets the applicability and threshold requirements under the NESHAP, then EPA (or the delegated agency) must

be notified in advance of the removal in accordance with the requirements of §61.145(b), as follows:

• Notification must be given in writing at least 10 working days in advance and must include the information in §61.145(b)(4), except for emergency renovations as discussed below.

• The notice must be updated as necessary, including, for example, when the amount of asbestos-containing roofing material reported changes by 20 percent or more.

• EPA must be notified if the start date of the roof removal changes. If the start date of a roof removal project is changed to an earlier date, EPA must be provided with a written notice of the new start date at least 10 working days in advance. If the start date changes to a later date, EPA must be notified by telephone as soon as possible before the original start date and a written notice must be sent as soon as possible.

• For emergency renovations (as defined in §61.141), where work must begin immediately to avoid safety or public health hazards, equipment damage, or unreasonable financial burden, the notification must be postmarked or delivered to EPA as soon as possible, but no later than the following work day.

III. Emission Control Practices

A. Requirements To Adequately Wet and Discharge No Visible Emission

3.A.1. The principal controls contained in the NESHAP for removal operations include requirements that the affected material be adequately wetted, and that asbestos waste be handled, collected, and disposed of properly. The requirements for disposal of waste materials are discussed separately in section IV below. The emission control requirements discussed in this section III apply only to roof removal operations that are covered by the NESHAP as set forth in Section I above.

3.A.2. For any operation subject to the NESHAP, the regulation (§§61.145(c)(2)(i), (3), (6)(i)) requires that RACM be adequately wet (as defined in §61.141) during the operation that damages or disturbs the asbestos material until collected for disposal.

3.A.3. When using an RB roof cutter (or any other method that sands, grinds, cuts or abrades the roofing material) to remove Category I asbestos-containing roofing material, the emission control requirements of §61.145(c) apply as discussed in Section I above. EPA will consider a roof removal project to be in compliance with the "adequately wet" and "discharge no visible emission" requirements of the NESHAP if the RB roof cutter is equipped and operated with the following: (1) a blade guard that completely encloses the blade and extends down close to the roof surface; and (2) a device for spraying a fine mist of water inside the blade guard, and which device is in operation during the cutting of the roof.

B. Exemptions From Wetting Requirements

3.B.1. The NESHAP provides that, in certain instances, wetting may not be required during the cutting of Category I asbestos roofing material with an RB roof cutter. If EPA determines in accordance with §61.145(c)(3)(i), that wetting will unavoidably damage the building, equipment inside the building, or will present a safety hazard while stripping the ACM from a facility component that remains in place, the roof removal operation will be exempted from the requirement to wet during cutting. EPA must have sufficient written information on which to base such a decision. Before proceeding with a dry removal, the contractor must have received EPA's written approval. Such exemptions will be made on a case-by-case basis.

3.B.2. It is EPA's view that, in most instances, exemptions from the wetting requirements are not necessary. Where EPA grants an exemption from wetting because of the potential for damage to the building, damage to equipment within the building or a safety hazard, the NESHAP specifies alternative control methods (§61.145(c)(3)(i)(B)). Alternative control methods include (a) the use of local exhaust ventilation systems that capture the dust, and do not produce visible emissions, or (b) methods that are designed and operated in accordance with the requirements of §61.152, or (c) other methods that have received the written approval of EPA. EPA will consider an alternative emission control method in compliance with the NESHAP if the method has received written approval from EPA and the method is being implemented consistent with the approved procedures (§61.145(c)(3)(ii) or §61.152(b)(3)).

3.B.3. An exemption from wetting is also allowed when the air or roof surface temperature at the point of wetting is below freezing, as specified in §61.145(c)(7). If freezing temperatures are indicated as the reason for not wetting, records must be kept of the temperature at the beginning, middle and end of the day on which wetting is not performed and the records of temperature must be retained for at least 2 years. 42 CFR §61.145(c)(7)(iii). It is EPA's interpretation that in such cases, no written application to, or written approval by the Administrator is needed for using emission control methods listed in §61.145(c)(3)(i)(B), or alternative emission control methods that have been previously approved by the Administrator. However, such written application or approval is required for alternative emission control methods that have not been previously approved. Any dust and debris collected from cutting must still be kept wet and placed in containers. All of the other requirements for notification and waste disposal would continue to apply as described elsewhere in this notice and the Asbestos NESHAP.

C. Waste Collection and Handling

3.C.1. It is EPA's interpretation that waste resulting from slicing and other methods that do not cut, grind, sand or abrade Category I nonfriable asbestos-containing roofing material is not subject to the NESHAP and can be disposed of as nonasbestos waste. EPA further construes the NESHAP to provide that if Category II roofing material (such as A/C shingles) is removed and disposed of without crumbling, pulverizing, or reducing it to powder, the waste from the removal is not subject to the NESHAP waste disposal

requirements. EPA also interprets the NESHAP to be inapplicable to waste resulting from roof removal operations that do not meet or exceed the coverage thresholds described in section I above. Of course, other State, local, or Federal regulations may apply.

3.C.2. It is EPA's interpretation that when an RB roof cutter, or other method that similarly damages the roofing material, is used to cut Category I asbestos containing roofing material, the damaged material from the cut (the sawdust or debris) is considered asbestos containing waste subject to §61.150 of the NESHAP, provided the coverage thresholds discussed above in section 1 are met or exceeded. This sawdust or debris must be disposed of at a disposal site operated in accordance with the NESHAP. It is also EPA's interpretation of the NESHAP that if the remainder of the roof is free of the sawdust and debris generated by the cutting, or if such sawdust or debris is collected as discussed below in paragraphs 3.C.3, 3.C.4, 3.C.5 and 3.C.6, the remainder of the roof can be disposed of as nonasbestos waste because it is considered to be Category I nonfriable material (as long as the remainder of the roof is in fact nonasbestos material or if it is Category I asbestos material and the removal methods do not further sand, grind, cut or abrade the roof material). EPA further believes that if the roof is not cleaned of such sawdust or debris, *i.e.,* it is contaminated, then it must be treated as asbestos-containing waste material and be handled in accordance with §61.150.

3.C.3. In order to be in compliance with the NESHAP while using an RB roof cutter (or device that similarly damages the roofing material) to cut Category I asbestos containing roofing material, the dust and debris resulting from the cutting of the roof should be collected as soon as possible after the cutting operation, and kept wet until collected and placed in leak-tight containers. EPA believes that where the blade guard completely encloses the blade and extends down close to the roof surface and is equipped with a device for spraying a fine mist of water inside the blade guard, and the spraying device is in operation during the cutting, most of the dust and debris from cutting will be confined along the cut. The most efficient methods to collect the dust and debris from cutting are to immediately collect or vacuum up the damaged material where it lies along the cut using a filtered vacuum cleaner or debris collector that meets the requirements of 40 CFR 61.152 to clean up as much of the debris as possible, or to gently sweep up the bulk of the debris, and then use a filtered vacuum cleaner that meets the requirements of 40 CFR 61.152 to clean up as much of the remainder of the debris as possible. On smooth surfaced roofs (nonaggregate roofs), sweeping up the debris and then wet wiping the surface may be done in place of using a filtered vacuum cleaner. It is EPA's view that if these decontamination procedures are followed, the remaining roofing material does not have to be collected and disposed of as asbestos waste. Additionally, it is EPA's view that where such decontamination procedures are followed, if the remaining portions of the roof are non-asbestos or Category I nonfriable asbestos material, and if the remaining portions are removed using removal methods that slice, shear, punch or pry, as discussed in section 1.C above, then the remaining portions do not have to be collected and disposed of as asbestos waste and the NESHAP's no visible emissions and adequately wet requirements are not applicable to the removal of the remaining portions. In EPA's interpretation, the failure of a filtered vacuum cleaner or debris collector to collect larger chunks or pieces of damaged roofing material created by the RB roof cutter does not

require the remaining roofing material to be handled and disposed of as asbestos waste, provided that such visible chunks or pieces of roofing material are collected (e.g. by gentle sweeping) and disposed of as asbestos waste. Other methods of decontamination may not be adequate, and should be approved by the local delegated agency.

3.C.4. In EPA's interpretation, if the debris from the cutting is not collected immediately, it will be necessary to lightly mist the dust or debris, until it is collected, as discussed above, and placed in containers. The dust or debris should be lightly misted frequently enough to prevent the material from drying, and to prevent airborne emissions, prior to collection as described above. It is EPA's interpretation of the NESHAP that if these procedures are followed, the remaining roofing material does not have to be collected and disposed of as asbestos waste, as long as the remaining roof material is in fact nonasbestos material or if it is Category I asbestos material and the removal methods do not further sand, grind, cut or abrade the roof material.

3.C.5. It is EPA's interpretation that, provided the roofing material is not friable prior to the cutting operation, and provided the roofing material has not been made friable by the cutting operation, the appearance of rough, jagged or damaged edges on the remaining roofing material, due to the use of an RB roof cutter, does not require that such remaining roofing material be handled and disposed of as asbestos waste. In addition, it is also EPA's interpretation that if the sawdust or debris generated by the use of an RB roof cutter has been collected as discussed in paragraphs 3.C.3, 3.C.4 and 3.C.6, the presence of dust along the edge of the remaining roof material does not render such material "friable" for purposes of this interpretive rule or the NESHAP, provided the roofing material is not friable prior to the cutting operation, and provided that the remaining roofing material near the cutline has not been made friable by the cutting operation. Where roofing material near the cutline has been made friable by the use of the RB cutter (*i.e.* where such remaining roofing material near the cutline can be crumbled, pulverized or reduced to powder using hand pressure), it is EPA's interpretation that the use of an encapsulant will ensure that such friable material need not be treated or disposed of as asbestos containing waste material. The encapsulant may be applied to the friable material after the roofing material has been collected into stacks for subsequent disposal as nonasbestos waste. It is EPA's view that if the encapsulation procedure set forth in this paragraph is followed in operations where roofing material near the cutline has been rendered friable by the use of an RB roof cutter, and if the decontamination procedures set forth in paragraph 3.C.3 have been followed, the NESHAP's no visible emissions and adequately wet requirements would be met for the removal, handling and disposal of the remaining roofing material.

3.C.6. As one way to comply with the NESHAP, the dust and debris from cutting can be placed in leak-tight containers, such as plastic bags, and the containers labeled using warning labels required by OSHA (29 CFR 1926.58). In addition, the containers must have labels that identify the waste generator (such as the name of the roofing contractor, abatement contractor, and/or building owner or operator) and the location of the site at which the waste was generated.

IV. Waste Disposal

A. Disposal Requirements

4.A.1. Section 61.150(b) requires that, as soon as is practical, all collected dust and debris from cutting as well as any contaminated roofing squares, must be taken to a landfill that is operated in accordance with §61.154 or to an EPA-approved site that converts asbestos waste to nonasbestos material in accordance with §61.155. During the loading and unloading of affected waste, asbestos warning signs must be affixed to the vehicles.

B. Waste Shipment Record

4.B.1. For each load of asbestos waste that is regulated under the NESHAP, a waste shipment record (WSR) must be maintained in accordance with §61.150(d). Information that must be maintained for each waste load includes the following:

• Name, address, and telephone number of the waste generator

• Name and address of the local, State, or EPA regional office responsible for administering the asbestos NESHAP program

• Quantity of waste in cubic meters (or cubic yards)

• Name and telephone number of the disposal site operator

• Name and physical site location of the disposal site

• Date transported

• Name, address, and telephone number of the transporter(s)

• Certification that the contents meet all government regulations for transport by highways.

4.B.2. The waste generator is responsible for ensuring that a copy of the WSR is delivered to the disposal site along with the waste shipment. If a copy of the WSR signed by the disposal site operator is not returned to the waste generator within 35 days, the waste generator must contact the transporter and/or the disposal site to determine the status of the waste shipment. 40 CFR 61.150(d)(3). If the signed WSR is not received within 45 days, the waste generator must report, in writing, to the responsible NESHAP program agency and send along a copy of the WSR. 40 CFR 61.150(d)(4). Copies of WSRs, including those signed by the disposal site operator, must be retained for at least 2 years. 40 CFR 61.150(d)(5).

V. Training

5.1. For those roof removals that are subject to the NESHAP, at least one on-site supervisor trained in the provisions of the NESHAP must be present during the removal of the asbestos roofing material. 40 CFR 61.145(c)(8). In EPA's view, this person can be a job foreman, a hired consultant, or someone who can represent the building owner or contractor responsible for the removal. In addition to the initial training requirement, a refresher training course is required every 2 years. The NESHAP training requirements became effective on November 20, 1991.

5.2. Asbestos training courses developed specifically to address compliance with the NESHAP in roofing work, as well as courses developed for other purposes can satisfy this requirement of the NESHAP, as long as the course covers the areas specified in the regulation. EPA believes that Asbestos Hazard Emergency Response Act (AHERA) training courses will, for example, satisfy the NESHAP training requirements. However, nothing in this interpretive rule or in the NESHAP shall be deemed to require that roofing contractors or roofing workers performing operations covered by the NESHAP must be trained or accredited under AHERA, as amended by the Asbestos School Hazard Abatement Reauthorization Act (ASHARA). Likewise, state or local authorities may independently impose additional training, licensing, or accreditation requirements on roofing contractors performing operations covered by the NESHAP, but such additional training, licensing or accreditation is not called for by this interpretive rule or the federal NESHAP.

5.3. For removal of Category I asbestos containing roofing material where RB roof cutters or equipment that similarly damages the asbestos-containing roofing material are used, the NESHAP training requirements (§61.145(c)(8)) apply as discussed in Section I above. It is EPA's intention that removal of Category I asbestos-containing roofing material using hatchets, axes, knives, and/or the use of spud bars, pry bars and shovels to lift the roofing material, or similar removal methods that slice, punch, or shear the roof membrane are not subject to the training requirements, since these methods do not cause the roof removal to be subject to the NESHAP. Likewise, it is EPA's intention that roof removal operations involving Category II nonfriable ACM are not subject to the training requirements where such operations are not subject to the NESHAP as discussed in section I above.

[59 FR 31158, June 17, 1994, as amended at 60 FR 31920, June 19, 1995]

ATTACHMENT 2

South Carolina Department of Health
and Environmental Control

REGULATION 61-86.1
STANDARDS OF PERFORMANCE FOR ASBESTOS PROJECTS

Effective May 27, 2011

Bureau of Air Quality
SC Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
(803) 898-4123

Statutory Authority
Sections 44-1-140, 48-1-30, and 44-87-10 *et seq.*
of the 1976 South Carolina Code of Laws, as amended.

SOUTH CAROLINA
DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

REGULATION 61-86.1
STANDARDS OF PERFORMANCE FOR ASBESTOS PROJECTS

(Statutory Authority: Sections 44-1-140; 48-1-30; 44-87-10 *et seq.*
of the 1976 South Carolina Code of Laws, as Amended)

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(Statutory Authority: Sections 44-1-140; 48-1-30; 44-87-10 *et seq.*
of the 1976 South Carolina Code of Laws, as Amended)

SECTION I. - DEFINITIONS.

1. "Abatement" - Procedures to control fiber release from regulated asbestos-containing materials. This includes removal, enclosure, encapsulation, repair, and any associated preparation, clean up and disposal activities having the potential to disturb regulated asbestos-containing material.

2. "Adequately wet" - To sufficiently mix or penetrate with liquid to prevent the potential release of particulates. The absence of visible emissions is not sufficient evidence of being adequately wet.

3. "Aggressive clearance sampling" - A method of sampling which uses electric fan(s), electric leaf blower(s), and other devices to simulate vigorous activity in the abated area while air samples are being collected.

4. "AHERA" - Regulations developed pursuant to the Asbestos Hazard Emergency Response Act, 40 CFR Part 763, Asbestos Containing Materials in Schools (October 30, 1987).

5. "AIHA" - American Industrial Hygiene Association.

6. "Airlock" - A chamber which permits entrance and exit with minimum air movement between a contaminated area and an uncontaminated area, consisting of two doorways protected by two overlapping polyethylene sheets and separated by a sufficient distance such that one passes through one doorway into the chamber, allowing the doorway sheeting to overlap and close off the opening before proceeding through the second doorway. The airlock maintains a pressure differential between the contaminated and uncontaminated areas, thereby minimizing flow-through contamination further.

7. "Air sampler - A person licensed by the Department to implement air-monitoring plans and analysis schemes during abatement.

8. "Air sampling" - A method such as NIOSH 7400 for PCM, the OSHA Reference Method, 40 CFR 763 Appendix A for TEM, or an equivalent method accepted by the Department used to determine the fiber content of a known volume of air during a specified period of time.

9. "Amended water" - Water to which a surfactant (for example, a non-sudsing detergent) has been added.

10. "Area air sampling" - Any form of air sampling whereby the sampling device is placed at a stationary location either inside or outside the regulated work area.

11. "Asbestos" - The asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), cummingtonite-grunerite (amosite), anthophyllite, and actinolite-tremolite.

12. "Asbestos abatement entity" - Any individual, partnership, firm, association, corporation, sole

proprietorship or other business concern, as well as an employee or member of any governmental, religious, or social organization that is involved in asbestos abatement.

13. “Asbestos containing material (ACM)” - Material containing asbestos of any type, either alone or mixed with other materials, in an amount greater than one percent (1%) as determined by using the method specified in 40 CFR Part 763, Appendix A, Subpart F, Section 1, as amended, or an accepted equivalent. (NOTE: “Appendix A to Subpart F” has been redesignated as, and shall hereinafter be referred to as, “Appendix E to Subpart E” - 60 FR 31917, June 19, 1995.)

14.“Asbestos containing waste materials” - As applied to demolition and renovation operations, this term includes regulated asbestos-containing waste materials and materials contaminated with asbestos, including disposable equipment and clothing.

15. “Asbestos project” - Any activity associated with abatement including inspection, design, air monitoring, in-place management, encapsulation, enclosure, renovation, repair, removal, any disturbance of regulated asbestos containing materials (RACM), and demolition of a facility.

16. “Asbestos project design” - A written or graphic plan prepared by an accredited project designer specifying how an asbestos abatement project will be performed that includes, but is not limited to, scope of work and technical specifications.

17. “Asbestos training course” - A Department-approved initial or refresher course in any discipline listed herein (for example, workers, supervisors, management planners, etc.) that meets the requirements of this regulation and is acceptable for licensing purposes.

18. “Asbestos training course instructor” - A Department-approved individual who will teach work practice topics, non-work practice topics, and/or hands-on topics in any Department-approved initial and/or refresher training course and who meets the qualifications of this regulation.

19. “Asbestos training course provider” - The person, sole proprietorship, public corporation, or incorporated entity that meets the qualifications of this regulation to provide instruction in any of the work practice topics or disciplines, non-work practice topics, and/or hands-on topics in any Department-approved initial and/or refresher training course.
20. “ASHARA” - Regulations developed pursuant to 40 CFR Part 763, Subpart E, Appendix C Model Accreditation Plan, Asbestos School Hazard Abatement Reauthorization Act (November 28, 1992).

21. “Authorized visitor” - The facility owner/operator, or any representative of a regulatory or other agency having jurisdiction over the project. This is limited to government project inspectors, police, paramedics, fire-safety personnel, nuclear plant operators, and insurance loss prevention safety auditors, or other personnel as approved on a case-by-case basis by the Department.

22. “Background monitoring” - Area sampling performed prior to abatement to obtain an index of existing airborne fiber levels under typical activity.

23. “Building inspection” - An activity undertaken at a facility by a Department-licensed asbestos building inspector to determine the presence and location of regulated and non-regulated ACM, and to assess the condition of materials identified as ACM. This includes visual or physical examination and bulk sample collection.

24. “Building inspector” - A person licensed by the Department to examine a facility for the presence of ACM, to identify and assess the condition of the material, and to collect bulk samples.

25. “Category I nonfriable asbestos containing material (ACM)” - Nonfriable asbestos or nonfriable asbestos-containing packing, gaskets, and resilient floor covering; and asphalt roofing products containing greater than one percent (1%) asbestos as determined using the method specified in 40 CFR Part 763, Appendix E, Subpart E, or an accepted equivalent.

26. “Category II nonfriable ACM” - Any material that cannot, when dry, be crumbled, pulverized, or reduced to powder by the forces expected to act upon it in the course of demolition or renovation operations, excluding Category I nonfriable ACM and containing greater than one percent (1%) asbestos as determined using the methods specified in 40 CFR Part 763, Appendix E, Subpart E, or an accepted equivalent.

27. “Clean room” - An uncontaminated area or room that is part of the decontamination enclosure system and that has provisions for storage of street clothing and protective equipment.

28. “Clearance monitoring” - Area air sampling performed using Department accepted aggressive clearance sampling techniques to determine the airborne concentrations of residual fibers upon conclusion of asbestos abatement.

29. “Commercial labor provider” - Any individual, partnership, corporation, or other business concern that is not engaged in an asbestos project but does provide temporary workers or supervisors to the owner/operator of the project.

30. “Contractor” - Any individual, partnership, corporation or other business concern that performs asbestos abatement but is not a permanent employee of the facility owner.

31. “Control measure” - Use of amended water, negative pressure differential equipment, encapsulant, high efficiency particulate air filtration device, glove-bag or other state-of-the-art equipment designed to prevent fiber release into the air.

32. “Critical barrier” - At minimum, two independent layers of 6-mil plastic sheeting applied to any opening into a work area in a manner that creates a leak-tight seal within the work area to isolate vents, windows, doors, switches, outlets, and any other cavity or opening to the contaminated work area.

33. “Cut” - To penetrate with a sharp-edged instrument. This includes sawing, but may not include shearing, slicing, or punching.

34. “Decontamination enclosure system” - An enclosed area adjacent and connected to the regulated work area consisting of an equipment room, shower area, and clean room, each separated by airlocks, that is used for the decontamination of employees, materials, and equipment that are contaminated with asbestos.

35. “Demolition” - Wrecking or taking out any load-supporting structural member of a facility together with any related handling operations, the burning of any facility, or moving of a structure.

36. “Department” - The South Carolina Department of Health and Environmental Control’s Asbestos Section.

37. “Electrical generating facility” - Any establishment primarily engaged in the generation, transmission and/or distribution of electrical energy for sale.

38. “Emergency operation” - A renovation or demolition operation that was not planned but results from a sudden, unexpected event that, if not immediately attended to, will present an imminent safety or public

health hazard, will cause equipment damage, or will impose an unreasonable financial burden. This term specifically excludes routine equipment maintenance.

39. “Encapsulation” - A form of abatement involving the treatment of regulated asbestos-containing material (RACM) with a liquid that covers the surface with a protective coating (bridging) or embeds fibers in an adhesive matrix (penetrating) to prevent the release of asbestos fibers.

40. “Enclosure” - A form of abatement involving placement of a leak-tight, impermeable, permanent barrier to prevent access to regulated asbestos-containing material and to prevent the release of asbestos fibers.

41. “EPA” - United States Environmental Protection Agency.

42. “Equipment room” - A contaminated area or room that is part of the decontamination enclosure system and that has provisions for the storage of contaminated clothing and equipment.

43. “Examination date” - The date printed on the Departmental Asbestos Abatement License that indicates the date of successful completion of an examination administered upon completion of an asbestos training course.

44. “F/cc” - Fibers per cubic centimeter.

45. “Facility” - Any institutional, commercial, public, industrial, or residential structure, installation, or building (including any structure, installation, or building containing condominiums or individual dwelling units operated as a residential cooperative, but excluding residential buildings having four or fewer dwelling units); any bridge; any ship; and any active or inactive waste disposal site. For purposes of this definition, any building, structure, or installation that contains a loft used as a dwelling is not considered a residential structure, installation, or building. Any structure, installation or building that was previously subject to this requirement is included in this definition, regardless of its current use or function.

46. “Facility component” - Any part of a facility including equipment.

47. “Friable” - Refers to ACM, which may, when dry, be crumbled, pulverized, or reduced to powder by the forces expected to act upon it in the course of demolition or renovation operations. This also refers to previously non-friable ACM after such material becomes damaged to the extent that when dry, can be or has been crumbled, pulverized, or reduced to powder.

48. “Friable asbestos containing material” - Any material that, when dry, can be or has been crumbled, pulverized, or reduced to powder and contains greater than one percent (1%) asbestos as determined using the method specified in 40 CFR Part 763, Appendix E, Subpart E, as amended, or an accepted equivalent.

49. “Goose neck” - Process for sealing the outer bag by twisting the opening of the bag, folding twisted portion of bag over, and creating a loop. Adequately secure the opening of the bag to the base of the twist, using duct tape.

50. “Glovebag” - A sealed compartment with attached inner gloves used for the handling of asbestos-containing materials. Information on glovebag installation, equipment and supplies, and work practices is contained in the Occupational Safety and Health Administration’s (OSHA’s) final rules on occupational exposure to asbestos, 29 CFR 1926.1101 (August 10, 1994), as amended, and any subsequent amendments or editions.

51. “Grind” - To reduce to powder or small fragments. Grinding includes mechanical chipping or drilling.

52. “HEPA filter” - A high efficiency particulate air filter that will capture particles with an aerodynamic diameter of 0.3 micrometers with a minimum efficiency of 99.97 percent.

53. “Homogeneous area” - Area of surfacing material, thermal system insulation material, or a miscellaneous material that is uniform in color or texture.

54. “HVAC” - Heating, ventilation, and air conditioning.

55. “Industrial manufacturing facility” - Any establishment whose Standard Industrial Classification code falls within Major Groups 20 through 39, excluding any office space that is part of such an establishment.

56. “In poor condition” - Refers to any ACM where the binding of the material is losing its integrity as indicated by peeling, cracking, or crumbling of the material.

57. “Installation” - Any building or structure or any group of buildings or structures at a single demolition or renovation site that are under the control of a single owner or operator (or of owners or operators under common control).

58. “Issue date” - The date a license is issued by the Department.

59. “Leak-tight” - Dust, solids, or liquids cannot escape or spill out.

60. “License” - A document issued by the Department that allows an asbestos abatement contractor, building inspector, project designer, management planner, air sampler, supervisor, worker, or other to engage in asbestos projects.

61. “Long-term, in-house contractor” - A contractor having a long-term, often multi-year, contractual arrangement with an industrial manufacturing or electrical generating facility to provide construction and maintenance services, including asbestos abatement. The employees of a designated long-term, in-house contractor shall be covered under the group license of the assigned facility.

62. “Management planner” - A person licensed in accordance with the requirements of this regulation who interprets inspection reports, conducts hazard assessments of asbestos-containing materials, determines appropriate response actions, develops a schedule for implementing response actions, and prepares written management plans.

63. “Manometer” - Instrument for the measurement of gas pressure whose units are represented in inches of water column.

64. “Minor project” - A project where 25 or fewer square or linear feet of regulated asbestos-containing material (RACM) are removed, or where 10 or fewer cubic feet of RACM off a facility component are cleaned up.

65. “Movable object” - A structure within the work area that can be moved (e.g., chair, desk, etc.).

66. “Negative pressure differential equipment” - A portable exhaust system equipped with a HEPA filter.

67. “NESHAP” - National Emission Standards for Hazardous Air Pollutants, 40 CFR 61, Subpart M, February 3, 1994, as amended, and any subsequent amendments or editions.

68. “NESHAP project” - An asbestos project which involves at least 160 square feet or 260 linear feet of regulated asbestos containing material (RACM), or 35 or more cubic feet of RACM off a facility component such that the area or length could not be measured prior to abatement. If several contemporaneous projects in the same area within the same building being performed by the same contractor are smaller than 160 square or 260 linear feet individually but add up to that amount, then the combination of the smaller projects shall be considered one NESHAP project.

69. “NIOSH” - National Institute for Occupational Safety and Health.

70. “Non-industrial facility”- Any public, private, institutional or governmental entity that does not meet the definition of an electrical generating or industrial manufacturing facility as defined in this regulation.

71. “Operation and maintenance (O&M) activity” - The disturbance of regulated asbestos-containing material only when required in the performance of an emergency or routine maintenance activity that is not intended solely as asbestos abatement. In no event shall the amount of ACM disturbed exceed that which can be contained in one glovebag or 6-mil polyethylene bag that shall not exceed 60 inches in length and width.

72. “O&M worker” - An individual licensed under a facility group license to perform an operation and maintenance activity at that facility.

73. “OSHA” - Occupational Safety and Health Administration.

74. “Owner/operator” - Any person or contractor who owns, leases, operates, controls, or supervises a facility being demolished or renovated, or any person who operates, controls, or supervises the demolition or renovation operation, or both.

75. “Owner’s representative” - A licensed supervisor, management planner, project designer, or air sampler designated by the facility owner to manage the asbestos project, and who serves to ensure that abatement work is completed according to specification and in compliance with all relevant statutes and regulations.

76. “Personal air sampling” - A method used to obtain an index of an employee’s exposure to airborne fibers. Samples are collected outside the respirator in the worker’s breathing zone.

77. “Planned renovation operations” - A renovation operation, or a number of such operations, in which some RACM will be disturbed, removed, or stripped within a given period of time and that can be predicted. Individual non-scheduled operations are included if a number of such operations can be predicted to occur during a given period of time based on operating experience.

78. “Project designer” - A person licensed in accordance with the requirements of this regulation who is directly responsible for planning all phases of an asbestos abatement project design from project site preparation through complete disassembly of all abatement area barriers.

79. “Reciprocity” - A written agreement between another state and South Carolina to use the same or equivalent auditing criteria when evaluating training course materials, course presentations, and instructor qualifications.

80. “Regulated area” - An area established by the owner/operator of an asbestos project to demarcate areas where asbestos abatement activities are conducted; any adjoining area where debris and waste from such asbestos work is stored; and any work area within which airborne concentrations of asbestos exceed,

or there is a reasonable possibility they may exceed, the permissible exposure limit.

81. “Regulated asbestos-containing material (RACM)” - (a) Friable asbestos-containing material; (b) Category I nonfriable ACM that has become friable; (c) Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, drilling, or abrading; or (d) Category II nonfriable ACM that is likely to become or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations subject to this regulation.

82. “Removal” - Taking out RACM or facility components that contain or are covered with RACM from any facility.

83. “Renovation” - Altering a facility or one or more facility components in any way, including the stripping or removal of RACM from a facility component. Operations in which load-supporting structural members are wrecked or taken out are demolitions.

84. “Repair” - Returning damaged asbestos-containing material to an undamaged condition or to an intact state so as to prevent fiber release.

85. “Resilient floor covering” - Asbestos-containing floor tile, including asphalt and vinyl floor tile, and sheet vinyl floor covering containing greater than one percent (1%) asbestos as determined using polarized light microscopy according to the method specified in 40 CFR Part 763, Appendix E, Subpart E, Polarized Light Microscopy, or an accepted equivalent.

86. “Shower room” - A room located between the clean room and the equipment room in the decontamination enclosure system containing a shower with hot and cold or warm running water controllable at the tap.

87. “Small project” - A project where more than 25 but fewer than 160 square feet or more than 25 but fewer than 260 linear feet of RACM are to be abated, or where more than 10 but fewer than 35 cubic feet of RACM off a facility component are to be cleaned up.

88. “Start date” - The date printed on the Departmental-issued asbestos abatement project license, which indicates when asbestos renovation or demolition operations, including any abatement activity having the potential to disturb RACM, will begin.

89. “Strip” - To remove RACM from any part of a facility or facility component.

90. “Structural member” - Any load-supporting member of a facility, such as beams and load-supporting walls; or any non-load-supporting member, such as ceilings and non-load-supporting walls.

91. “Structures per square millimeter” - Reporting measure for Transmission Electron Microscopy (TEM) Analysis. TEM clearance requires fewer than 70 structures per square millimeter (70s/mm^2).

92. “Supervisor” - A person licensed by the Department and designated as the contractor’s representative to provide direct on-site supervision and guidance to workers engaged in abatement of RACM.

93. “Surfactant” - A chemical wetting agent added to water to improve penetration, such as a non-sudsing detergent.

94. “Temporary storage license” - A license issued by the Department that authorizes storage of asbestos waste from small and minor projects at a secure location deemed acceptable by the Department.

95. “Variance” - Written Departmental approval for the use of alternative work practices at an asbestos project.

96. “Visible emissions” - Any emissions that are visually detectable without the aid of instruments that originate from RACM or asbestos-containing waste material or a regulated work area.

97. “Waste generator” - Any owner/operator of an asbestos project covered by this regulation whose act or process produces asbestos-containing waste material.

98. “Waste shipment record” - The shipping document, required to be originated, prepared, and signed by the waste generator, used to track and substantiate the disposition of asbestos-containing waste material.

99. “Wet cleaning” - The process of removing asbestos contamination from facility surfaces and objects by using cloths, mops, or other cleaning tools that have been dampened with amended water.

100. “Work area” - Designated rooms, spaces, or areas in which asbestos abatement activities are to be undertaken, or that may be contaminated as a result of such abatement activities.

101. “Worker” - A person licensed by the Department to perform asbestos abatement under the direct guidance of an accredited and licensed supervisor.

102. “Working day” - Monday through Friday, including holidays that fall on any of the days Monday through Friday.

SECTION II. - APPLICABILITY

A. The requirements of this regulation shall apply to: any owner/operator, building inspector, management planner, project designer, contractor, asbestos abatement entity, air sampler, commercial labor provider, supervisor, worker, non-industrial facility owner and/or operator, or demolition contractor involved in the inspection, in-place management, design, removal, encapsulation, enclosure, renovation, repair, demolition activity, or any other disturbance of RACM; and any asbestos training course provider or asbestos training course instructor who conducts mandatory asbestos training courses.

B. There are no size limits for abatement projects involving RACM for which the applicable requirements of this regulation shall not apply unless otherwise specified.

C. An owner/operator may request that the Department determine whether a project is an asbestos project subject to the requirements of this regulation.

D. Asbestos projects occurring at a private residential structure of four units or fewer may be exempt from the requirements of this regulation unless:

1. Performed by a person or persons holding an asbestos abatement license.

2. Performed as part of a larger commercial or public project, such as, but not limited to, highway construction; development of a shopping mall, industrial facility, other private development; or urban renewal, etc.

3. The project involves multiple structures within a compact area (“city block”) under the ownership and/or control of a single owner and/or operator. Examples would be a municipality clearing a block of houses for urban renewal purposes or SCDOT clearing a row of houses for a highway-right-of-way

project.

4. The structure meets the definition of an installation.

5. The residential structure is being burned for fire training.

E. If asbestos projects occur at separate buildings (different school buildings, for example) then each separate building shall be considered a separate project.

SECTION III. - ASBESTOS LICENSE FEE SCHEDULE.

A. Applicability.

1. The requirements of this Section shall apply to: any owner/operator, asbestos abatement entity, building inspector, management planner, project designer, contractor, asbestos abatement entity, air sampler, commercial labor provider, supervisor, worker, non-industrial facility owner and/or operator, demolition contractor involved in the inspection, in-place management, design, removal, renovation, encapsulation, enclosure, repair, clean-up, demolition activity, or any other disturbance of RACM; and any asbestos training course provider or asbestos training course instructor who conducts mandatory asbestos training courses.

2. Acceptable methods of payment shall be by check or money order made payable to SCDHEC, by credit card (VISA, MasterCard, or Discover), or cash.

3. Each separate building at a multi-building site shall be considered a separate asbestos project, and fees will be assessed for each.

B. Personnel Licensing Fees.

1. No application will be processed unless accompanied by the required fee.

2. Departmental receipt and deposit of fees submitted with an application shall in no way indicate approval of the application or guarantee the issuance of a license.

3. Fees shall not be refunded if a license application is denied per Section IV.F.

4. Fees for any duplicate original license shall be $10.00.

5. Fee schedule: Individual license fees are assessed on a per person per discipline basis.

a. Contractor - $100.00

b. Building Inspector - $100.00

c. Air Sampler - $100.00

d. Supervisor (Any type) - $50.00

e. Worker (Any type) - $10.00

6. Facility Operation & Maintenance (O&M) Worker Group License Fee Schedule:

a. The minimum fee for an O&M Worker Group License is $25.00 and the maximum is $500.00.

b. Fee Schedule:

(1) Up to 10 people - $25.00 minimum fee

(2) 11 to 20 people - $2.50 per person

(3) 21 to 50 people - $5.00 per person

(4) 51 to 90 people - $7.50 per person

(5) 91 or more persons - $500.00 minimum fee

C. Renovation Project Fees.

1. The Department shall collect project license fees based on all RACM being removed and ACM rendered regulated by use of destructive removal techniques such as chipping, grinding, sawing, abrading, drilling, or extensive breaking.

2. Abatement project fees for regulated asbestos-containing materials (RACM) are calculated at 10 cents per linear, square, or cubic foot, with a minimum fee of $25.00 and a maximum fee of $1,000.00.

3. The Department shall not issue an abatement project license for a renovation or demolition until all requested information has been submitted and reviewed and all applicable fees have been paid.

4. Fees shall not be refunded for projects for which the Department has issued an asbestos project license.

5. An abatement project license that has been issued shall automatically become invalid if an instrument of payment is returned for insufficient funds.

D. Demolition Project Fees.

1. The Department shall charge a fee of $50.00 to issue a project license for demolition projects.

2. A project license is required for every facility to be demolished, including any facility in which the required building survey indicates there is no ACM present.

3. The Department shall not issue a project license for a demolition until all requested information has been submitted and reviewed, and all applicable fees have been paid.

4. Fees shall not be refunded for projects for which the Department has issued a project license.

5. A project license that has been issued shall automatically become invalid if an instrument of payment is returned for insufficient funds, and the licensee shall be subject to enforcement action for operation without a valid license.

SECTION IV. - PERSONNEL LICENSING REQUIREMENTS.

A. Applicability.

1. No person or contractor shall engage in any asbestos project or abatement involving RACM, or ACM rendered regulated by removal techniques or methods, unless licensed to do so by the Department.

2. Every contractor, supervisor, worker, air sampler, project designer, building inspector, or management planner who engages in any asbestos project shall have a current and valid license specific to the duties performed under the license.

3. When a person or contractor engaged in an asbestos project performs duties in more than one discipline, a separate license shall be obtained specific for each discipline. However, a management planner may perform the duties of a building inspector, and a supervisor may perform the duties of a worker without having to obtain separate licenses.

4. A license in any discipline shall only be utilized in accordance with the conditions and provisions contained in the license.

5. When an individual or a company for hire plans to remove RACM, a Department-issued asbestos contractor license must be obtained prior to performing abatement.

B. Training Documentation.

Acceptable documentation of training shall be:

1. An original certificate issued by a Department-approved training course provider and that meets the requirements specified in this regulation; or

2. A valid, original license or accreditation (photocopies or telephone facsimile transmissions shall not be accepted) issued by a state with which the Department has a reciprocal arrangement; or

3. A letter verifying successful completion of training, which includes the name, last four digits of Social Security number, unique certificate number, test score, and printed name and signature of the course instructor and which is sent directly to the Department from the training provider.

C. License Application.

1. Each applicant seeking an asbestos personnel license in any discipline shall:

a. Successfully complete a Department-approved initial training course specific to the discipline and, at the conclusion of the course, pass an examination with a score of 70 percent or above;

b. Submit a completed application to the Department in a format designated by the Department;

c. Submit a color passport style photo or have a photo taken by the Department. Digital photos should be at least one mega pixel in resolution. Still photos should be a minimum of 2” x 2” and a maximum of 3” x 5”.

2. The application must state the type of license for which the application is being made and must include all of the following information:

a. Supervisor License:

(1) Applicant’s name, Social Security number, mailing address, telephone number, and, when

applicable, company affiliation; and

(2) Documentation of successful completion of an initial asbestos abatement five-day supervisor training course and all subsequent eight-hour refresher training courses, if applicable.

b. AHERA Worker License:

(1) Applicant's name, Social Security number, mailing address, telephone number, and, when applicable, company affiliation; and

(2) Documentation of successful completion of an initial asbestos abatement four-day worker training course and all subsequent eight-hour refresher training courses, if applicable.

c. Air Sampler License:

(1) Applicant's name, Social Security number, mailing address, telephone number, and, when applicable, company affiliation;

(2) Documentation of successful completion of an initial asbestos abatement five-day supervisor training course; and

(3) Documentation of successful completion of NIOSH 582 course or equivalent, or documentation that the applicant is a Certified Industrial Hygienist.

d. Project Designer License:

(1) Applicant's name, Social Security number, mailing address, telephone number, and, when applicable, company affiliation; and

(2) Documentation of successful completion of an initial three-day asbestos abatement project designer training course and all subsequent eight-hour refresher training courses.

e. Building Inspector License:

(1) Applicant's name, Social Security number, mailing address, telephone number, and, when applicable, company affiliation; and

(2) Documentation of successful completion of an initial three-day asbestos building inspector training course and all subsequent four-hour refresher training courses, if applicable.

f. Management Planner License:

(1) Applicant's name, Social Security number, mailing address, telephone number, and, when applicable, company affiliation; and

(2) Documentation of successful completion of an initial three-day asbestos building inspector training course and all subsequent four-hour refresher training courses, if applicable; and

(3) Documentation of successful completion of an initial two-day asbestos management planners' training course and all subsequent four-hour refresher training courses, if applicable.

g. Contractor's License:

(1) Company name, mailing address, street address, telephone number, name, and title of a responsible company official, registered agent with the South Carolina Secretary of State's office, and the Federal Employer Identification Number (FEIN); and

(2) The name and license number of a company employee who is currently licensed as a supervisor in affiliation with that company pursuant to this regulation, or an application completed as required herein for a supervisor's license for a company employee.

h. Non-Industrial Facility O&M Group License (this license is facility-affiliated only):

(1) The facility representative shall, on company letterhead, submit the name, Social Security number, and type of training received for each individual to be covered under the facility license; and

(2) Documentation shall be submitted in the form of an original initial and/or refresher asbestos training certificate that is discipline-specific for the duties to be performed by each individual covered under the facility license.

D. Continuing Education.

1. After successful completion of an approved initial training course, an applicant seeking a license in any discipline except that of Contractor shall thereafter successfully complete a Department-approved initial or refresher training course specific to the discipline and, at the conclusion of each course, shall pass an examination with a score of 70 percent or above.

2. If more than 12 months but fewer than 24 months have elapsed since completing an initial or refresher training course, an applicant shall successfully complete either a refresher training course or an initial training course.

3. If more than 24 months have elapsed since successfully completing an initial or refresher training course, an applicant shall complete an initial training course.

4. The Department may require additional initial or refresher training specific to the requirements of this regulation or to air sampling strategies.

E. Action on an Application.

1. Within 15 calendar days after receiving an application, the Department will acknowledge receipt of the application and notify the applicant of any deficiency in the application. Within 30 calendar days after receiving a completed application, including all additional information requested, the Department will issue a license or deny the application.

2. The Department reserves the right to request documentation to verify an applicant's previous training or accreditation in any discipline prior to issuing a license.

3. The Department reserves the right to request documentation, including Social Security numbers, to verify an applicant's identity prior to issuing a license.

F. Denial.

1. The Department shall deny an application if it determines that the applicant has not demonstrated the ability to comply with applicable requirements, procedures, and standards established by:

a. The Department as per South Carolina Regulation 61-86.1;

b. Chapter 87 of the 1976 South Carolina Code of Laws, as amended;

c. The U. S. Environmental Protection Agency as per:

(1) National Emission Standards for Hazardous Air Pollutants, 40 CFR Part 61, Subpart M, as amended, and any subsequent amendments and editions; and

(2) Asbestos-Containing Materials in Schools, 40 CFR Part 763, Subpart E, as amended, and any subsequent amendments and editions; and

d. Occupational Safety and Health Administration in 29 CFR Part 1926.1101 and 1910.1001, as amended, and any subsequent amendments and editions.

2. The Department shall deny a license to any applicant who has failed to comply with the requirements of a properly issued consent, administrative, or judicial order initiated by the Department.

3. The Department shall deny a license to any applicant if it determines that any information or documentation, including a Social Security number, required by this regulation is fraudulent or has been altered or falsified.

4. The Department shall deny a license to any applicant who fails to remit applicable fees.

5. The Department shall deny a license to any applicant who submits fraudulent or falsified information or documents.

6. The Department will not return fees submitted with any invalid or falsified training and/or identification documents submitted for the purposes of licensing.

7. The Department shall send notification of the denial of an application by certified mail, unless the individual is present when the application is evaluated, in which case the Department will inform the applicant in person of the denial.

8. Reapplication after denial. An application denied per this Section shall be resubmitted as follows:

a. For failure to comply with the requirements of a properly issued consent, administrative, or judicial order initiated by the Department, the application shall not be considered until the applicant complies with said order.

b. For altered or falsified documents**,** including but not limited to, training certificates, Social Security cards or numbers, and photo IDs, the application shall not be considered by the Department prior to 180 days after receipt of such documents and will only be considered thereafter with proper proof of the applicant having successfully completed an initial course in the discipline in which licensure is sought.

c. For failure to remit applicable fees, the application shall not be considered until all applicable fees have been received.

9. The applicant may request a hearing pursuant to the provisions of this regulation.

G. Conditions and Generic Alternatives.

In granting a license, the Department may impose reasonable terms and conditions to ensure continuous compliance with the requirements of this regulation.

H. Duration of Licenses.

1. A license shall automatically become invalid if an instrument of payment is returned for insufficient funds.

2. A Contractor's license shall expire one year from the issue date, unless the Department suspends or revokes the license at an earlier date. A Contractor's license shall be considered invalid unless at least one company employee maintains a current, company-affiliated supervisor's license pursuant to this regulation.

3. All other licenses shall expire one year from the examination date printed on the license, which is based on the most recent acceptable training certificate submitted with the application, unless the Department suspends or revokes the license at an earlier date.

4. No license shall be extended beyond its expiration date.

SECTION V. - ASBESTOS PROJECTS/GENERAL INFORMATION.

A. Applicability.

The requirements of this Section shall apply to the owner/operator, building inspector, management planner, project designer, air sampler, supervisor, worker, non-industrial facility owner/operator, or demolition contractor of any asbestos project involving the disturbance of RACM or ACM.

B. General Requirements.

1. A person licensed as an asbestos project designer shall prepare the written design for each abatement renovation project involving the removal of greater than 3,000 square, 1,500 linear or 656 cubic feet of RACM in a facility. However, all projects must be designed in accordance with 40 CFR 763.90(g) (*Federal Register*, Volume 52, Number 210, Friday, October 30, 1987), as amended, and any subsequent amendments and editions, and this regulation.

2. The asbestos project design must address:

a. Preparation of each asbestos-related work area;

b. Establishment of each containment;

c. Establishment of each decontamination unit and procedures for use;

d. Evaluation and selection of various fiber release control options;

e. Establishment, maintenance, and monitoring of negative air pressure within each containment;

f. RACM enclosure, removal, encapsulation, or repair work practices;

g. Visual inspection procedures for each asbestos abatement containment area;

h. Clean-up and final clearance procedures;

i. Air monitoring, including analysis, documentation, and any other required record keeping;

j. Respiratory protection and personal protective equipment requirements;

k. Procedures for on-site storage, handling, and disposal of ACM and project waste; and

l. Procedures for maintaining personnel licenses and training certificates on-site.

3. An owner/operator shall obtain an asbestos project license from the Department prior to beginning any NESHAP, small, minor, or demolition asbestos project subject to this regulation unless reporting quarterly as specified herein or in the case of an emergency removal.

4. When air monitoring is required by this regulation, the facility owner shall utilize a person licensed as an air sampler and ensure that all air monitoring is performed.

5. When any negative pressure enclosure or contained work area is required for any sized asbestos abatement project or demolition project, the following requirements shall apply:

a. There shall be sufficient negative pressure differential equipment to ensure at least four air changes per hour;

b. A minimum of -0.02 column inches of water pressure differential, relative to outside pressure, shall be maintained as verified and recorded by a manometer;

c. The manometer record of daily readings (to be taken four times during every eight-hour work shift by a licensed air sampler independent from the contractor) verifying the negative pressure shall be maintained at the job site for Department review for the duration of the project;

d. The inlet sensor of the manometer shall be located at the farthest point from any source of make-up air;

e. The manometer must be calibrated prior to the start of each work shift;

f. Negative pressure shall be maintained until final clearance has been achieved; and

g. Air movement shall be directed away from employees performing asbestos work within the enclosure/containment and toward a HEPA filtration or other collection device.

6. The owner/operator shall notify the Department by telephone and follow up in writing as soon as possible, but not later than, the following working day when a project has been canceled.

7. The disposal requirements of this regulation shall be applicable to all asbestos-containing and asbestos-contaminated materials for any abatement activity.

8. The owner/operator shall ensure that contaminated water is filtered through a five-micron or smaller filter and discharged to a sanitary sewer system. No contaminated or filtered water shall be allowed to leak or drain outside of the work area.

C. Other Requirements at the Project Sites.

1. Every asbestos abatement entity performing abatement work shall have at the project site a legible, clear copy of a valid current initial or refresher training certificate issued by an approved training provider.

2. Every asbestos abatement entity performing abatement work shall have a clear, legible copy of a valid Department-issued personnel license at the project site.

3. For the duration of an abatement project, the asbestos owner/operator shall ensure that:

a. Each worker and supervisor employed at the abatement project site meets the applicable training and licensing requirements of this regulation.

b. At all times while abatement (including preparation, removal, and cleanup) of RACM is being performed at NESHAP and small projects, at least one licensed supervisor remains inside of each contained work area supervising the work. During abatement at regulated roofing projects, the supervisor shall be in the immediate work area supervising the work.

c. A means is available at all times during abatement at NESHAP and small abatement projects for Department inspectors or other authorized visitors to communicate with persons within the immediate contained work area in order to gain access.

d. For the duration of the asbestos project, a daily log containing the name and signature of every individual entering the negative pressure enclosure/regulated area shall be maintained on site.

e. The contained work area is secured at all times to prevent access of unauthorized visitors or unprotected persons.

f. Legible copies of Department letters of approval for alternative work practices are at the project site and available for inspection for the duration of abatement.

4. The contractor shall not proceed with abatement unless the air sampler fulfills all specified air monitoring requirements.

5. Commercial labor providers shall ensure that each worker or supervisor has completed appropriate training as specified in this regulation.

D. Alternative Work Practices for Any Sized Asbestos Project.

1. The Department may, on a case-by-case basis, approve and issue a variance for an alternative procedure for control of emissions from an asbestos abatement project, provided the owner/operator submits a written description of the alternative procedure to the Department prior to beginning work and demonstrates to the satisfaction of the Department that compliance with the prescribed procedures will not be practical or feasible, and that the proposed alternative procedures provide equivalent protection from asbestos exposure.

2. The owner/operator shall keep a copy of the Department's written approval at the work site and make it available for review by Department personnel upon request.

E. Emergency Operation.

1. For an emergency operation, the owner/operator must notify the Department by telephone (outside of normal business hours, an electronically recorded verbal notification is acceptable for approval to execute the emergency operation) and must submit a project notification/application as early as possible before, but not later than, the working day following the emergency operation. The notification/application may be transmitted via facsimile.

2. The facility owner shall notify the Department in writing of the date and hour that the emergency occurred; a description of the sudden, unexpected event; and an explanation of how the event caused an unsafe condition, public safety or health threat, equipment damage or would impose an unreasonable financial burden. The owner shall submit this information with the project notification/application.

SECTION VI. - ASBESTOS BUILDING INSPECTION REQUIREMENTS.

A. Applicability.

1. Prior to beginning a renovation or demolition operation at any facility, the facility owner and/or owner's representative shall ensure that an asbestos building inspection is performed to identify the presence of ACM.

2. The asbestos building inspection shall include the facility or part of the facility affected by the renovation or demolition operation.

3. The facility owner and/or owner's representative shall ensure the asbestos building inspection is completed by a person licensed as an asbestos building inspector or management planner.

4. When materials that will be disturbed by the renovation or demolition operation are assumed to be asbestos without the use of laboratory bulk sample results, the provisions of Section VI.A.3 of this regulation does not apply.

5. In a multi-unit building, each separate room in each part of the building or areas affected by the renovation or demolition operation shall be inspected to confirm and quantify ACM homogeneous areas for sampling purposes.

6. To be acceptable, a building inspection shall have been performed no earlier than three years prior to the renovation or demolition, or, if more than three years have elapsed since the most recent inspection, the previous inspection shall be confirmed and verified by a person licensed as a building inspector.

7. The Department will not accept an asbestos building inspection or written report for any structure from an employee of an abatement company also involved in the removal of asbestos-containing materials from that structure, unless the licensed inspector is an employee of an entity regulated under Section XX of this regulation.

8. An asbestos building inspector shall not participate in the analysis of the bulk samples he or she has collected.

B. Asbestos Inspection.

The building inspector or management planner shall:

1. Visually inspect the areas that may be affected by the renovation or demolition operation to identify the locations of all suspected ACM. For a pre-demolition inspection, destructive sampling techniques shall be utilized;

2. Touch all suspected ACM to determine condition, friability, and whether ACM is a regulated material in areas that may be affected by the renovation or demolition operation;

3. Identify all homogeneous areas of suspected ACM in areas that may be affected by the renovation or demolition operation;

4. In areas that may be affected by the renovation or demolition operation, assume that some or all of the homogeneous areas are ACM, and/or for each homogeneous area that is not assumed to be ACM, collect and submit bulk samples for analysis in compliance with this Section;

5. Material Safety Data Sheets (MSDS), statements from the manufacturer, and architecture signoff will not be accepted as proof that a building product contains no asbestos, except in cases where the owner can verify the direct correlation of the building product to the MSDS, statements from the manufacturer, and/or architecture signoff documents. The Department reserves the right to reject documentation that it deems unacceptable.

C. Asbestos Inspection Report Contents.

1. Prior to each demolition operation and upon request for renovations, the Department shall be provided with a complete, legible copy of the asbestos building inspection report.

2. The inspection report shall include:

a. A title page denoting:

(1) The client's name, company, address, and telephone number, and the name and exact location of the facility inspected;

(2) The date the inspection was performed;

(3) The date the inspection report was written; and

(4) The printed name and telephone number of the inspector(s), and his or her affiliated company name, address, and telephone number.

b. A cover letter to the building owner or owner's representative that describes the purpose of the inspection; a general synopsis of the inspection and results; and the name, title, and signature of the inspector(s) and report writer, if different.

c. A detailed narrative of the physical description of the building or part of the building affected by the renovation or demolition operation that includes:

(1) The square footage of the building or part of the building affected by the renovation or

demolition operation;

(2) The building materials used in the construction of the exterior, roof, interior, and basement or crawlspace of the building affected by the demolition or affected by the renovation materials operation; and

(3) An estimated or exact quantity (square or linear feet) for all suspect materials whether sampled for or assumed to be asbestos that may be affected by the renovation or demolition operation;

(4) Also include a description of non-suspect materials excluding: glass, metals, kiln brick, cement, fiberglass, concrete, pressed wood, cinder block, and rubber.

d. An executive summary that details:

(1) The type of suspect ACM (e.g., TSI, floor tile, mastic), total square or linear footage, and the total number of samples collected for each separate homogenous area affected by the renovation or demolition operation;

(2) The date of the inspection, type, condition, quantity, sample results, and exact location of ACM positively identified or assumed to be ACM in the part of the building affected by the renovation or demolition operation; and

(3) A list of the homogeneous areas identified are:

(a) Surfacing material that includes, but is not limited to, joint compound; plaster; and painted, troweled on, or spray-applied textured material;

(b) Thermal system insulation (TSI) that includes, but is not limited to, pipe and boiler insulation; or

(c) Miscellaneous material that includes, but is not limited to, flooring, roofing, mastics, gaskets, cementitious materials, caulkings, ceiling tiles, fire doors, wall boards, and flexible duct connections;

(4) Whether the material is accessible for the building or part of the building affected by the renovation or demolition operation; and

(5) The material's potential for disturbance for the building or part of the building affected by the renovation or demolition operation.

e. For renovation and demolition operations, the inspector’s determination that ACM is friable or non-friable.

f. Except when suspect ACM materials are assumed to be asbestos, include a complete, clear, legible copy of all laboratory bulk sample results.

g. Clear, legible drawings and/or photographs to clarify the scope of the renovation or demolition operation. Illustrate the exact location of each sample collected. For facilities that involve a trade secret or confidential component or an affected area process, a request for a variance may be submitted.

h. The printed name and signature of each accredited inspector who collected the samples, and a

clear legible copy of his or her Department issued asbestos building inspector or management planner license.

D. Sampling.

1. A licensed asbestos inspector shall collect, in a statistically random manner, a minimum of three bulk samples from each homogeneous area of any surfacing that is not assumed to be ACM, and shall collect the samples as follows:

a. At least three bulk samples shall be collected from each homogeneous area that is 1,000 or fewer square feet (sf) or linear feet (Lf) in size.

b. At least five bulk samples shall be collected from each homogeneous area that is greater than 1,000 but fewer than or equal to 5,000 sf or Lf.

c. At least seven bulk samples shall be collected from each homogeneous area that is greater than 5,000 sf or Lf.

2. A licensed asbestos inspector shall collect, in a statistically random manner, at least three bulk samples from each homogeneous area of TSI and any miscellaneous material that is not assumed to be ACM. In accordance with ASTM E2356, and any subsequent amendments and editions, negative results for non-friable organically bound materials such as flooring and roofing shall be verified with at least one TEM analysis.

3. Each owner/operator shall have all bulk samples collected per this regulation analyzed for asbestos using laboratories accredited by the National Institute of Standards and Technology (NIST), National Voluntary Laboratory Accreditation Program (NVLAP), or an equivalent standard as approved by the Department.

4. Bulk samples shall be analyzed for asbestos content by polarized light microscopy (PLM) using the "Interim Method for the Determination of Asbestos in Bulk Insulation Samples" found in Appendix E to subpart E of 40 CFR 763, the "Method for the Determination of Asbestos in Bulk Building Materials" (EPA/600/R-93/116), ASTM E2356, or other method(s) deemed acceptable by the Department on a case-by-case basis.

5. A homogeneous area is not considered to contain ACM only if the results of all samples required to be collected from the area show asbestos in amounts of one percent (1%) or less.

6. A homogeneous area shall be determined to contain ACM based on a finding that the results of at least one sample collected from that area shows that asbestos is present in an amount greater than one percent (1%).

SECTION VII. - STANDARDS FOR AIR SAMPLERS.

A. Applicability.

This Section shall apply to each owner, owner's representative and/or air sampler engaged in an asbestos project where air sampling is required.

B. General Requirements.

1. Area air sampling shall be performed by a licensed air sampler.

2. Abatement air sampling data collected by a licensed air sampler under contract with or employed by the asbestos contractor performing the abatement will not be acceptable to the Department.

3. Air sampling shall be conducted using collection media, procedures, and analytical methods in accordance with NIOSH Method 7400 when Phase Contrast Microscopy (PCM) is used, and with *Electron Microscope Measurement of Airborne Asbestos Concentrations* [EPA Report 600/2-77-178 (1978) and EPA Contract No. 68-02-3266 (1984)] when Transmission Electron Microscopy (TEM) is used.

4. Any alternative procedure for clearance sampling shall require prior written approval from the Department. The written request must provide a detailed description of the alternative procedure and an explanation of how it will provide an equivalent level of protection to facility occupants.

5. The air sampler shall:

a. Ensure that all air sampling pumps are accurately calibrated prior to operation by utilizing a rotometer that has been calibrated within the past six months using a primary standard, such as a bubble burette or a dry calibrator. Calibration data shall be maintained at the project site for the duration of abatement.

b. Ensure that all air sampling pumps are operating properly and that the filtered sampling cassettes are securely attached to the pumps for the duration of sampling.

c. Maintain current background, daily, and clearance air monitoring data at the project site, and make the data available for review by Department personnel and other authorized visitors upon request.

d. Ensure that there are always at least four sampling pumps operating properly for the duration of any asbestos project requiring daily area air monitoring.

e. Collect area air samples for a minimum of two and one half hours for each four-hour work period during preparation, removal, and clean-up activities at NESHAP projects.

f. Maintain a log for the duration of an asbestos project describing daily activities.

g. Follow the procedures specified in NIOSH 7400 or an equivalent method acceptable to the Department when conducting clearance air monitoring.

h. Submit a written copy of the sampling procedures and clearance air monitoring results to the facility owner within five working days following the completion of the project and to the Department upon request.

C. Background Monitoring.

1. The air sampler shall collect a minimum of five air samples at a NESHAP abatement project prior to the start of abatement activities in order to obtain an index of background airborne fiber concentrations.

2. Samples shall be taken both inside and outside the work area to establish existing ambient air levels under normal activity conditions.

3. The air sampler shall document any variations and justifications for the variations, and shall maintain a written copy of the sampling variation(s) at the project site for the duration of the abatement, and shall provide the information to the Department upon request.

4. No background air sampling is required at small, minor, and O&M abatement projects.

5. Background sampling, when required, may be analyzed using PCM methods.

D. Daily Monitoring.

1. Once abatement activities begin at a NESHAP abatement project, the air sampler shall conduct representative daily area sampling in the following areas:

a. In the equipment room of the decontamination enclosure systems;

b. At the entrance to the clean room of each decontamination enclosure system;

c. Outside the work area in uncontaminated areas of the facility;

d. Where the negative pressure differential equipment exhausts, at a distance no greater than five to eight feet from the air flow when feasible. When multiple machines are in operation, the air sampler may rotate the sampling; however, all exhausts must be monitored daily; and

e. The total volume of air collected for daily area air sampling shall be in accordance with 40 CFR Part 763 and/or NIOSH 7400 and any subsequent revisions for analytical methodology.

2. The air sampler shall document any variations and justifications for the variations, and shall maintain a written copy of the sampling variation at the project site for the duration of the abatement and provide the information to the Department upon request.

3. Daily air sampling, when required, may be analyzed using PCM methods.

E. Clearance Monitoring.

1. Where clearance air monitoring is required by this regulation, the clearance standard for any NESHAP abatement project shall be: by Phase Contrast Microscopy less than or equal to 0.01 f/cc; or by Transmission Electron Microscopy (TEM). The clearance standard is less than or equal to 70 s/mm^2 using the Mandatory TEM Method described in 40 CFR 763, Appendix A of Subpart E, as amended, and any subsequent amendments and editions. The Z test with a value of Z less than or equal to 1.65 for a Z test carried out as described in 40 CFR 763, Appendix A of Subpart E, as amended, and any subsequent amendments and editions, shall be allowed for clearance purposes only with prior Department approval.

2. The total volume of air collected for clearance air sampling shall be in accordance with 40 CFR Part 763 and/or NIOSH 7400 and any subsequent revisions for analytical methodology.

3. A licensed air sampler shall conduct, at a minimum, PCM clearance air monitoring at the completion of each NESHAP project. Projects exceeding the project design threshold (3,000 sf, 1,500 Lf, and 656 cubic feet of RACM) will require TEM clearance air monitoring.

4. When conducting clearance air monitoring, the air sampler shall follow the procedures specified in *Measuring Airborne Asbestos Following An Abatement Action*, EPA Report 600/4-85-049 (1985), which

is hereby incorporated by reference, or an equivalent method acceptable to the Department. Procedures shall be summarized and submitted to the facility owner. The air sampler shall report the clearance air monitoring results in writing to the facility owner within five working days following completion of the project and to the Department upon request.

5. Sampling shall not begin until wet cleaning has been completed and no visible pools of water or condensation remain. Sufficient time shall be allowed for all surfaces to dry. The sampling zone shall be representative of the building occupants' breathing zone.

6. Sampling shall not begin until the air sampler has performed a visual inspection and authorizes final clearance air monitoring.

7. Sampling shall be conducted only after all interior wall, ceiling, and floor polyethylene sheeting has been removed. Critical barriers and the five-stage decontamination enclosure system shall remain in place until the abated area has passed final clearance.

8. For projects subject to 40 CFR Part 763, AHERA, as amended, and any subsequent amendments or editions, conduct clearance air monitoring after abatement in areas to be reoccupied (including interior spaces, porticos, and covered exterior walkways) and abatement on exterior portions of mechanical systems used to condition interior spaces. For projects equal to or greater than 160 sf, 260 Lf or 35 cubic feet, TEM clearance air monitoring is required.

9. At least one licensed asbestos project supervisor shall remain at an asbestos project site for the duration of the final clearance visual inspection and clearance air sample collection process.

SECTION VIII. - DISPOSAL REQUIREMENTS.

A. Applicability.

This Section shall apply to each owner/operator engaged in a renovation abatement project.

B. General Requirements.

1. Each owner/operator engaged in a renovation abatement project subject to this Section shall ensure that:

a. Each container (bag, drum, wrapped component, etc.) is labeled so that labels have the appearance of or are designed in accordance with OSHA 29 CFR 1926.1101 (August 10, 1994), as amended, and any subsequent amendments and editions, and EPA 40 CFR 61.150 (November 20, 1990), as amended, and any subsequent amendments and editions.

b. All asbestos waste bags and/or containers shall be properly labeled prior to being placed into the waste transport vehicle.

c. Waste generator labels are:

(1) Written legibly and in indelible ink; and

(2) Displayed in a prominent location on the outer most bag or container.

d. Asbestos waste is disposed of at a landfill approved or permitted to accept asbestos waste.

e. Asbestos waste is not stored at a location other than the facility site without prior written approval from the Department.

f. Stored asbestos waste is maintained in a secured, locked location where access is controlled.

g. Asbestos waste is transported and disposed of in a manner that will not permit the release of asbestos fibers into the air (e.g., enclosed or retrofitted covered vehicle).

h. Asbestos waste is transported in accordance with the following procedures:

(1) The cargo area of the transport vehicle shall be free of debris and be lined with at least one layer of 6-mil polyethylene sheeting.

(a) Floor sheeting shall be installed first and shall extend up the side walls at least 12 inches and shall be taped securely into place.

(b) Wall sheeting shall overlap by at least six inches and be taped into place.

(c) Ceiling sheeting shall extend down the sides of the walls at least six inches and be taped into place.

(2) If asbestos waste is transported exclusively in leak-tight clean drums, or other leak-tight, rigid containers approved by the US Department of Transportation as appropriate shipping containers for asbestos waste, then polyethylene sheeting is not required.

(3) Drums, bags, wrapped components, and other leak-tight containers that have been removed from the work area shall be labeled in accordance with 1.a. of this Section prior to being loaded into an appropriate vehicle for transportation.

(4) Any debris or residue observed on containers or surfaces outside of the work area resulting from abatement activities shall immediately be cleaned using wet methods and a vacuum equipped with a HEPA filter.

(5) Containers shall be carefully placed, not thrown, into the truck cargo area. Drums shall be placed on a level surface in the cargo area and packed tightly or blocked and braced to prevent shifting and tipping. Large structural components shall be secured to prevent shifting.

(6) Asbestos waste that is removed from a facility site shall be transported directly to an approved landfill unless it is stored in the location designated in a temporary storage license issued to the owner/operator by the Department.

(7) Metal dumpsters or containers in which asbestos waste is temporarily stored at the abatement site shall be lined with 6-mil polyethylene sheeting to prevent contamination and shall have doors or tops. The doors and tops shall be closed and locked except during loading or unloading of asbestos waste.

(8) Metal dumpsters or containers used for waste storage shall be labeled in accordance with OSHA 29 CFR 1926.1101, August 10, 1994, as amended, and any subsequent amendments and editions.

(9) Bags shall be free of splits, rips, and tears, and shall be carefully placed, not thrown, into the transport vehicle.

(10) Any equipment, materials, or supplies stored in the waste transport vehicle shall be isolated from the asbestos waste by a leak-tight barrier. All containers and wrappings shall be free of asbestos contamination.

(11) Non-asbestos waste shall not be placed in waste containers or bags labeled as asbestos waste.

(12) The vehicle used to transport asbestos wastes shall be labeled in accordance with 40 CFR 61.149(d)(1)(i), (ii), and (iii), as amended, and any subsequent amendments and editions.

2. The owner/operator shall dispose of asbestos waste in accordance with the following procedures:

a. Upon reaching the landfill, vehicles shall approach the dump location as closely as possible to unload asbestos waste.

b. Bags, drums, and wrapped components shall be inspected when unloaded at the disposal site. Material in damaged containers shall be rewrapped or repacked in empty drums or bags.

c. Waste containers shall be placed on the ground at the disposal site, not dropped or thrown out.

d. Unloading of metal dumpsters or containers by tipping or tilting is permitted without re-inspecting individual bags or drums, provided there are no visible emissions.

e. Following the removal of all containerized waste, polyethylene sheeting shall be removed and discarded in bags or drums along with contaminated cleaning materials and protective clothing.

f. After asbestos waste has been unloaded, the truck cargo area, including the floor, walls, and ceiling, shall be decontaminated using wet methods or a vacuum equipped with a HEPA filter until no visible residues remain.

g. A copy of a completed waste shipment record with signature of the landfill operator shall be submitted to the Department by the asbestos contractor within 45 working days of completion of removal.

h. A waste shipment record shall be used and shall include the asbestos project license number; names of the facility owner, contractor and disposal site; the estimated quantity of asbestos waste; and the type and number of containers used. Each time the material changes custody, the record shall be signed by the person(s) receiving the waste. If a separate hauler is used, the hauler's name, address, telephone number, and the driver's signature shall also appear on the record.

i. The owner/operator shall ensure that asbestos-containing or asbestos-contaminated waste materials are not burned or recycled.

j. Commercial rental vehicles shall not be used to transport any asbestos, asbestos-containing, or asbestos-contaminated waste. This prohibition does not apply to tractors but does apply to cargo compartment areas used to store and/or transport asbestos waste. Rental vehicles do not include leased vehicles.

C. Temporary Asbestos Storage Containment Area Site.

1. Prior written approval must be obtained from the Department before a site other than an asbestos

abatement project site can be used for the storage of regulated asbestos-containing waste from small, minor, or O&M asbestos projects. NESHAP asbestos project waste must be deposited into an approved landfill and may not be stored.

2. Written authorization shall also be obtained from the facility owner or his representative prior to transporting regulated asbestos-containing waste from the facility site of generation (verification of the property owner's authorization must be sent directly to the Department by the facility owner).

3. In order to have a site permitted as a Temporary Asbestos Storage Containment Area, the operator must demonstrate that adequate precautions have been and will continue to be taken to ensure that the waste is properly maintained for the duration of its storage.

4. An operator must submit an application requesting a license for a Temporary Asbestos Storage Containment Area to the Department for review at least 45 working days in advance. The Department will acknowledge receipt of the application and notify the applicant of any deficiency in the application.

5. Within 45 working days after receiving a completed application, including additional information requested, the Department will issue a license or deny issuance of the license.

6. The Department reserves the right to inspect the proposed Temporary Asbestos Storage Containment Area prior to granting final approval.

7. Approval of the Temporary Asbestos Storage Containment Area will be valid for one year from the date of issuance unless the authorization is revoked or suspended by the Department at an earlier date.

8. The Department may revoke or suspend a license based on falsification of or known omission of information from an application for this license, omission or improper use of work practices, improper disposal of ACM, and/or spread of asbestos waste beyond the containment area.

9. In order to renew a storage license, the operator of a Temporary Asbestos Storage Containment Area must resubmit an application for off-site storage of regulated asbestos-containing waste to the Department at least 45 working days prior to the expiration of the existing permit. Previous approval of a site as a Temporary Asbestos Storage Containment Area does not guarantee re-issuance or continuance of a storage license.

SECTION IX. - EXEMPTION FROM WETTING FOR ANY SIZED PROJECT.

A. General Provisions.

In renovation operations, wetting is not required if:

1. The owner/operator has obtained prior written approval from the Department based on a written application that wetting to comply with this Section would unavoidably damage equipment or present a safety hazard; and

2. The owner/operator uses one or more of the following emission control methods:

a. A local exhaust ventilation and collection system designed and operated to capture the particulate asbestos material produced by the stripping and removal of asbestos materials. The system must exhibit no visible emissions to the outside air or must be designed and operated in accordance with the requirements in EPA Regulation 40 CFR 61.152, as amended, and any subsequent amendments and

editions;

b. A glovebag system designed and operated in accordance with the requirements of OSHA regulation 29 CFR 1926.1101, as amended, and any subsequent amendments and editions;

c. Leak-tight wrapping to contain all RACM prior to dismantlement;

3. In renovation operations where wetting would result in equipment damage or a safety hazard and the methods allowed in this Section cannot be used, an owner or operator may use another method after obtaining written approval from the Department based on its determination that the alternative method is equivalent to wetting. The owner/operator shall keep a copy of the Department's written approval at the work site and make it available for review by Department personnel upon request.

B. Temperature Constraints.

When the temperature at the point of wetting is below 0^{o} C (32^{o} F):

1. During periods when wetting operations are suspended due to freezing temperatures, the owner/operator must record the temperature in the area containing the asbestos-coated or covered facility components at the beginning, middle, and end of each workday and keep daily temperature records. A copy of these records must be maintained at the project site and made available for inspection by Department personnel upon request. The facility owner must maintain these temperature records for two years from the date the project is completed and shall provide a legible copy of the data to the Department upon request.

2. The owner/operator may request to use an alternative work practice by submitting to the Department a written description of control measures to be used that will afford the same level of protection as wetting. A legible copy of the Department's approval letter must be available at the project site for the duration of the asbestos project and shall be made available for review by Department personnel upon request.

3. The owner/operator shall remove facility components containing, coated with, or covered with RACM as units or in sections and shall secure the units or sections leak-tight in 6-mil or thicker polyethylene sheeting.

SECTION X. - NESHAP PROJECTS.

A. Applicability.

The notification/application, work practice, air sampling, clean-up and disposal requirements of this Section shall apply to each owner/operator of a renovation asbestos project, where the combined amount of RACM to be stripped, removed, dislodged, cut, drilled, or similarly disturbed includes at least 260 linear feet on pipes, or 160 square feet on other facility components, or 35 cubic feet off of facility components where the area or length could not be measured prior to abatement.

B. Notification/Application.

1. Each owner/operator of a renovation or demolition operation to which this Section applies shall:

a. Provide the Department with written notification/application at least ten complete working days prior to any renovation or demolition operation, and pay all applicable project fees. Acceptable delivery

of the notification and fee payment is by U.S. Postal Service or commercial delivery service, by hand, or by other methods deemed acceptable by the Department.

b. Update/revise the notification/application and pay appropriate fees as required when any previously-notified information changes, including but not limited to, when the amount of asbestos affected increases or decreases more than five percent (5%), when the project start or completion date changes, when the disposal site changes, and/or the project has been cancelled. The owner/operator shall notify the Department by telephone and follow up in writing as soon as possible before, but not later than, the following working day.

c. Prior to each demolition operation, and upon request for renovations, provide the Department with a complete legible copy of the asbestos building inspection report.

d. Begin abatement on the start date contained in the Department-issued asbestos project license.

e. Project designs shall be submitted at the Department's request.

2. When the asbestos stripping or removal operation or demolition operation covered by this Section will begin on a date earlier than the previously-notified start date, the owner/operator shall provide the Department with written notification/application of the new start date at least ten working days before asbestos stripping or removal work will begin. The Department may waive this requirement on a case-by-case basis, although the owner/operator shall provide all required information in writing prior to commencing any abatement activities.

3. The owner/operator of an asbestos stripping or removal operation covered by this Section shall:

a. Notify the Department of the new start date by telephone as soon as possible before, but not later than, the original start date, when the renovation will begin after the date contained in the initial notification/application and in the asbestos project license issued by the Department.

b. Provide the Department with an updated written notice of the new start date as soon as possible before, but not later than, the original start date. Acceptable delivery of the updated notice is by the U.S. Postal Service or commercial delivery service, by hand, or by other methods deemed acceptable by the Department.

c. Provide the Department with an updated written notice of the new completion date as soon as possible before, but not later than, one working day following the completion of the project when the asbestos stripping or removal operation covered by this Section will end on a date earlier than contained in the initial notification and in the asbestos project license issued by the Department. Acceptable delivery of the updated notice is by the U.S. Postal Service or commercial delivery service, by hand, or by other methods deemed acceptable by the Department.

d. Provide the Department with written notification/application of the new completion date as soon as possible before, but not later than, the original completion date when the asbestos stripping or removal operation covered by this Section will end on a date later than contained in the initial notification/application and in the asbestos project license issued by the Department. Acceptable delivery of the updated notice is by the U.S. Postal Service or commercial delivery service, by hand, or by other methods deemed acceptable by the Department.

4. The written notification /application shall include:

a. Indication whether the notification/application is an original, revision, or cancellation;

b. Name, address, and telephone number of the owner/operator;

c. Type of operation: demolition or renovation;

d. Description of the facility or affected part of the facility, including the square footage, number of floors, age, and prior, present, and intended use of the facility;

e. Description of the procedures and analytical methods used to detect the presence of ACM (regulated and non-regulated), date of inspection, and name, address, telephone number, and license number of the building inspector;

f. An estimate of the approximate amount of RACM and Category II nonfriable ACM to be removed from the facility in terms of length of pipe in linear feet; surface area in square feet on other facility components, or volume in cubic feet, if already off facility components;

g. Location and street address (including building number or name and floor or room number, if appropriate), city, county, and state of the facility being demolished or renovated;

h. Scheduled starting and completion dates of asbestos renovation or demolition;

i. Description of planned renovation or demolition work to be performed, emission control measure(s) to be employed, and a description of the affected facility or facility components;

j. Description of the engineering controls and procedures to be used to comply with the work practice requirements of this regulation;

k. Name and location of the waste disposal site where the regulated asbestos-containing waste material will be deposited. Regulated asbestos-containing waste must be deposited into a landfill approved or permitted to accept asbestos waste;

l. Description of procedures to be followed in the event that unexpected RACM is found or Category I or II nonfriable ACM becomes regulated;

m. Name, address, and telephone number of the waste transporter; and

n. Printed name and signature of the asbestos owner/operator submitting the notification, and date signed.

5. A complete notification/application shall contain all of the above information and shall be reported on a form similar to the one found in 40 CFR Part 61, Subpart M, as amended, and any subsequent amendments and editions.

C. Work Practice Requirements.

1. Preparation.

a. Prior to beginning removal, each owner/operator engaged in a renovation project subject to this Section shall:

(1) Define the work area using barrier tape and danger signs in accordance with the following or OSHA 29 CFR 1926.1101, as amended, and any subsequent amendments and editions, if more stringent:

(a) Warning signs and tape that clearly separate the regulated area shall be provided and displayed at each location where a regulated area is required to be established by this Section. Signs shall be posted at a distance from the regulated area such that an employee may read the signs and take necessary protective steps before entering the area marked by the signs.

(b) The warning signs required by this Section shall bear the following information:

DANGER

ASBESTOS

CANCER AND LUNG DISEASE HAZARD

AUTHORIZED PERSONNEL ONLY

(2) Shut down, lock, and tag out all HVAC equipment in or passing through the work area. Seal each intake and exhaust opening and any seam in system components with two sheets of 6-mil polyethylene sheeting and tape.

(3) Detach and wet clean removable electrical, heating, and ventilating equipment and other items which may be connected to asbestos surfaces.

(4) Remove existing filters from the HVAC system and dispose of as asbestos-contaminated waste.

(5) Seal each opening between the work area and uncontaminated areas including windows, doorways, elevator openings, corridor entrances, drains, ducts, electrical outlets, grills, grates, diffusers, and skylights with a critical barrier consisting of at least two independent sheets of 6-mil or thicker polyethylene sheeting secured in place. These critical barriers must be maintained leak-tight for the duration of asbestos abatement.

(6) Thoroughly clean and remove all movable objects from the work area.

(7) Thoroughly clean, then cover and secure each non-movable object in the work area with at least one sheet of 4-mil or thicker polyethylene sheeting.

(8) Use polyethylene sheeting to isolate contaminated from uncontaminated areas, and ensure the sheeting is attached securely in place and properly maintained at all times.

(9) Prevent contamination of carpet with ACM, or dispose of the carpet as asbestos-contaminated waste.

(10) Cover floors not being abated with at least two layers of 6-mil or thicker polyethylene sheeting. Floor sheeting shall be installed first and shall extend at least 12 inches up the walls and be taped into place. No seams shall be located at wall/floor joints. Spray-applied polyethylene coating shall not be used.

(11) Cover walls and ceilings not being abated with at least one sheet of 4-mil or thicker

polyethylene sheeting. Wall sheeting shall be installed to minimize joints and shall extend at least six inches beyond wall/floor joint and be taped into place. Ceiling sheeting shall extend at least 12 inches down the wall and be sized and taped into place. No seams shall be located at wall/ceiling or wall/wall joints.

(12) Construct a decontamination enclosure system adjoining the contained work area. The decontamination enclosure shall be built in a manner that will prevent track-out of RACM, and shall consist of: a clean room equipped with appropriate storage containers and adequate space for changing clothing; an air lock; a shower room containing hot and cold or warm running water controllable at the tap; and an equipment room suitable for storage of tools and equipment.

(13) Construct a clear viewing port measuring at least 24 inches by 24 inches in an external wall of the contained work area to allow unobstructed observation of abatement activities in the work area.

(14) Operate negative pressure differential equipment with HEPA filtration continuously from the time that barrier construction is completed through the time that acceptable final clearance air monitoring results are obtained.

(15) Utilize a manometer to measure negative pressure differential and operate it in accordance with the General Requirement Section of this regulation.

2. Removal.

Each owner/operator engaged in a renovation asbestos project subject to this Section shall ensure that:

a. Prior to removal, all RACM is thoroughly wet through to the substrate using amended water.

b. All RACM that has been stripped or removed in sections or units shall be:

(1) Thoroughly wet during stripping or removal and shall remain wet until disposed of in accordance with this regulation and 40 CFR 61.150, as amended, and any subsequent amendments and editions;

(2) Carefully lowered to the ground or floor, not dropped or thrown; and

(3) When removed or stripped at an elevation greater than 50 feet above ground level, transported to the ground via leak-tight chutes or containers.

c. At no time shall an owner/operator allow RACM to accumulate or become dry.

d. Structural components are thoroughly wet prior to wrapping in polyethylene sheeting for disposal.

e. For facility components such as reactor vessels, large tanks, and steam generators (but not beams, which must be stripped), ACM is not required to be stripped if the following requirements are met:

(1) The component is removed, transported, stored, disposed of, or reused without disturbing or damaging any of the ACM;

(2) The component is encased in leak-tight wrappings; and

(3) The leak-tight wrapping is labeled in accordance with EPA Regulation 40 CFR 61.149(d)(1)(i),(ii),and(iii), as amended, and any subsequent amendments and editions, during all loading, unloading, and storage operations.

f. When double polyethylene bags of at least 6-mil thickness are used for waste, bags shall be leak-tight. Excess air shall be removed from bags prior to sealing using a vacuum equipped with a HEPA filtration system in accordance with OSHA regulation 29 CFR 1926.1101, as amended, and any subsequent amendments and editions.

g. ACM from within the work area is not permitted outside of the work area except in sealed leak-tight containers.

h. Any person exiting or any equipment or machinery being removed from the contaminated work area shall be thoroughly decontaminated. If equipment or machinery is not or cannot be thoroughly decontaminated, it shall be sealed in leak-tight containers. No visible residue shall appear on the outside surface of the container.

3. Cleanup.

a. Each owner/operator engaged in a renovation abatement project subject to this Section shall ensure that:

(1) Following abatement, a visual inspection of the abated substrate is performed.

(2) A coating of a compatible encapsulating agent is applied to porous surfaces that have been stripped and cleaned of ACM. The encapsulant must be allowed to thoroughly dry prior to additional cleaning or final air clearance.

(3) The air sampler or the owner’s representative inspects the abated area prior to final clearance. If there is any evidence of contamination, the asbestos contractor shall perform additional wet cleaning and HEPA vacuuming.

(4) All polyethylene sheeting, except for critical barriers and the decontamination enclosure system, is removed and disposed of as asbestos-contaminated waste.

(5) With only the critical barriers and decontamination enclosure system left in place, the entire work area, including any duct work, is wet-cleaned and HEPA vacuumed until no visible residue remains.

(6) Areas exceeding clearance standards are re-cleaned by the contractor using wet methods and HEPA vacuuming. Re-cleaning, drying, and retesting shall be repeated until the satisfactory clearance standard is achieved.

(7) Following satisfactory clearance of the work area, remaining polyethylene critical barriers and decontamination enclosure systems are removed and disposed of as asbestos-contaminated waste.

(8) Portable decontamination trailers are cleaned and polyethylene sheeting disposed of as contaminated waste.

b. Re-establishment of the work area shall only occur following completion of clean-up procedures and after clearance air monitoring has been performed and documented to the satisfaction of the air sampler or of the facility owner or his representative.

c. Replacement materials shall only be installed following completion of abatement. This does not include outdoor projects subject to this regulation.

4. Disposal.

The disposal requirements of the Disposal Section of this regulation shall apply.

D. Air Sampling and Analysis Procedures.

The background, daily, and clearance air monitoring requirements of the Air Sampling Section of this regulation shall apply.

SECTION XI. - SMALL PROJECTS.

A. Applicability.

The notification/application, work practice, air sampling, clean-up, and disposal requirements of this Section shall apply to each abatement project where the combined amount of RACM to be stripped, removed, dislodged, cut, drilled, or similarly disturbed is more than 25 but fewer than 260 linear feet on pipes, or more than 25 but fewer than 160 square feet on other facility components, or more than ten but fewer than 35 cubic feet of RACM off of facility components such that area or length could not be measured prior to abatement.

B. Notification/Application.

In a facility being renovated subject to this Section, the owner/operator shall provide the Department with written notification prior to any abatement and pay all applicable fees as follows:

1. Deliver the notification/application by U.S. Postal Service or commercial delivery service, facsimile transmission, by hand or by other methods deemed acceptable by the Department.

2. Postmark or deliver the notice at least four working days before asbestos stripping or removal work or any other activity begins that would break up, dislodge, or similarly disturb RACM.

3. Update/revise the notification/application and pay appropriate fees as required, when any previously-notified information changes, including but not limited to: when the amount of asbestos affected increases or decreases more than ten percent (10%), when the project start or completion date changes, and/or when the disposal site changes, and/or the project has been cancelled. The owner/operator shall notify the Department by telephone and follow up in writing as soon as possible before, but not later than, the following working day. When the amount of asbestos affected changes such that the total quantity being abated qualifies as a NESHAP project, prior approval must be granted by the Department for work to proceed.

4. The Department may waive the four working days prior notice requirement on a case-by-case basis.

C. Air Sampling and Analysis Procedures.

The facility owner shall ensure that air sampling is performed in accordance with applicable requirements of the Air Sampling Section of this regulation.

D. Work Practice and Clean-up Requirements.

1. An owner/operator engaged in a small asbestos abatement project shall:

a. Construct critical barriers to prevent the potential release of asbestos fibers from within the work area;

b. Prevent contamination of carpet with ACM, or dispose of the carpet as asbestos-contaminated waste;

c. Thoroughly wet all RACM prior to removal and keep it wet until disposal;

d. Prevent track-out and leakage of RACM onto uncontaminated surfaces;

e. Use HEPA vacuum equipment and wet-cleaning techniques to clean up the work area following abatement until there is no visible residue;

f. Ensure that ACM from within the work area is not permitted outside of the work area except in sealed, leak-tight containers;

g. Ensure that any person exiting or any equipment or machinery being removed from the contaminated work area is thoroughly decontaminated. If equipment or machinery is not thoroughly decontaminated, it shall be sealed in leak-tight containers. No visible residue shall appear on the outside surface of the container; and

h. Ensure porous surfaces that have been stripped or cleaned of RACM are encapsulated to secure any residual fibers that may be present. The encapsulant used must be compatible with subsequent coverings.

2. Disposal.

The owner/operator shall comply with the requirements of the Disposal Section of this regulation.

SECTION XII. - MINOR PROJECTS.

A. Applicability.

The notification, work practice, clean-up, and disposal requirements of this Section shall apply to each abatement project where the combined amount of RACM to be stripped, removed, dislodged, cut, drilled, or similarly disturbed is equal to or fewer than 25 linear feet on pipes, or is equal to or fewer than 25 square feet on other facility components, or is equal to or fewer than 10 cubic feet of RACM off facility components where the area or the length or area could not be measured prior to abatement.

B. Notification/Application.

In a facility being abated subject to this Section:

1. The owner/operator shall provide the Department with a written application at least two working days prior to any abatement and pay all applicable fees as follows:

a. Acceptable delivery of the notification shall be by U.S. Postal Service, commercial delivery

service, facsimile transmission, by hand or by other methods deemed acceptable by the Department.

b. Update/revise the notification/application and pay appropriate fees as required when any previously-notified information changes, including but not limited to: when the amount of asbestos affected increases or decreases more than ten percent (10%), when the project start or completion date changes, and/or when the disposal site changes, and/or the project has been cancelled; or

c. The owner/operator shall notify the Department by telephone and follow up in writing as soon as possible before, but not later than, the following working day. When the amount of asbestos affected changes such that the total quantity being abated qualifies as a small or NESHAP project, prior approval must be granted by the Department for work to proceed.

2. Facility employees who do not meet the definition of a contractor as defined by this regulation, or a contractor who has obtained a temporary storage license may maintain a log of all minor abatements performed during a quarter, report them to the Department within 30 calendar days after the end of the quarter, and pay applicable project fees. The log shall include, but is not limited to: the name and address of the facility being abated, amount and type of ACM removed, date(s) of removal, names of individuals who performed the abatement, exact location for temporary storage of asbestos wastes, and the name of the landfill used for disposal.

C. Air Sampling and Analysis Procedures.

The facility owner shall ensure that air sampling is performed in accordance with applicable requirements of the Air Sampling Section of this regulation.

D. Work Practice and Clean-up Requirements.

1. An owner/operator engaged in a minor asbestos abatement project shall:

a. Construct critical barriers to contain asbestos fibers released within the work area;

b. Wet all RACM prior to removal and during containerization for disposal in an approved landfill;

c. Prevent track-out and leakage of RACM onto uncontaminated surfaces;

d. Use HEPA vacuum equipment and wet-cleaning techniques to clean up the work area following abatement until there is no visible residue;

e. Ensure that ACM from within the work area is not permitted outside of the work area except in sealed leak-tight containers;

f. Ensure that any person exiting or any equipment or machinery being removed from the contaminated work area is thoroughly decontaminated. If equipment or machinery is not thoroughly decontaminated, it shall be sealed in a leak-tight container. No visible residue shall appear on the outside surface of the container;

g. Ensure porous surfaces, that have been stripped or cleaned of RACM are encapsulated to secure any residual fibers that may be present. The encapsulant used must be compatible with subsequent coverings;

h. Containerize waste in appropriately labeled impermeable containers (6-mil polyethylene

sheeting, bags, and/or fiber or metal drums), and store in an area that is secured and locked; and

i. Transport asbestos waste in a manner that does not release fibers into the air and dispose of at a landfill permitted to accept asbestos waste.

2. Disposal.

The owner/operator shall comply with the requirements of the Disposal Section of this regulation.

SECTION XIII. - OPERATION AND MAINTENANCE ACTIVITIES.

A. Applicability.

1. The notification/application, work practice, clean-up, and disposal requirements of this Section shall apply to the non-industrial facility owner/operator and the O&M personnel covered under the facility's group license.

2. Workers are limited to an activity in which the amount of RACM disturbed does not exceed that which can be contained in one glovebag or one 6-mil polyethylene bag measuring no greater than 60 inches in length and width.

B. Notification/Application.

In a facility being abated that is subject to this Section:

1. The non-industrial facility owner/operator shall provide the Department with written notification/application and pay all applicable fees as follows:

a. Acceptable delivery of the notification shall be by U.S. Postal Service, commercial delivery service, facsimile transmission, by hand or by other methods deemed acceptable by the Department.

b. Update the notification when any previously-notified information changes.

c. Notify the Department by telephone and follow up in writing as soon as possible, but not later than, the original start date when a project for which notification was made has been canceled.

2. Alternately, facility employees who do not meet the definition of a contractor as defined by this regulation may maintain a log of all O&M activities performed during a quarter, report them to the Department within 30 calendar days of the end of the quarter, and pay applicable project fees. The log shall include, but is not limited to: the name and address of the facility being abated, amount and type of ACM removed, date(s) of removal, names of individuals who performed the abatement, exact location for temporary storage of asbestos wastes, and the name of the landfill used for disposal.

C. Air Sampling and Analysis Procedures.

The facility owner shall ensure that sampling is performed in accordance with applicable requirements of the Air Sampling Section of this regulation.

D. Work Practice and Clean-Up Requirements.

1. An owner/operator engaged in an operation and maintenance activity shall:

a. Construct critical barriers to prevent the potential release of asbestos fibers from within the work area;

b. Wet all RACM prior to removal and during containerization for disposal at an approved landfill;

c. Prevent track-out and leakage of RACM onto uncontaminated surfaces;

d. Use HEPA vacuum equipment and wet-cleaning techniques to clean up the work area following abatement until there is no visible residue;

e. Ensure that ACM from within the work area is not permitted outside of the work area except in sealed leak-tight containers;

f. Containerize wetted waste in appropriately labeled impermeable containers (6-mil polyethylene sheeting, bags, and/or fiber or metal drums) and store in an area that is secured and locked;

g. Transport asbestos waste in a manner that does not release fibers into the air, and dispose of at a landfill permitted to accept asbestos waste.

2. Each owner/operator engaged in an O&M glovebag operation shall:

a. Ensure that the glovebag procedure is being performed only by persons who have received training in the method and are licensed as workers or supervisors in accordance with the requirements of this regulation;

b. Ensure that the glovebag is constructed and utilized in accordance with the glovebag requirements of this regulation and OSHA 29 CFR 1926.1101, as amended, and any subsequent amendments and editions;

c. Isolate the work area to prevent access by unprotected persons;

d. Display danger signs in accordance with OSHA 29 CFR 1926.1101, as amended, and any subsequent amendments and editions, at all approaches to any asbestos abatement area;

e. Remove all polyethylene sheeting, tape, glovebags and other equipment, and inspect the area for visible residue following abatement;

f. Wet-clean the area using amended water and a HEPA vacuum after surfaces have been allowed to dry. The sequence of wet cleaning and vacuuming shall be repeated until no visible residue is observed in the work area; and

g. Ensure that porous surfaces that have been stripped or cleaned of RACM are encapsulated to secure any residual fibers that may be present. The encapsulant used must be compatible with subsequent coverings.

E. Disposal.

The owner/operator shall comply with the requirements of the Disposal Section of this regulation.

SECTION XIV. - GLOVEBAG TECHNIQUE.

A. Applicability.

1. The requirements of this Section shall apply to the owner/operator of any NESHAP, small, minor, or O&M abatement project when glovebag operations are implemented.

2. The owner/operator shall ensure that asbestos-containing waste from glovebag operations is wet at all times during abatement, storage, and transportation and is deposited in a landfill approved or permitted to accept asbestos waste.

B. Glovebag Operations.

Glovebag systems may be used to remove ACM from straight runs of piping, elbows, and other connections when performed in compliance with the provisions of this Section and OSHA 29 CFR 1926.1101, as amended, and any subsequent amendments and editions.

1. The owner/operator shall ensure that the glovebag is constructed and utilized in accordance with the following requirements:

a. The work area is isolated to prevent access by unprotected persons.

b. Danger signs are displayed at all approaches to any asbestos abatement area in accordance with OSHA 29 CFR 1926.1101, as amended, and any subsequent amendments and editions.

c. The glovebag procedure is performed only by persons who have received training in the method and are licensed as workers or supervisors in accordance with the requirements of this regulation.

d. At least two persons shall perform glovebag removal operations.

e. Each glovebag shall be made of 6-mil thick plastic and shall be seamless at the bottom.

f. Each glovebag used on elbows and other connections must be designed for that purpose and used without modifications.

g. Each glovebag shall be installed so that it completely covers the circumference of pipe or other structures where the work is to be performed.

h. Each glovebag shall be smoke-tested for leaks and any leaks sealed prior to use.

i. A glovebag shall be used only once and may not be slid or moved.

j. Each glovebag shall not be used on surfaces whose temperature exceeds 150 degrees Fahrenheit.

k. Prior to disposal, each glovebag shall be collapsed by removing air within it using a HEPA vacuum.

l. Before beginning the operation, loose and friable material adjacent to the glovebag or glovebox operation shall be wrapped and sealed in at least two layers of 6-mil polyethylene.

m. Where a system uses an attached waste bag, such bag shall be connected to the collection bag

using a hose or other material that shall withstand the pressure of ACM waste and water without losing its integrity.

n. A sliding valve or other device shall separate the waste bag from the hose to ensure no exposure when the waste bag is disconnected.

C. Negative Pressure Glovebag Systems.

1. Negative pressure glovebag systems shall be used to remove ACM from piping.

2. In addition to the requirements for glovebag systems in Section B above, negative pressure glovebag systems shall have a HEPA vacuum attached to the glovebag/box to prevent collapse during removal.

3. A HEPA vacuum shall be used to prevent collapse of the bag during removal and shall run continually until completion of operation, at which time the pipe shall be encapsulated, and the bag and ACM shall be isolated prior to removal of the bag from the pipe.

D. Negative Pressure Glovebox Systems.

Negative pressure gloveboxes may be used to remove ACM from pipe runs when the following work practices are utilized:

1. Gloveboxes shall be constructed with rigid sides and made from metal or other material that can withstand the weight of the ACM and water used during removal.

2. A negative pressure generator shall be used to create negative pressure in the system.

3. An air filtration unit shall be attached to the box.

4. The box shall be fitted with gloved apertures:

a. An aperture at the base of the box shall serve as a bagging outlet for waste ACM and water.

b. A back-up generator shall be present on site.

c. Waste bags shall consist of 6-mil or thicker plastic and be double-bagged before they are filled.

5. At least two persons shall perform the removal.

6. The box shall be smoke-tested for leaks and any leaks sealed prior to use.

7. Loose or damaged ACM adjacent to the box shall be wrapped and sealed in at least two layers of 6-mil or thicker plastic prior to the job or otherwise made intact prior to the job.

8. A HEPA filtration system shall be used to maintain pressure barrier in the box.

E. Air Sampling and Analysis Procedures.

1. Background and daily area monitoring shall be performed for all NESHAP glovebag/glovebox projects. Personnel air sampling in the worker’s breathing zone may be used to satisfy the requirement for

daily area monitoring.

2. Non-aggressive Phase Contrast Microscopy (PCM) clearance air monitoring shall, at a minimum, be required for NESHAP and small glovebag or glovebox projects.

3. If personnel fiber counts exceed the PCM clearance standard of 0.01 fibers per cubic centimeter, aggressive clearance air monitoring shall be performed.

F. Glovebag/Glovebox Work Practices.

1. Use of the glovebag shall be terminated, cleanup procedures contained in this Section shall be implemented, and clearance by TEM analysis performed if the owner/operator:

a. Fails to keep RACM in the glovebag/glovebox;

b. Fails to keep RACM adequately wet;

c. Disturbs or dislodges RACM outside of the glovebag/glovebox; and/or

d. Experiences glovebag failure, including any breach in the glovebag/glovebox.

2. Glovebag/Glovebox Clean-up. Following removal, the owner/operator shall ensure that:

a. Porous surfaces that have been stripped or cleaned of RACM are encapsulated to secure any residual fibers that may be present prior to removing the glovebag or glovebox from the abated pipe. The encapsulant used must be compatible with subsequent coverings.

b. All polyethylene sheeting, tape, glovebags or gloveboxes and other equipment must be removed and the area inspected for visible residue.

c. Wet-cleaning using amended water is performed, followed by HEPA vacuuming after surfaces have been allowed to dry. The sequence of wet cleaning and vacuuming shall be repeated until no visible residue is observed in the work area.

d. When required, final TEM air clearance shall be performed following visual clearance.

G. Disposal.

All applicable disposal requirements of this regulation shall apply.

SECTION XV. - NON-FRIABLE PROJECTS.

A. Applicability.

The requirements of this Section shall apply to the owner/operator of any renovation at any facility where the ACM being removed remains non-friable.

B. Notification/Application.

1. Each owner/operator shall:

a. Contact the landfill to ensure acceptance of non-friable ACM waste;

b. Provide the Department with a written application and obtain a Department-issued abatement license for the project four (4) working days prior to beginning abatement for NESHAP sized projects of 160 sf or 260 Lf. The license shall be maintained at the project site for the duration of the project;

c. For all other projects, provide a written application prior to disposal;

d. Facilities and those in possession of a temporary asbestos storage containment area license may notify the Department quarterly;

e. Prior to disposing of a non-regulated residential structure, provide a written application to the Department;

f. Applications must also be submitted for projects where waste will be disposed of out-of-state;

g. Provide the following information in the written application:

(1) Name, address, and telephone number of property/facility owner;

(2) Street address of the property or facility where removal will occur;

(3) Amount of non-friable ACM to be abated;

(4) Description of material (for example, cement-like tiles, asphaltic shingles, cementitious siding, roof flashing); and

(5) Name, address, telephone number, contact person, and location (county, city, state) of the landfill that the owner/operator has contacted for disposal of ACM waste;

h. The written disposal license issued by the Department must accompany the non-friable ACM waste to the landfill.

C. Work Practices.

1. The owner/operator shall prevent dust from being released during the removal of non-friable ACM to prevent exposure.

2. Category I and Category II ACM that will be or has been subjected to grinding, sanding, cutting, chipping, drilling, or abrading shall be considered regulated ACM, and the owner/operator shall comply with all applicable requirements of this regulation.

3. Category I and Category II ACM that will not be or has not been subjected to grinding, sanding, cutting, chipping, drilling, or abrading shall be considered non-regulated ACM, and the owner/operator shall comply with all applicable requirements of OSHA 29 CFR 1926.1101, as amended, and any subsequent amendments or editions.

4. The owner/operator shall ensure that ACM and asbestos-contaminated waste is not intentionally burned or recycled.

D. Disposal.

1. Transport and disposal shall occur in a manner that will not permit the release of asbestos fibers into the air.

2. Disposal shall occur at a landfill permitted or approved to accept asbestos waste.

3. All containers shall be labeled with the following warning:

DANGER

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST

CANCER AND LUNG DISEASE HAZARD

4. The owner/operator shall:

a. Obtain a waste shipment record or other shipment manifest at the landfill to document disposal of all asbestos waste;

b. Ensure that a waste shipment record or other shipment manifest is signed by the landfill operator; and

c. Submit a copy of the waste shipment record or other shipment manifest to the Department within 30 working days after abatement completion.

SECTION XVI. - STANDARDS FOR DEMOLITIONS.

A. Applicability.

The requirements of this Section shall apply to the owner/operator of a facility to be demolished.

B. Notification/Application.

1. Each owner/operator of a demolition to which this Section applies shall:

a. Submit to the Department a written DHEC demolition application at least ten working days in advance of the proposed demolition start date.

b. Delivery of the application shall be by U.S. Postal Service, commercial delivery service, by hand or by other methods deemed acceptable by the Department.

c. Acceptable methods of payment shall be by check or money order made payable to SCDHEC, credit card (VISA, MasterCard, or Discover), and cash.

d. Submit a written demolition project license application for each separate facility that includes all information required on the application form.

e. Submit a complete, legible copy of the building inspection report, which must be less than three

years old, for each facility to be demolished.

2. Obtain an asbestos demolition license for any facility, regardless of whether the required building inspection indicates the presence of ACM.

3. When a demolition will begin on a date earlier than the previously-notified start date, the facility owner/operator shall provide the Department with a written notification of the new start date at least ten working days prior to the previously-notified demolition start date.

4. The owner/operator of a demolition operation covered by this section shall:

a. Notify the Department by telephone no later than the original start date when the demolition will begin on a date later than the previously-notified start date.

b. Provide the Department with a revised written application of the new start date no later than the previously-notified start date.

c. Provide the Department with a revised written notification/application immediately when any information pertaining to the demolition project changes, including but not limited to, the start and/or completion date, the demolition contractor, or the landfill.

5. Any facilities being demolished under order of a State or local government agency because the facility is structurally unsound, in imminent danger of collapse, and is a threat to public health or safety may be exempt from the ten-working day notification requirement. However, the owner/operator shall submit a complete demolition license application and written justification documents to the Department for approval prior to commencing the demolition activities.

a. The application shall include all of the following information:

(1) Indication whether the notification is an original, revision, or cancellation;

(2) Name, address, and telephone number of the owner/operator;

(3) Indication that demolition is the type of operation;

(4) Description of the facility or affected part of the facility, including the square footage, number of floors, age, and prior, present, and intended use of the facility;

(5) Description of the procedures and analytical methods used to detect the presence of ACM (regulated and nonregulated), date of inspection, and name, address, telephone number, and license number of the building inspector;

(6) Location and street address (including building number or name and floor or room number, if appropriate), city, county, and state of the facility being demolished or renovated;

(7) Scheduled starting and completion dates of asbestos renovation or demolition;

(8) Description of planned demolition work to be performed, emission control measure(s) to be employed, and a description of the affected facility or facility components;

(9) Description of the engineering controls and procedures to be used to comply with the work

practice requirements of this regulation;

(10) Name and location of the waste disposal site where the regulated asbestos-containing waste material will be deposited. Regulated asbestos-containing waste must be deposited into a landfill approved or permitted to accept asbestos waste;

(11) Description of procedures to be followed in the event that unexpected RACM is found;

(12) Name, address, and telephone number of the waste transporter; and

(13) Printed name and signature of the owner/operator submitting the notification and the date signed.

b. The owner/operator shall submit to the Department a clear, legible copy of the signed order that contains all of the following information along with the completed demolition project application:

(1) The name, title, and authority of the State or local government representative who ordered the demolition;

(2) The date that the order was issued; and

(3) The date on which the demolition was ordered to begin.

C. Removal of ACM prior to Demolition.

1. Any demolition of a structure or portion of a structure that contains structural members or components composed of or covered by ACM shall be preceded by removal of all such materials.

2. All ACM, with the exception of those material referenced in Paragraph E. of this Section, shall be removed in accordance with work practice requirements for applicable NESHAP, small, or minor projects prior to demolition.

D. Air Sampling Procedures.

Air monitoring is not required during a demolition except when necessary due to an extenuating circumstance and/or required by the Department.

E. Exemptions from Removal of ACM prior to Demolition.

The following categories of asbestos-containing materials may be left in place during demolition:

1. ACM on a facility component that is encased in concrete or other similarly hard material and is adequately wet whenever exposed during demolition.

2. RACM that was not accessible for testing and was, therefore, not discovered until after demolition began and, as a result of the demolition, cannot be safely removed. If not removed for safety reasons, all exposed RACM and any asbestos-contaminated debris must be treated as regulated asbestos-containing waste material.

3. Category I and Category II nonfriable mastic, glue, and adhesive ACM that is not friable or in poor condition, and where the probability is low that the materials will become crumbled, pulverized, or

reduced to powder during demolition operations.

F. Disposal of Demolition Debris.

1. Waste that does not contain asbestos may be disposed of as construction debris at a landfill approved or permitted to accept such waste.

2. The owner/operator shall comply with the requirements of the Disposal Section of this regulation and shall ensure that asbestos-containing or asbestos-contaminated waste materials are not burned or recycled.

G. Project License Fees.

1. A project license is required for every facility that is to be demolished, including those that have been destroyed by fire or those whose required building survey indicates there is no ACM present.

2. The Department shall not issue a project license for a demolition until all requested information has been submitted and reviewed and all applicable fees have been paid.

3. Fees shall not be refunded for projects for which the Department has issued a project license.

4. A project license that has been issued shall automatically become invalid if an instrument of payment is returned for insufficient funds, in which case the licensee shall be subject to enforcement action for operation without a valid license.

SECTION XVII. - OUTDOOR PROJECTS.

A. Applicability.

The notification, work practice, clean-up, and disposal requirements of this Section shall apply to each owner/operator of any regulated O&M or minor, small or NESHAP outdoor renovation.

B. Notification/Application.

1. NESHAP Project.

a. Each owner/operator of a renovation or demolition operation to which this Section applies shall:

(1) Provide the Department with written notification/application at least ten working days prior to any renovation or demolition and pay all applicable project fees. Acceptable delivery of the notification and fee payment is by U.S. Postal Service or commercial delivery service, by hand, or by other methods deemed acceptable by the Department.

(2) Update the notification/application and pay appropriate fees as necessary when any previously-notified information changes, including but not limited to, when the amount of asbestos affected changes, when the project start or completion date changes, or when the disposal site changes.

(3) Provide the Department with a legible copy of the building inspection report upon request.

(4) Begin abatement on the start date contained in the Department-issued asbestos project license.

b. When the asbestos stripping or removal operation covered by this Section will begin on a date earlier than the previously-notified start date, the owner/operator shall provide the Department with written notification of the new start date at least ten working days before asbestos stripping or removal work will begin.

c. When the asbestos stripping or removal operation covered by this Section will begin after the date contained in the initial notification and in the asbestos project license issued by the Department, the owner/operator must:

(1) Notify the Department of the new start date by telephone as soon as possible before, but not later than, the original start date; and

(2) Provide the Department with an updated written notice of the new start date as soon as possible before, but not later than, the original start date. Acceptable delivery of the updated notice is by the U.S. Postal Service or commercial delivery service, by hand, or by other methods deemed acceptable by the Department.

d. The written notification/application shall include:

(1) Indication whether the notification is an original, revision, or cancellation;

(2) Name, address, and telephone number of the owner/operator;

(3) Type of operation: demolition or renovation;

(4) Description of the facility or affected part of the facility, including the square footage, number of floors, age, and prior, present, and intended use of the facility;

(5) Description of the procedures and analytical methods used to detect the presence of ACM (regulated and non-regulated), date of inspection, and name, address, telephone number, and license number of the building inspector;

(6) An estimate of the approximate amount of RACM and Category II nonfriable ACM to be removed from the facility in terms of length of pipe in linear feet, in terms of surface area for other facility components in square feet, or in terms of volume if already off of facility components in cubic feet;

(7) Location and street address (including building number or name and floor or room number, if appropriate), city, county, and state of the facility being demolished or renovated;

(8) Scheduled starting and completion dates of asbestos renovation or demolition.

(9) Description of planned renovation or demolition work to be performed, emission control measure(s) to be employed, and a description of the affected facility or facility components;

(10) Description of the engineering controls and procedures to be used to comply with the work practice requirements of this regulation;

(11) Name and location of the waste disposal site where the regulated asbestos-containing waste material will be deposited. Regulated asbestos-containing waste must be deposited into a landfill approved or permitted to accept asbestos waste;

(12) Name, address, and telephone number of the waste transporter; and

(13) Printed name and signature of the asbestos owner/operator submitting the notification and date signed.

e. A complete notification/application shall contain all of the above information and shall be reported on a form similar to the one found in 40 CFR Part 61, Subpart M, as amended, and any subsequent amendments and editions.

2. Small Project.

In a facility being renovated subject to this Section, the owner/operator shall provide the Department with at least a five calendar day advance written notification of intent to renovate and pay applicable fees as follows:

a. Acceptable delivery of the notification/application shall be by U.S. Postal Service, commercial delivery service, by hand, facsimile transmission, or by other methods deemed acceptable by the Department.

b. Postmark or deliver the notice before asbestos stripping or removal work or any other activity begins that would break up, dislodge, or similarly disturb RACM.

c. Update the notification/application when any previously-notified information changes and pay additional project fees as necessary.

d. The Department may waive the five calendar-day notice on a case-by-case basis.

3. Minor or O&M Projects.

In a facility being abated subject to this Section:

a. The owner/operator shall provide the Department with written notification/application prior to any abatement and pay all applicable fees as follows:

(1) Acceptable delivery of the notification/application shall be by U.S. Postal Service, commercial delivery service, facsimile transmission, by hand or by other methods deemed acceptable by the Department.

(2) Update the notification/application when any previously-notified information changes.

(3) Notify the Department by telephone and follow up in writing as soon as possible, but not later than, the original start date when a project for which notification was made has been canceled; or

b. Facility employees who do not meet the definition of a contractor as defined by this regulation or a contractor who has obtained a temporary storage license may maintain a log of all minor abatements performed during a quarter, report them to the Department within 30 calendar days of the end of the quarter, and pay applicable project fees. The log shall include, but is not limited to: the name and address of the facility being abated, amount and type of ACM removed, date(s) of removal, names of individuals who performed the abatement, exact location for temporary storage of asbestos wastes, and the name of the landfill used for disposal.

C. Air Sampling and Analysis Procedures.

1. For projects subject to 40 CFR Part 763, AHERA, as amended, and any subsequent amendments or editions, the facility owner shall ensure that a licensed air sampler performs clearance air monitoring after abatement in areas to be reoccupied, including porticos and covered exterior walkways, and abatement on exterior portions of mechanical systems used to condition interior spaces.

2. Air monitoring is not required for Outdoor Projects that are not subject to EPA 40 CFR Part 763, AHERA regulation.

D. Work Practice Requirements.

1. Preparation.

The owner/operator shall minimize, to the extent reasonable and necessary, the exposure to persons downwind of the project.

2. Removal.

a. Wet removal methods shall be used.

b. There shall be no release of visible emissions during preparation, removal, or cleanup.

3. Clean-up.

a. Following removal, the owner/operator shall ensure that:

(1) The abated area is thoroughly cleaned using wet methods and amended water and surfaces have been allowed to dry.

(2) Once dry, the abated area is vacuumed using a vacuum equipped with HEPA cartridges or filters.

(3) The sequence of wet cleaning and vacuuming is repeated until no visible residue can be observed.

b. The facility owner shall ensure that the work area is inspected for any remaining visible residue. Evidence of contamination will necessitate additional cleaning by the contractor.

c. For porous surfaces that have been stripped or cleaned of RACM, the owner/operator shall ensure that a coat of encapsulant is applied to the abated surface to secure any residual fibers that may be present. The encapsulant chosen must be compatible with subsequent coverings.

E. Disposal.

The disposal requirements of the Disposal Section of this regulation shall apply to outdoor projects.

SECTION XVIII. - ENCAPSULATION AND ENCLOSURE.

A. Applicability.

1. The notification/application, air sampling, work practice, clean-up, and disposal requirements of this Section shall apply to each owner/operator engaged in an encapsulation or enclosure operation where mechanical sprayers will be utilized and the potential to disturb RACM will involve amounts greater than 160 square or 260 linear feet of surfacing materials or thermal system insulation.

2. Surfaces that have been previously coated or treated with an encapsulant and that are not in poor condition are exempt from the requirements of this Section.

B. Notification/Application.

1. In a facility with RACM being encapsulated, the owner/operator shall:

a. Provide the Department with written notification/application at least ten complete working days prior to beginning any encapsulation activities.

b. Notify the Department as soon as possible by telephone and follow-up in writing when any previously-notified information changes or when a previously-notified project has been canceled.

2. Acceptable delivery of notification/application shall be by U. S. Postal Service, commercial delivery service or facsimile transmission, by hand, or by other methods deemed acceptable by the Department.

C. Air Sampling and Analysis Procedures.

1. Background Monitoring.

a. Background ambient air sampling shall be required.

b. At least five air samples shall be collected prior to the start of abatement activities in order to obtain an index of background airborne fiber concentrations.

c. Representative samples should be taken both inside and outside the work area within the facility to establish existing ambient air levels under normal activity conditions.

d. The air sampler shall document any variations and justifications for the variances, and shall provide the information to the Department upon request.

2. Clearance.

The owner/operator shall ensure that non-aggressive TEM clearance air monitoring is conducted prior to re-occupancy of any area that has been encapsulated.

D. Work Practice Requirements.

1. Preparation.

a. The owner/operator of an encapsulation or enclosure operation shall:

(1) Define the work area using barrier tape and danger signs in accordance with OSHA 29 CFR 1926.1101, as amended, and any subsequent amendments and editions.

(2) Shut down, lock, and tag out all HVAC equipment in or passing through the work area.

(3) Remove existing filters and dispose of as asbestos-containing waste.

(4) Securely seal all intake and exhaust openings and any seams in system components with 6-mil or thicker polyethylene sheeting and tape.

(5) Securely seal each opening between the work area and uncontaminated areas, including but not limited to windows, doorways, elevator openings, corridor entrances, drains, ducts, electrical outlets, grills, grates, diffusers, and skylights, with a critical barrier consisting of at least one sheet of 6-mil or thicker polyethylene sheeting and tape.

(6) Thoroughly clean and remove all movable objects from the work area.

(7) Thoroughly clean, then cover and secure all non-movable objects in the work area with at least one layer of 4-mil or thicker polyethylene sheeting.

(8) Cover and secure all surfaces not being encapsulated or enclosed with at least one layer of 4-mil polyethylene sheeting for walls or ceilings and 6-mil polyethylene sheeting for floors.

2. Encapsulation/Enclosure Procedures.

a. During any encapsulation of RACM, the owner/operator shall ensure that:

(1) The encapsulant chosen for use is compatible with the substrate to which it will be applied and is appropriate for the application intended.

(2) When airless sprayers are utilized, nozzle pressure shall be adjusted between 400 and 1,500 pounds per square inch (psi).

(3) Loose, damaged, or fallen RACM is cleaned immediately using wet methods and HEPA vacuuming.

(4) RACM is not tracked from the work area onto uncontaminated surfaces.

(5) Once all encapsulated surfaces have completely dried, each surface is wet wiped or HEPA vacuumed.

b. During any enclosure of RACM, the owner/operator shall ensure that:

(1) The enclosure is constructed air-tight so as to prevent the escape of airborne asbestos fibers.

(2) Loose, damaged, or fallen RACM is cleaned immediately using wet methods and HEPA vacuuming and is properly packaged for disposal.

(3) RACM is not tracked from the work area onto uncontaminated surfaces.

(4) Wet methods and HEPA vacuums are used to clean any fallen RACM immediately.

3. Disposal.

The requirements of the Disposal Section of this regulation shall apply.

SECTION XIX. - REQUIREMENTS FOR TRAINING COURSES, INSTRUCTORS, AND TRAINING PROVIDERS.

A. Asbestos Training Course Licenses.

1. An asbestos training course provider who intends to present asbestos training courses within the State shall submit an application for approval, for each initial or refresher training course discipline to be taught, that contains all information necessary to verify qualifications as required by the regulation.

2. An asbestos training course provider must have a separate Department-issued license for each different initial or refresher training course discipline.

3. Licenses for asbestos training course providers will be restricted to courses approved by the Department in accordance with the requirements of this regulation.

4. Each asbestos course license is valid for one year from date of issue, regardless of the number of times the course is taught during the year.

5. Each individual seeking to teach or instruct any portion of any mandatory asbestos training course, regardless of discipline, must submit an instructor application that contains all information necessary to verify qualifications as required by this Section and be approved by the Department.

6. When an asbestos training course instructor seeks to conduct mandatory asbestos training courses in more than one discipline, the instructor must be approved for each separate discipline by the Department.

7. Upon initial approval and licensing of an asbestos training course, the Department will audit and assess the training course provider an initial audit fee prescribed in this regulation.

8. Upon renewal of a training course license, the training course provider will be assessed the annual license renewal fee prescribed in this regulation.

9. An asbestos training course must be approved and currently licensed by the Department on the date that it is taught to be acceptable as a basis for documentation that the person receiving the course certificate has completed the requisite training for asbestos accreditation in any specific work practice topic or discipline.

B. Personnel Licensing Requirements.

In order for an initial or refresher training course in any discipline to be acceptable as a basis for personnel licensing pursuant to this regulation, the course must be licensed and instructor(s) must be approved by the Department.

C. Department Approval.

To qualify for Department approval, an initial or refresher training course in any discipline shall meet the following requirements:

1. Course Content.

a. Each course shall:

(1) Correspond only to a single discipline; and

(2) Provide coverage of specific topics, including instruction in the requirements of this regulation as requested by the Department, and satisfy the requirements of:

(a) The AHERA Model Contractor Accreditation Plan, 40 CFR 763, Subpart E, Appendix C (Federal Register, Volume 59, Number 23, Thursday, February 3, 1994), as amended, and any subsequent amendments and editions, and this regulation; and

(b) The 16-hour Operation and Maintenance Worker Course as specified in this Section.

b. Initial training courses for all supervisors and workers shall include hands-on glovebag training with smoke testing of the glovebag seal in accordance with OSHA 29 CFR 1926.1101(g)(5)(ii), as amended, and any subsequent amendments and editions.

c. Supervisor and worker refresher course hands-on training shall be required and shall include instructor demonstrations; video applications; and written illustrations or representations or other methods designed to communicate work practice procedures to the student. Students are not required to handle equipment or to participate in simulated abatement activities.

2. Course Presentation.

a. An initial worker or O&M worker training course may be conducted by a single qualified instructor if the instructor meets the minimum requirements of this Section.

b. Initial training courses in all disciplines (except worker) shall be taught by at least two Department-approved instructors.

3. Duration of Training.

a. A training course shall not include more than eight hours of training during a single 24-hour period.

b. One day of training equals no less than six and one-half hours of actual classroom or hands-on activities.

c. The total number of hours required for any initial training course shall be completed within a period not to exceed 14 calendar days.

4. Effectiveness of Training.

a. Instructors shall be evaluated by Department-conducted on-site audits or by audits conducted by representatives from states with whom the Department has established reciprocity.

b. Training providers shall conduct courses in a physical environment conducive to learning (such as a classroom).

c. The maximum enrollment of an initial asbestos course shall be 40 participating students.

d. There shall be no more than ten students per instructor during all hands-on portions of initial training.

5. Foreign-Language Instruction.

a. Worker course instructors and students shall be fluent in the language in which the course is being taught.

(1) An English-speaking instructor shall not use an interpreter to instruct foreign-language trainees.

(2) Training courses in all disciplines (except worker) shall be conducted only in English.

b. The training provider shall provide trainees with course materials accurately translated into the language in which the course is being conducted.

6. Testing.

a. At the conclusion of each initial or refresher course, the training provider shall administer an examination in written or oral form to any trainee seeking to obtain a license to perform asbestos-related activities. Oral examinations are allowed to be administered only to individuals seeking training in the worker category.

b. The training provider shall administer an examination designed to test the trainees' familiarity with those issues relevant to the safe and proper performance of asbestos projects.

c. The training provider shall construct the course examination from a pool of validated questions and shall prepare a new examination for each course presentation.

d. A trainee who fails to pass an initial examination by not achieving a minimum score of 70 on a 100-point scale may be retested once. Upon failing to pass an examination on the second attempt, the trainee shall retake the entire training course before being allowed to retest for that discipline.

e. The Department may approve alternative testing it deems appropriate.

7. Certificates.

a. The training course provider shall issue a unique numbered certificate to each student who successfully completes the training course and passes the examination.

b. Each numbered certificate shall include the following information:

(1) Name and last four digits of the Social Security number of the trainee;

(2) Unambiguous course title indicating the discipline and specifying whether the training is an initial or refresher course;

(3) A unique certificate number;

(4) Inclusive dates of training course;

(5) Examination date;

(6) A statement indicating that the person whose name appears on the certificate has completed the training course and successfully passed an examination;

(7) For courses covered under 40 CFR Part 763, Subpart E, Appendix C, as amended, and any subsequent amendments and editions, a certificate expiration date that is one year after the date the course was completed and the applicable examination passed;

(8) The name, address, and telephone number of the training provider;

(9) The printed name and signature of the principal instructor;

(10) Training course location; and

(11) A statement that the person receiving the certificate has completed the requisite training for asbestos accreditation under Title II of Section 206 of the Toxic Substances Control Act (15 U.S.C.A. Section 2646), with the exception of O&M certificates.

8. Notifications and Reporting.

a. A training provider who intends to present a training course within the state shall notify the Department in writing at least ten calendar days prior to the first day of the course. The written notification must include the following information:

(1) Training provider name, address, telephone number, and contact person;

(2) Training course title;

(3) Inclusive dates of course and applicable exam;

(4) Daily start and completion times;

(5) Location and detailed directions to course facility;

(6) Language in which the course is taught;

(7) Names of the instructors; and

(8) A copy of the training course agenda. (If the agenda is identical to one previously submitted to the Department, an additional copy is not required.)

b. Within seven days of conclusion of a training course presented within the State, the training provider shall submit the following information to the Department:

(1) Name of the course indicating whether initial or refresher;

(2) Inclusive dates of the course and examination;

(3) Names of all course instructors and topics taught;

(4) The course location;

(5) The name and Social Security number of every trainee, including names of those who did not successfully pass or otherwise complete the course;

(6) The unique certificate numbers of every trainee who completed the course and passed the examination; and

(7) Name, address, and telephone number of the training provider.

c. Out-of-state training providers shall submit any information specified in this Section to the Department upon request.

d. Failure to submit a written course notification or course roster in the timeframe prescribed by this Section may result in the rejection of the course and certificates for licensure by the Department.

9. Record Keeping.

a. The person, sole proprietorship, public corporation, or incorporated entity operating as a training provider shall retain copies of records related to asbestos training approved pursuant to this regulation for three years or for a period of time as defined in Title II, Section 206 of the Toxic Substances Control Act of the United States (15 U.S.C.A. Section 2646), as amended.

b. In the event that ownership of the sole proprietorship, public corporation, or incorporated entity operating as a training provider is transferred to a different owner, all records maintained during the previous three years shall be transferred and maintained by the new owner.

c. Records that must be maintained shall include those defined in Title II, Section 206 of the Toxic Substances Control Act of the United States (15 U.S.C.A. Section 2646), as amended, and in all cases shall include the following:

(1) Course curriculum materials;

(2) Examinations and scores of all persons who have taken examinations;

(3) Instructor applications and resumes;

(4) Training course approval applications;

(5) Rosters of individuals taking training courses;

(6) Copies of training course notifications; and

(7) Copies of all correspondence with federal and/or state accreditation agencies regarding instructor and training course approvals, disapprovals, suspensions, or audits.

D. Operation and Maintenance (O&M) Worker Course.

1. An initial O&M training course shall be at least 16 hours in length and shall provide, at a

minimum, information on all of the following topics:

a. The physical characteristics of asbestos, including fiber size, aerodynamic characteristics, and physical appearance.

b. The health hazards of asbestos, including the nature of asbestos-related diseases, routes of exposure, dose-response relationships, synergism between cigarette smoking and asbestos exposure, latency period of diseases, and health basis for the standards.

c. Typical locations, uses, and types of ACM; and recognition of damage, deterioration, and delamination of ACM.

d. Employee personal protective equipment, including the types and characteristics of respirators; limitations of respirators; proper selection, inspection, donning use, maintenance and storage procedures for respirators; methods for field testing of the face-piece-to-face seal (positive and negative-pressure fit checks); qualitative and quantitative fit test procedures; variability between field and laboratory protection factors that alter respiratory fit (e.g., facial hair); the components of a proper respiratory protection program; selection and use of personal protective clothing; use, storage, and handling of non-disposable clothing; and regulations covering personal protective equipment.

e. Air monitoring procedures and requirements included under OSHA 29 CFR 1926.1101, as amended, and any subsequent amendments and editions, including a description of equipment and methods, reasons for air monitoring, types of samples, and current standards with proposed changes.

f. Description of the proper methods of handling RACM to include state-of-the-art work practices for asbestos O&M activities including: purpose, proper construction, and maintenance of barriers; posting of warning signs; electrical and ventilation system lockout/tagout; proper working techniques for minimizing fiber release; use of wet methods and surfactants; use of HEPA vacuums; and proper cleanup and disposal procedures. Work practice requirements as they apply to removal, encapsulation, enclosure, and repair shall be discussed individually.

2. A yearly review course shall be one day in length and shall review the health hazards associated with exposure to asbestos; the locations, uses, types, and condition of ACM; hands-on activities; updated information on state-of-the-art procedures and equipment; and regulatory changes and interpretations. Actual instruction time shall be a minimum of six and one-half hours. The Department may request coverage of specific topics.

3. The requirements of this Section pertaining to course presentation, effectiveness of training, foreign-language instruction, testing, certificates, notification and reporting, record keeping, qualifications for instructors, course approval, and periodic audits shall apply to O&M courses.

E. Qualifications for Instructors of Non-Work Practice Topics.

1. Applicants seeking approval to teach segments of asbestos training courses other than work practice or hands-on exercises shall be actively working in the field of expertise for which he or she is conducting training.

2. The following documentation is required for instructors of non-work practice topics:

a. A copy of a high school, General Education Development (GED), or college/university diploma;

b. A copy of all professional licenses relevant to the subject matter being taught; and

c. The name, address, and telephone number of the applicant's current employer.

F. Initial and Refresher Course Instructor Qualifications.

The Department reserves the right to reject instructor training and/or experience that it deems unacceptable for qualification.

1. Worker Discipline.

a. Previous Training.
The applicant shall meet current EPA and Department accreditation requirements for supervisors.

b. Education/Asbestos Work Experience.

The applicant shall meet at least one of the following education/asbestos work experience combinations:

(1) If the applicant does not possess either a GED or high school diploma, the applicant shall:

(a) Have at least 360 instructional hours as an instructor in an EPA-approved worker course; and

(b) Have at least 1,440 hours experience in a worker or supervisory capacity of contained work areas.

(2) If the applicant possesses either a high school or GED diploma, the applicant shall:

(a) Have at least 960 hours of documented experience in a worker, supervisory, or consulting capacity of contained work areas; or

(b) Have at least 240 documented hours as an instructor in an asbestos worker or supervisor course.

(c) The applicant may substitute 240 documented hours of occupational safety, health, and environmental instructional hours taught in courses required to meet federal or State regulations for the instructional hours required in Paragraph F.1.b.(2)(b) of this Section.

(3) If the applicant possesses at least an associate degree from a regionally-accredited college/university, the applicant shall:

(a) Have at least 480 hours of documented experience in a worker, supervisory, or consulting capacity of contained work areas; or

(b) Have at least 120 documented hours as an instructor in an asbestos worker or supervisor course.

(c) The applicant may substitute 120 documented hours of occupational safety, health, and environmental instruction taught in courses required to meet federal or State regulations for the instructional hours required in Paragraph F.1.b.(3)(b) of this Section.

2. Supervisor Discipline.

a. Previous Training.

The applicant shall meet current EPA accreditation requirements for supervisors.

b. Education Asbestos Work Experience.

The applicant shall meet at least one of the following education/asbestos work experience combinations:

(1) If the applicant does not possess either a high school or GED diploma, the applicant shall:

(a) Have at least 360 documented hours as an instructor in an EPA-approved supervisor course; and

(b) Have at least 1,440 hours of documented experience in a supervisory capacity of contained work areas.

(2) If the applicant possesses either a high school or GED diploma, the applicant shall:

(a) Have at least 960 hours of documented experience in a supervisory capacity of contained work areas; or

(b) Have at least 240 documented hours as an instructor in an asbestos worker or supervisor course.

(c) The applicant may substitute 240 documented hours of occupational safety, health, and environmental instruction taught in courses required to meet federal or State regulations for the instructional hours required in Paragraph F.2.b.(2)(b) of this Section.

(3) If the applicant possesses at least an associate degree from a regionally-accredited college/university, the applicant shall:

(a) Have at least 480 hours experience in a worker, supervisory, or consulting capacity of contained work areas; or

(b) Have at least 120 instructional hours as an instructor in an asbestos worker or supervisor course.

(c) The applicant may substitute 120 hours of occupational safety, health, and environmental instructional hours taught in courses required to meet federal and State regulations for the instructional hours required in Paragraph F.2.B.(3)(b) of this Section.

3. Management Planner Discipline.

a. Previous Training.

The applicant shall meet current EPA accreditation requirements for management planners.

b. Education/Asbestos Work Experience.

The applicant shall meet at least one of the following education/asbestos work experience combinations:

(1) If the applicant possesses either a high school or GED diploma, the applicant shall:

(a) Have documented management planning experience showing at least 25 management plans written in the last three years, or documented experience as the project manager for at least 25 asbestos projects in the last three years, or a combination of management plans and projects managed; or

(b) Have at least 48 documented hours as an instructor in an EPA-approved management planner course.

(c) The applicant may substitute 48 documented hours of occupational safety, health, and environmental instruction taught in courses required to meet federal or State regulations for the instructional hours required in Paragraph F.3.b.(1)(b) of this Section.

(2) If the applicant possesses at least an associate degree from a regionally-accredited college/university, the applicant shall:

(a) Have documented management planning experience showing at least 12 management plans written in the last three years, or documented experience as the project manager for at least 12 asbestos projects in the last three years, or a combination of management plans and projects managed; or

(b) Have at least 32 documented hours as an instructor in an EPA-approved management planner course.

(c) The applicant may substitute 32 documented hours of occupational safety, health, and environmental instruction taught in courses required to meet federal or State regulations for the instructional hours required in Paragraph F.3.b.(2)(b) of this Section.

4. Building Inspector Discipline.

a. Previous Training.

The applicant shall meet current EPA accreditation requirements for asbestos building inspectors.

b. Education/Asbestos Work Experience.

The applicants shall meet at least one of the following education/asbestos work experience combinations:

(1) If the applicant possesses either a high school or GED diploma, the applicant shall:

(a) Have documented experience including asbestos inspections in at least one million square feet of building space in the last three years; or

(b) Have at least 60 documented hours as an instructor in an EPA-approved building inspector course.

(c) The applicant may substitute 60 documented hours of occupational safety, health, and environmental instruction taught in courses required to meet federal or State regulations for the

instructional hours required in Paragraph F.4.b.(1)(b) of this Section.

(2) If the applicant possesses at least an associate degree from a regionally-accredited college/university, the applicant shall:

(a) Have documented experience including asbestos inspections in at least 500,000 square feet of building space in the last three years; or

(b) Have at least 40 documented hours as an instructor in an EPA-approved building inspector course.

(c) The applicant may substitute 40 documented hours of occupational safety, health, and environmental instruction taught in courses required to meet federal or State regulations for the instructional hours required in Paragraph F.4.b.(2)(b) of this Section.

5. Project Designer Discipline.

a. Previous Training.

The applicant shall meet current EPA accreditation requirements for asbestos project designers.

b. Education/Asbestos Work Experience.

The applicants shall meet at least one of the following education/asbestos work experience combinations:

(1) If the applicant possesses either a high school or GED diploma, the applicant shall:

(a) Have documented asbestos project design experience including the design of at least 12 asbestos projects in the last three years; or

(b) Have at least 30 documented hours as an instructor in an EPA-approved asbestos project designer course.

(c) The applicant may substitute completion of 30 documented hours of occupational safety, health, and environmental instruction taught in courses required to meet federal or State regulations for the instructional hours required in Paragraph F.5.b.(1)(b) of this Section.

(2) If the applicant possesses at least an associate degree from a regionally-accredited college/university, the applicant shall:

(a) Have documented asbestos project design experience including the design of at least six asbestos projects in the last three years; or

(b) Have at least 20 documented hours as an instructor in an EPA-approved asbestos project designer course.

(c) The applicant may substitute 20 documented hours of occupational safety, health, and environmental instruction taught in courses required to meet federal or State regulations for the instructional hours required in Paragraph F.5.b.(2)(b) of this Section.

G. Documentation of Instructor Qualifications.

1. Applicants seeking approval to teach work-practice or hands-on topics or to act as a sole instructor shall submit documentation of training, education, and work experience as required herein.

2. Documentation of Training.

a. The applicant shall submit a copy of initial and subsequent refresher certificates of training from courses approved by the EPA or by an EPA-accredited state, and provide for each course the title, dates of instruction, names of instructors, name, address, and telephone number of the training provider.

b. Instructors shall take refresher training from a training provider not affiliated with the instructor for at least one discipline every year. Instructors teaching multiple disciplines shall alternate among the different disciplines taught.

3. Documentation of Education.

The applicant shall submit a copy of high school, GED, or college or university diploma or the name and address of the conferring institution.

4. Documentation of Asbestos Work Experience.

a. An applicant for instructor of worker or supervisor training courses shall submit a detailed description of job duties and responsibilities as an asbestos worker, foreman, supervisor, or consultant, including all of the following:

(1) Inclusive dates of employment;

(2) The name of the employer;

(3) Types of ACM removed;

(4) Number of workers supervised;

(5) Name, address, and telephone number of each different employer; and

(6) Name of immediate supervisor at each different employer.

b. An applicant for instructor of building inspector, management planner, or project designer training courses shall include all relevant information concerning experience completing inspections, management plans, or project designs, including all of the following:

(1) Size and location of buildings inspected;

(2) Descriptions of management plans, projects managed, or projects designed;

(3) Name, address, and telephone numbers of building owners;

(4) Name, address, and telephone numbers of all employers; and

(5) Inclusive dates of employment.

c. Documentation of Instructor Experience.

The applicant shall submit a detailed description of instructor experience, including all of the following:

(1) Name of training courses taught;

(2) Topics taught for each course;

(3) Inclusive dates of each training course;

(4) Total hours taught for each training course; and

(5) Name, address, and telephone number of each training organization with which experience is claimed.

H. Work Practice Topics.

Instructors shall meet the qualifications for instructors listed in Section XIX.F. above in order to teach the following asbestos Work Practice Topics:

1. O&M Worker and Worker Refresher:

   a. State-of-the-Art Work Practices.

   b. Hands-on Exercises (initial course only).

2. Worker and Worker Refresher:

   a. State-of-the-Art Work Practices.

   b. Hands-on Exercises (initial course only).

3. Supervisor and Supervisor Refresher:

   a. State-of-the-Art Work Practices.

   b. Techniques for Asbestos Abatement Activities.

   c. Hands-on Exercises (initial course only).

4. Management Planner and Management Planner Refresher:

   a. Evaluation/Interpretation of Survey Results.

   b. Hazard Assessment.

   c. Developing an Operations and Maintenance (O&M) Plan.

   d. Record Keeping for the Management Planner.

   e. Assembling and Submitting the Management Plan.

5. Building Inspector and Building Inspector Refresher:

a. Pre-inspection Planning and Review of Previous Inspection Records.

b. Inspecting for Friable and Non-friable Asbestos Containing Materials (ACM).

c. Assessing the Condition of Friable ACM.

d. Bulk Sampling/Documentation of Asbestos in Schools.

e. Record Keeping and Writing Inspections Reports.

f. Field Trip.

6. Project Designer and Asbestos Project Designer Refresher:

a. Safety System Design Specifications.

b. Designing Abatement Solutions.

c. Budgeting/Cost Estimation.

d. Writing Abatement Specifications.

e. Preparing Abatement Drawings.

f. Occupied Buildings.

g. Field Trip.

I. Course Approval.

1. The Department may base approval of an initial or refresher training course in any discipline in whole or in part on the provider's compliance with the requirements of Section XIX.C., the accuracy and applicability of the materials submitted pursuant to this Section, observation by a Department representative of an actual presentation of the course, or approval from the EPA, an EPA-accredited state, or a state having reciprocity with the Department.

2. The training provider shall submit all of the following information to the Department not less than 30 days prior to the initial presentation of the course within the State:

a. Course sponsor's name, address, and telephone number;

b. The course curriculum;

c. Length of training in days;

d. Description of amount and type of hands-on training;

e. Topics covered in the course;

f. A copy of all course materials, including student manuals, student handouts, instructor notebooks, lecture outlines, etc;

g. A detailed statement regarding the length, format, and development of examinations, and copies of actual examinations;

h. A description of procedures used to administer examinations and to ensure their security;

i. Instructor names, documentation of qualifications (including resumes), and the subject areas that each instructor will teach;

j. Description and samples of numbered certificates that will be issued to students who successfully complete the course, and a statement regarding the manner in which certificate numbers are generated; and

k. Other applicable information requested by the Department.

3. The provider of any training course presented in the State shall allow Department representatives to attend, monitor, and evaluate the course without charge and without advance notice.

4. The provider of any training course approved by the Department shall notify the Department within ten days of any changes in course topics, materials, and instructors. The training provider shall provide notification in writing and shall submit appropriate documentation for Department approval.

5. The Department reserves the right to require additional training as appropriate, including training specific to this regulation, air sampling strategies, or roofing projects.

6. The Department shall withdraw approval of a training course if it determines that:

a. The course no longer meets the requirements of this regulation or the EPA Model Accreditation Plan.

b. Approval from the EPA, an EPA-accredited state, or a state with whom the Department has reciprocity has been withdrawn.

J. Periodic Audits.

1. The Department may conduct unannounced audits of any training course to ensure compliance with all requirements of this regulation.

2. All in-State training providers shall maintain the approval status of their training courses by submitting to periodic on-site audits by the Department. Such audits may be unannounced. In-State training courses that have been audited by a state having a written reciprocal agreement with the Department regarding periodic audits may be exempted from the periodic audit rule.

3. The Department shall conduct periodic audits for the purpose of verifying that:

a. The training course complies with all requirements of this regulation;

b. The training course content has been updated and is current with state-of-the-art methods and technology available in the asbestos abatement and management industry;

c. The training course meets instructor qualifications and performance standards, training course administration standards, hands-on training standards, and instructor-to-student and workstation-to-student ratios as established by the Department;

d. The training course sponsor has maintained training-related records as required in Paragraph C.9. of this Section; and

e. Previously-approved curriculum materials and instructors are subject to the training course standards as defined by the Department.

4. All training course sponsors shall allow, at no charge, representatives from the Department to attend all or any part of any training course for the purpose of conducting periodic audits. Training course sponsors shall not restrict access to any part of a training course for which the Department is conducting an on-site audit. As part of the audit process, training course sponsors shall make records that are required by this regulation available to the Department upon request.

5. As a result of a periodic on-site audit of any training course previously approved by the Department, the Department may revoke or suspend its approval; or, for training courses that have been approved by other federal or state approval agencies, the Department may refuse to accept certificates of training if any of the following deficiencies are noted during the audit:

a. The course is not in compliance with this regulation;

b. The training provider misrepresents the extent of the training course's approval; or

c. The Department finds evidence of falsification of any records required by this regulation.

6. The Department shall not recognize a certificate of training issued by any in-State training course that has had its acceptance suspended or revoked as a result of an on-site audit until a subsequent audit shows that the cause of suspension or revocation has been corrected.

7. The Department shall not recognize a certificate of training issued by any training course that has had its approval, acceptance, or certification revoked by any other state or federal approval agency until the approval has been reinstated by the revoking agency.

K. Training Course Fee Schedule.

1. Initial approval for each training course license - $350.00 per day per course.

2. Annual license renewal for Department-approved training courses - $200.00 per course.

3. Each course license is valid for an entire year, regardless of the number of times the course is taught during the year.

4. Fees shall not be refunded if a training course is denied a license per this regulation.

5. Failure to pay annual training course license renewal fees may, after a hearing in accordance with the provisions of this regulation, result in the course license being revoked.

SECTION XX. - INDUSTRIAL MANUFACTURING AND ELECTRICAL GENERATING FACILITIES.

A. Applicability.

1. In lieu of requirements described in other sections of this regulation except as specified herein, the requirements of this Section shall apply to the owner of an industrial manufacturing or electrical generating facility that has obtained a group license for facility employees or employees of the designated long-term in-house contractor.

2. Unless otherwise specified herein, the applicable requirements of this regulation shall apply to any asbestos project involving RACM, regardless of the size of the project.

3. No person shall engage in any asbestos project or abatement involving RACM unless licensed to do so by the Department.

4. Industries that choose not to obtain a facility group license or who hire companies or individuals not covered under the facility group license shall satisfy all applicable requirements described in other sections of this regulation, except for with regard to the frequency with which building inspections are required, as outlined in Section XX, J of this regulation.

B. Training.

Employees of industrial manufacturing or electrical generating facilities and of such facilities' long-term in-house contractors who perform asbestos abatement projects shall satisfy the training requirements as specified below:

1. Employees who perform OSHA-designated Class I and II work not subject to OSHA's exceptions shall receive training consistent in length and curriculum with 40 CFR Part 763, Subpart E, Appendix C, as amended, and any subsequent amendments and editions. Employees who perform OSHA-designated Class III work not subject to OSHA's exceptions shall receive training consistent in length and curriculum with 40 CFR 763.92(a)(2).

2. All training conducted for the purpose of satisfying B.1 of this Section shall be conducted by a person who meets the applicable instructor qualifications of the Training Section of this regulation.

C. License Application.

1. Each person covered under a facility group license shall successfully complete a Department-approved initial or refresher training course specific to the discipline, and at the conclusion of the course, shall successfully pass an examination, when applicable, with a score of 70 percent or above.

2. Each facility seeking a group license shall submit a completed application to the Department in a format designated by the Department. The application must state the type of license for which the application is being made and must include the following information:

a. Name, mailing address, and street address of the industrial manufacturing or electrical generating facility;

b. Name, title, and telephone number of a responsible company official;

c. Name of the designated long-term in-house contractor, when applicable; and

d. Name, Social Security number, discipline, training provider or approved instructor, and, when applicable, examination date of most recent training certificate for each person to be included under the license.

e. An owner shall notify the Department quarterly of any change in facility name, contact person, mailing address, street address, telephone number, long-term in-house contractor, and/or personnel covered by the group license.

3. Acceptable documentation of training may be requested by the Department and shall include:

a. An original certificate issued by the training course provider that meets the requirements specified in this regulation; or

b. A valid, original license or accreditation issued by a state that has a reciprocal arrangement with the Department (photocopies or telephone facsimile copies shall not be accepted); or

c. A letter verifying successful completion of training that is sent directly to the Department from the approved training instructor.

4. Duration of a License.

a. A license shall automatically become invalid if an instrument of payment is returned for insufficient funds.

b. A group license shall expire one year from the process date, unless the Department suspends or revokes the license at an earlier date. No person covered by a group license shall engage in any asbestos project after one year from the examination date printed on his or her most recent training certificate regardless of the expiration date of the group license.

D. Continuing Education

1. After successful completion of an approved initial training course, each employee to be covered under a group license shall thereafter successfully complete a Department-approved initial or refresher training course specific to the discipline, and, at the conclusion of each course shall pass an examination with a score of 70 percent or above where applicable.

2. If more than 12 months but fewer than 24 months have elapsed since completing an initial or refresher training course, an applicant shall successfully complete either a refresher training course or an initial training course.

3. If more than 24 months have elapsed since successfully completing an initial or refresher training course, an applicant shall complete another initial training course.

E. Fees.

1. No application will be processed unless accompanied by the required fee.

2. Departmental receipt and deposit of fees submitted with an application shall in no way indicate

approval of the application or guarantee the Department's issuance of a license.

3. Fees shall not be refunded if a license is denied.

F. Group License Fee Schedule.

The fee for a group license shall be as follows:

1. Up to 10 people - $ 25.00 minimum fee

2. 11 to 20 people - $ 2.50 per person

3. 21 to 50 people - $ 5.00 per person

4. 51 to 90 people - $ 7.50 per person

5. 91 persons or more - $ 500.00 maximum fee

6. The minimum fee for a group license is $25.00 and the maximum is $500.00.

G. Project Fees.

1. The Department shall collect project license fees for all RACM being removed and for previously non-regulated ACM rendered regulated by use of destructive removal techniques such as chipping, grinding, sawing, abrading, drilling, or extensive breaking.

2. Abatement project fees for RACM are calculated at 10 cents per linear, cubic, or square foot, with a minimum fee of $25.00 and a maximum fee of $1,000.00.

3. The Department will not issue an abatement project license for a renovation or demolition until all requested information has been submitted and reviewed and all applicable fees have been paid.

4. Fees will not be refunded on projects for which the Department has issued an asbestos project license.

5. An abatement project license that has been issued shall automatically become invalid if an instrument of payment is returned for insufficient funds.

H. Action on an Application.

Within 15 calendar days after receiving an application, the Department will acknowledge receipt of the application and notify the applicant of any deficiency in the application. Within 30 calendar days after receiving a completed application, including all additional information requested, the Department will issue a license or deny issuance of the application.

I. Conditions and Generic Alternatives.

In granting a license, the Department may impose reasonable terms and conditions to ensure continuous compliance with the requirements of this regulation.

J. Asbestos Project General Information.

1. Prior to beginning a renovation or demolition operation at a facility, the owner/operator shall ensure that a building inspection is performed to identify the presence, location, and estimated quantity of ACM that may be disturbed by the work activity. The building inspection shall be performed by a person licensed as a building inspector or management planner.

2. The building inspector or management planner shall comply with the Building Inspection Section of this regulation.

3. To be acceptable, a building inspection shall have been performed no earlier than five years prior to the renovation or demolition, or, if more than five years have elapsed since the most recent inspection, the previous inspection shall be confirmed and verified by a person licensed as a building inspector.

K. Notification.

1. For NESHAP renovation projects, refer to the NESHAP Project Section of this regulation.

2. For demolitions, refer to the Demolition Section of this regulation.

3. For small, minor, and O&M renovation projects, either:

a. Provide the Department with written notification/application prior to any abatement and pay all applicable fees.

(1) Deliver the notification by U.S. Postal Service or commercial delivery service, facsimile transmission, by hand or by other methods deemed acceptable by the Department.

(2) Postmark or deliver the notice at least four working days for small projects before commencing asbestos stripping or removal work or any other activity begins that would break up, dislodge, or similarly disturb RACM. For minor and O&M projects, postmark or deliver the notice prior to commencing abatement activities.

(3) Update the notification when any previously-notified information changes and pay additional project fees as necessary.

(4) Notify the Department by telephone and follow up in writing as soon as possible, but not later than, the originally notified start date when a project for which notification was sent has been canceled.

(5) The Department may waive the five-calendar-day prior notice requirement on a case-by-case basis.

b. Maintain a log of all small, minor, or O&M projects performed during a quarter, report them to the Department within 30 calendar days of the end of the quarter, and pay applicable project fees. The log shall include but is not limited to: the name and address of the facility being abated, amount and type of ACM removed, date(s) of the removal, names of individuals who performed the abatement, the temporary waste storage location, and the name of the landfill used for disposal.

4. The owner/operator shall notify the Department by telephone and follow up in writing as soon as possible before, but not later than, the notified start date when a project has been canceled.

5. A licensed asbestos project designer shall prepare and implement the written design for each abatement renovation project involving the removal of greater than 3,000 square, 1,500 linear, or 656 cubic feet of RACM in a facility to be reoccupied. However, all projects shall be designed in accordance with the requirements of 40 CFR 763.90(g), as amended, and any subsequent amendments and editions, and this regulation.

6. The disposal requirements of this regulation shall be applicable to asbestos-containing and asbestos-contaminated materials for any abatement activity.

L. Emergency Operation Documentation.

1. For an emergency operation, the owner/operator shall submit project notification as early as possible before, but not later than, the working day following the emergency operation.

2. The facility owner shall notify the Department in writing of the date and hour that the emergency occurred; a description of the sudden, unexpected event; and an explanation of how the event caused an unsafe condition, public safety or health threat, equipment damage, or would impose an unreasonable financial burden. The owner shall submit this information with the project notification as required in this Section.

M. Work Practices.

1. NESHAP projects performed at an industrial manufacturing or electrical generating facility by individuals covered under the facility's group license shall satisfy the work practice requirements of 40 CFR 61.145, as amended, and any subsequent amendments and editions, and shall ensure that: wet removal methods are used; no visible emissions are released to the outside air; and all asbestos waste is sealed in leak-tight containers and disposed of at a landfill permitted to accept asbestos waste.

2. Any small or minor asbestos project or any O&M activity performed at an industrial manufacturing or electrical generating facility shall be subject to the work practice requirements of the Small Project, Minor Project, or O&M Project Sections whenever feasible. When such work practice requirements are not feasible or when alternate Federal OSHA and EPA work practice standards are used, the owner/operator shall perform work in such a way to provide assurance of RACM containment.

3. The use of glovebags must be in accordance with the requirements of OSHA 29 CFR 1926.1101.

4. The owner/operator shall ensure that contaminated water is filtered through a five micron or smaller filter and discharged to a sanitary sewer system. No contaminated or filtered water shall be allowed to leak or drain outside of the work area.

5. The Department may, on a case-by-case basis, approve alternative procedures for work practices, control of emissions from an asbestos abatement project, or air monitoring, provided the owner/operator submits a written description of the alternative procedure to the Department prior to beginning work and demonstrates to the satisfaction of the Department that compliance with the prescribed procedures will not be practical or feasible and that the proposed alternative procedures provide equivalent protection from asbestos exposure.

6. Legible copies of Departmental letters of approval for alternative work practices shall be kept at the project site and available for inspection for the duration of abatement.

N. Exemption from Wetting for Any Sized Project.

The requirements of the Exemption From Wetting Section of this regulation shall apply.

O. Disposal.

The requirements of the Disposal Section of this regulation shall apply except as follows:

1. In lieu of locking metal dumpster doors and tops, the dumpster containing asbestos waste may be kept in a secured area to which access is controlled.
2. Asbestos waste may be kept at the site until a sufficient quantity has accumulated for a full shipment. In this instance, the facility owner shall submit a copy of a completed waste shipment record or other shipping manifest to the Department within 45 working days of shipment of the waste.

P. Requirements for Training Courses and Training Instructors.

In order for initial or refresher training subject to the requirements of 40 CFR Part 763 to be acceptable as a basis for licensing pursuant to this Section, the course curriculum and instructors must meet the applicable curriculum criteria in the Training Section of this regulation and be approved by the Department.

Q. The requirements of the Reprimands, Suspensions, and Revocation Section of this regulation shall apply.

R. The requirements of the Contested Cases Section of this regulation shall apply.

S. The requirements of the Records Section of this regulation shall apply.

T. The requirements of the Other Requirements Section of this regulation shall apply.

SECTION XXI. - REPRIMANDS, SUSPENSIONS AND REVOCATION.

The Department may reprimand any licensee or revoke or suspend any license based upon violation of any requirement stated herein. Reasons for reprimand, suspension, or revocation may include, but are not limited to, falsification or known omission of any written submittal required as part of this regulation, submission of fraudulent information or documentation, omission or improper use of work practices, improper disposal of ACM, or spread of asbestos emissions beyond the containment area.

SECTION XXII. - CONTESTED CASES.

A. A Department decision involving the issuance, denial, renewal, suspension, or revocation of a permit or license may be appealed by an affected person with standing pursuant to applicable law, including S.C. Code Title 44, Chapter 1 and Title 1, Chapter 23.

B. Any person to whom an order or civil penalty is issued may appeal it pursuant to applicable law, including S.C. Code Title 44, Chapter 1 and Title 1, Chapter 23.

SECTION XXIII. - RECORDS.

Each licensed asbestos owner/operator shall retain, for at least three years after their issuance, all records required herein unless otherwise stated. These records shall be made available to the Department for review upon request.

SECTION XXIV. - OTHER REQUIREMENTS.

A. The requirements of this regulation shall in no way be construed to relieve the owner/operator from compliance with other regulatory requirements or contractual agreements that may be more restrictive.

B. The Department reserves the right to assess additional fees for licensing, training course auditing, and abatement activities, should enabling legislation be enacted.

SECTION XXV. - SEVERABILITY CLAUSE.

The provisions of Sections I through XXV of this regulation must be construed as separate provisions. If a provision is judged to be invalid in a court of law of this State, the court's decree shall apply only to the provision and action specified and shall have no effect on any other provision unless stated in the court's decree. The invalidity does not affect other provisions or applications of the Section which may be given effect without invalid provision or application and pursuant to this requirement, the provisions of these Sections are severable.

R. 61-86.1 History - State Register:

Vol. 10, Issue No. 6, (Doc. No. 548), June 27, 1986;
Vol. 12, Issue No. 5, (Doc. No. 896), May 27, 1988;
Vol. 20, Issue No. 6, (Doc. No. 1914), June 28, 1996;
Vol. 20, Issue No. 7, (Doc. No. 1914), Errata July 26, 1996;
Vol. 22, Issue No. 5, (Doc. No. 2171), May 22, 1998;
Vol. 26, Issue No. 6, (Doc. No. 2670), June 28, 2002;
Vol. 32, Issue No. 6, (Doc. No. 3162), June 27, 2008;
Vol. 35, Issue No. 5, (Doc. No. 4130), May 27, 2011.

ATTACHMENT 3

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

AUG 10 2004

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

OSWER 9345.4-05

MEMORANDUM

SUBJECT: Clarifying Cleanup Goals and Identification of New Assessment Tools for Evaluating Asbestos at Superfund Cleanups

FROM: Michael B. Cook, Director
Office of Superfund Remediation and Technology Innovation

TO: Superfund National Policy Managers, Regions 1-10

Purpose

The purpose of this memo is twofold. The first purpose is to clarify that Regions should develop risk-based, site-specific action levels to determine if response actions should be taken when materials containing less than 1 percent asbestos (including chrysotile and amphibole asbestos) are found on a site. Regions should not assume that materials containing less than 1 percent asbestos do not pose an unreasonable risk to human health. The second purpose is to outline some activities underway to assist in the evaluation of asbestos risks at Superfund sites.

It is important to note that this memorandum is not a regulation itself, nor does it change or substitute for any regulations. Thus, it does not impose legally binding requirements on EPA, States, or the regulated community. This memorandum does not confer legal rights or impose legal obligations upon any member of the public. Interested parties are free to raise questions and objections about the substance of this memorandum and the appropriateness of the application of this memorandum in a particular situation. EPA and other decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from those described in this memorandum. The use of the word "should" in this document means that something is suggested or recommended, but not required.

Background

The 1 percent threshold for asbestos-containing materials was first used in the 1973 National Emissions Standards for Hazardous Air Pollutants (NESHAP), where the intent of the threshold was:

> *... to ban the use of materials which contain significant quantities of asbestos, but to allow the use of materials which would: (1) contain trace amounts of asbestos which occur in numerous natural substances, and (2) include very small quantities of asbestos (less than 1 percent) added to enhance the material's effectiveness.* (38 FR 8821)

All subsequent EPA regulations and the Asbestos Hazardous Emergency Response Act Statute included this 1 percent threshold. In the 1990 NESHAP revisions, EPA retained the threshold, stating that it was related to the phase contrast microscopy (PCM) analytical method detection limits. The Occupational Safety and Health Administration (OSHA) Standards also defined an asbestos-containing material as a material containing more than 1 percent of asbestos[1] (29 CFR Part 1910.1001 and 29 CFR Part 910.134). The wide use of the 1 percent threshold in regulations may have caused site managers to assume that levels below the threshold did not pose an unreasonable risk to human health. However, it is important to note that the 1 percent threshold concept was related to the limit of detection for the analytical methods available at the time and also to EPA's prioritization of resources on materials containing higher percentages of asbestos.

Issue

Currently, many site managers continue to employ the use of the 1 percent threshold to determine if response actions for asbestos should be undertaken. However, based upon scientific discussions and findings reported by EPA and ATSDR from the Libby, Montana Superfund site, as well as EPA's "Peer Consultation Workshop on a Proposed Asbestos Cancer Risk Assessment[2]," there may be confusion regarding the appropriate use of the 1 percent threshold at Superfund sites. This concern was discussed at EPA's "Asbestos Site Evaluation, Communication, and Cleanup Workshop[3]," and it was concluded that the 1 percent threshold for asbestos in soil/debris as an action level may not be protective of human health in all instances of site cleanups. The 1 percent threshold is not risk-based and an accurate exposure value could only be determined through site sampling techniques that generate fibers from soil and bulk samples. Therefore, we recommend the development of risk-based, site-specific action levels to determine if response actions for asbestos in soil/debris should be undertaken.

Recent data from the Libby site and other sites provide evidence that soil/debris containing significantly less than 1 percent asbestos can release unacceptable air concentrations of all types of asbestos fibers (i.e., serpentine/chrysotile and amphibole/tremolite). The most critical determining factors in the level of airborne concentrations are the degree of disturbance, which is associated with the level of activity occurring on the site, and the presence of complete exposure pathways. For example, activities such as excavation or plowing generate large amounts of dust that can result in the generation of airborne fibers that can be inhaled even from a complex soil matrix. To address this evolving issue, OSRTI will be hosting a review of methods for determining conversion of soil to air concentrations in 2004.

Future Action

OSRTI has formed three technical working groups to assist in developing guidance and policy relating to risk assessment, field sampling, and analytical methods. These working groups have already contributed to a new toolbox that is located on the EPA Intranet. The location of the tool box is http://intranet.epa.gov/osrtinet/hottopic.htm.

The toolbox will be continually updated as products are developed and will eventually contain information on risk assessments, generic site sampling, and analytical approaches for asbestos cleanup projects. In the interim, numerous site reports that discuss specific concerns and issues from current asbestos site actions are contained in the toolbox. Additionally, to facilitate the development of sampling plans, there are examples of approved site sampling plans with data quality objectives, and a list of asbestos analytical laboratories which have passed an EPA audit.

Our goal is to have the majority of the guidance and policy documents prepared by the end of this year. If you have any questions, please consult with Richard Troast of my staff, who is the lead scientist within OSRTI for asbestos. He can be reached at (703) 603-8805 or by e-mail at: troast.richard@epa.gov.

cc:

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Dave Kling, FFEO
Susan Bromm, OSRE
Earl Salo, OGC
Charles Openchowski, OGC
Joanna Gibson, OSRTI Documents Coordinator

Endnotes:

1. Pursuant to industry comments, the 1994 amendments to the OSHA Standards incorporated a definition of asbestos-containing material that included the 1 percent threshold to be consistent with EPA, and noted that the National Institute for

Occupational Safety and Health (NIOSH) had raised questions whether even one percent may be below the accuracy level for certain microscopic methods. However, OSHA's Hazard Communication Standard requires a Material Safety Data Sheet (MSDS) to be prepared by the manufacturer or importer of a chemical substance, mixture, or product containing more than 0.1 percent of any carcinogen, including asbestos. Additionally, OSHA has recently issued several letters stating that some of the requirements in the OSHA Asbestos Construction Standard (29 CFR 1926.1101) do cover materials containing less than one percent asbestos.

2. USEPA's *Peer Consultation Workshop on a Proposed Asbestos Cancer Risk Assessment* was held in San Francisco, California on February 25-27, 2003. The purpose of the workshop was to discuss the scientific merit of the proposed methodology developed for EPA by Dr. Wayne Berman and Dr. Kenny Crump. The proposed methodology distinguishes carcinogenic potency by asbestos fiber size and asbestos fiber type and advocates use of a new exposure index to characterize carcinogenic risk. Proceedings from this conference can be located at: http://www.epa.gov/superfund/programs/risk/asbestos/index.htm.

3. USEPA's *Asbestos Site Evaluation, Communication and Cleanup Workshop* was held in Keystone, Colorado on September 23-26, 2003. The purpose of the workshop was to provide an opportunity to share lessons learned from working on large sites contaminated with asbestos. The meeting was also used to identify key outstanding technical and policy issues, and to begin to develop a consistent approach to measuring "success", especially short-term impacts and long-term risk reduction. Proceedings from this conference can be located at: http://www.epa.gov/superfund/programs/risk/asbestos/workshop/index.htm.

ATTACHMENT 4

OSWER DIRECTIVE #9200.0-68
SEPTEMBER 2008

FRAMEWORK FOR INVESTIGATING ASBESTOS-CONTAMINATED SUPERFUND SITES

PREPARED BY THE
ASBESTOS COMMITTEE OF THE
TECHNICAL REVIEW WORKGROUP
OF THE OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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Technical support provided by Syracuse Research Corporation.

Executive Summary

This document presents a recommended framework for investigating and characterizing the potential for human exposure from asbestos contamination in outdoor soil and indoor dust at Superfund removal and remedial sites. This document is one piece of broader intra- and inter-Agency efforts to utilize recent developments regarding asbestos so that current scientific information can be used to better assess exposure and risk from asbestos (e.g., Agency efforts to update cancer and non-cancer assessments for asbestos). The recommended framework presented herein provides a process that supplements other EPA guidance concerning exposure and risk assessment (e.g., Risk Assessment Guidance for Superfund, EPA, 1989), and is specific to assessment of sites contaminated with asbestos. This recommended framework is needed because there are a number of unique scientific and technical issues associated with the investigation of human exposure and risk from asbestos, and it is important for risk assessors and risk managers to understand these issues when performing assessments of asbestos sites. This recommended framework discusses specific strategies that are based on the best available science and recommends common industrial hygiene methods for characterizing exposure and risk from asbestos.

Asbestos fibers in outdoor soil, indoor dust, or other source materials typically are not inherently hazardous, unless the asbestos is released from the source material into air where it can be inhaled. If inhaled, asbestos fibers can increase the risk of developing lung cancer, mesothelioma, pleural fibrosis, and asbestosis.

The relationship between the concentration of asbestos in a source material and the concentration of fibers in air that results when that source is disturbed is very complex and dependent on a wide range of variables. To date, no method has been found that reliably predicts the concentration of asbestos in air given the concentration of asbestos in the source. Additional research is ongoing to characterize this relationship.

This recommended framework emphasizes an empiric approach to site characterization because models to predict airborne asbestos concentrations from soil concentrations have not been validated. Specifically, a combination of soil, dust, and air samples are recommended to characterize exposure. Concentrations of asbestos in air at the location of a source disturbance are measured rather than predicted.

This recommended framework presents options to provide flexibility to site managers. At any point in the process, site managers can take action at a site without further site characterization (for example, if site characterization shows >1% asbestos in soil, framework users have the option to proceed directly to response).

Personal air monitors are generally preferred over stationary air monitors to measure an individual's exposure to fiber concentrations in air, since the personal monitors more accurately reflect the concentration of asbestos in the breathing zone of the exposed person. Activity-based sampling (ABS), a standard method used by industrial hygienists to evaluate workplace exposures, is a personal monitoring approach that can provide data for risk assessment and is

emphasized in this recommended framework. ABS can be useful for assessment of asbestos contamination of both outdoor soil and indoor dust.

To allow for improved risk assessments, the analytical procedure used to analyze samples from a site should capture information concerning the specific mineralogy of asbestos fibers that are present. Hence, the TRW Asbestos Committee is recommending that a modification of the International Organization for Standardization (ISO) Method 10312 generally should be used for measuring asbestos at Superfund and other asbestos sites.

Depending on its application, potential limitations of the approach may include the representativeness of samples over an area of concern and the ability to generalize findings from a point in time and space to future exposures, other locations, others engaged in dissimilar activities, and differing environmental conditions. Site-specific data quality objectives (DQOs) and sampling plans should consider such issues prior to sample collection. Furthermore, cost of ABS approaches and sample analysis, analytical sensitivity, and other site-specific factors should be considered in the planning process.

In order to assist with the complexities of the recommended exposure assessment for asbestos-contaminated sites, members of the TRW Asbestos Committee will provide technical assistance to site teams to develop optimal strategies for site investigation and characterization on a site-specific basis.

This recommended framework does not seek to provide direction or guidance on risk management decisions that may be required during a site assessment. Typically the key management decision at asbestos sites is how to interrupt or eliminate the complete inhalation exposure pathway. As always, risk management issues should be evaluated by the site manager, with input from the site-scientific teams, stakeholders, Regional management, and legal staff, as appropriate.

Table of Contents

RECOMMENDED FRAMEWORK FOR INVESTIGATING ASBESTOS-CONTAMINATED SUPERFUND SITES

1.0 Introduction

Historically, asbestos has been addressed in the Superfund program by reference to the term asbestos-containing material (ACM[1]) as it is used in the National Emission Standard for Asbestos, which is found in Subpart M of the National Emission Standards for Hazardous Air Pollutants (NESHAP), 40 CFR Part 61. Under the asbestos NESHAP, Category I and Category II nonfriable ACM are defined in part as certain products or materials containing >1% asbestos as analyzed by polarized light microscopy (PLM). (See 40 CFR 61.141.) OSWER Directive 9345.4-05 (Clarifying Cleanup Goals and Identification of New Assessment Tools for Evaluating Asbestos at Superfund Cleanups, EPA, 2004 [August]) indicated that the 1% definition may not be reliable for assessing potential human health hazards from asbestos-contaminated soils at Superfund sites, and that instead a risk-based, site-specific action level generally is appropriate when evaluating response actions for asbestos at Superfund sites. This OSWER Directive (9345.4-05) is provided in Appendix B.

Although the OSWER Directive (9345.4-05) is designed to help steer asbestos investigations to a risk-based paradigm, it does not provide guidance for investigating and evaluating asbestos at Superfund sites. The purpose of this document is to provide a recommended flexible and usable framework for investigating and evaluating asbestos contamination at removal and remedial sites. This document also provides remedial/removal managers, remedial project managers, on-scene coordinators, site assessors, and other decision makers with information that should assist in the evaluation of asbestos risks at Superfund sites, along with information to facilitate site decisions under conditions of incomplete characterization and to accommodate the varied nature of environmental asbestos contamination. This guidance is not intended to serve as a prescriptive guide for risk assessment or risk management activities at asbestos sites.

If asbestos present at a site is not to be addressed by the Superfund program, an effort should be made to identify other programs or regulations that may have the authority and capability of addressing exposures (e.g., the Asbestos Hazard Emergency Response Act [AHERA], asbestos NESHAP, or state/local authorities as discussed in the following section). Additional guidance is available elsewhere for developing a risk management-based response strategy that is protective of human health and the environment (EPA, 1988b) (www.epa.gov/superfund/resources/remedy/pdf/540g-89006-s.pdf).

This document provides technical and policy guidance to the EPA staff on making risk management decisions for contaminated sites. This document is one piece of broader intra- and inter-Agency efforts to utilize recent information on asbestos so that current scientific information can be used to better assess exposure and risk from asbestos (e.g., Agency efforts to update cancer and non-cancer assessments for asbestos). The recommended framework presented herein provides a process that supplements other EPA guidance concerning exposure and risk assessment (e.g., EPA, 1989), and is specific to assessment of sites contaminated with asbestos. It also provides information to the public and to the regulated community on how EPA

[1] Refer to Appendix A (Glossary and Acronym List) for more information.

intends to exercise its discretion in implementing its regulations at contaminated sites. It is important to understand, however, that this document does not substitute for statutes that EPA administers or their implementing regulations, nor is it a regulation itself. Thus, this document does not impose legally-binding requirements on EPA, states, or the regulated community, and may not apply to a particular situation based upon the specific circumstances. Rather, the document suggests approaches that may be used at particular sites, as appropriate, given site-specific circumstances.

2.0 Applicability of Recommended Asbestos Framework

This asbestos framework provides guidance for assessing Superfund sites addressed under CERCLA response authority. In general, CERCLA authority may be appropriate to respond to the release or potential release of asbestos into the environment; however, CERCLA section 104(a)(3) does provide some potential qualified limitations on the authority to respond to certain releases of asbestos (including, for example, where the asbestos is a "naturally occurring substance in its unaltered form…" or where the asbestos is "part of the structure of" a residential building).

This recommended framework generally does not contain recommendations that would be appropriate for addressing asbestos in schools, for building demolition, or for addressing widespread asbestos occurrence from natural sources[2]. Authorities other than CERCLA may be more appropriate to address asbestos contamination in such circumstances.

Outside of CERCLA, EPA primarily addresses asbestos under two laws: (a) AHERA, and (b) asbestos NESHAP. EPA's regulations implementing AHERA require local education agencies to take appropriate action to inspect for and prevent the release of asbestos in schools. These regulations are found in 40 CFR Part 763, Subpart E—Asbestos-Containing Materials in Schools.

The asbestos NESHAP also may be applicable when seeking to curtail asbestos emissions from, among other things, asbestos mills, manufacturing and fabricating operations using commercial asbestos, spraying operations involving asbestos-containing materials, and demolition or renovation operations. Included among the asbestos NESHAP regulations are work practices designed to minimize the release of asbestos fibers during activities involving processing, handling, and disposal of asbestos, including when a building is being demolished or renovated. In the latter instances, owners and operators subject to the asbestos NESHAP are required to notify delegated state and local agencies and/or their EPA Regional Offices before demolition or renovation activity begins. The asbestos NESHAP also regulates asbestos waste handling and disposal for certain covered sources. The asbestos NESHAP requirements and standards are described in 40 CFR Part 61, Subpart M.

EPA generally maintains an oversight role while relying on state and local programs to enforce requirements under AHERA and the asbestos NESHAP; however, EPA's Regional asbestos management programs may separately enforce the AHERA and NESHAP requirements.

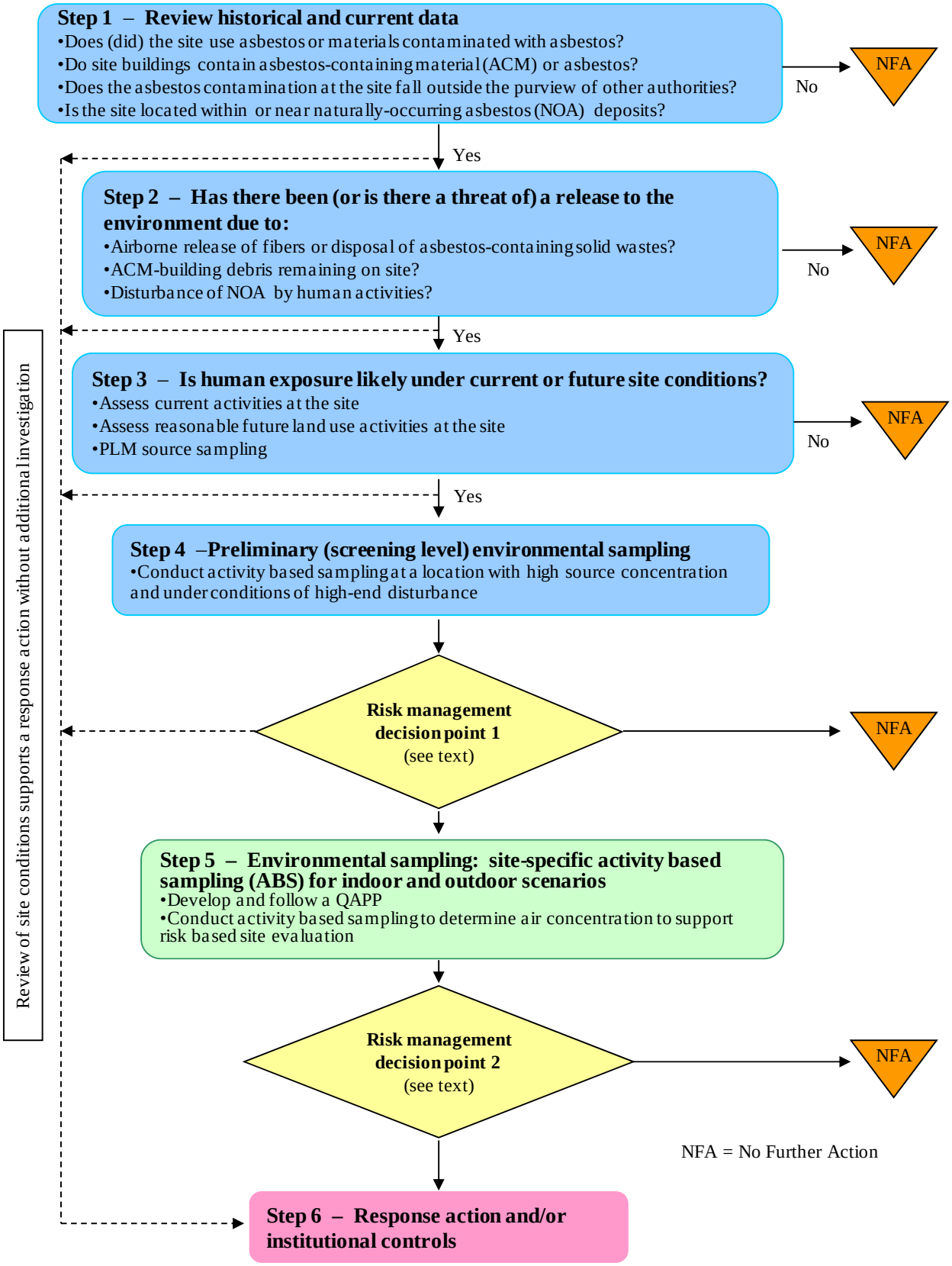
[2] See the Fact Sheet, "Naturally Occurring Asbestos: Approaches for Reducing Exposures" available online at: http:www.epa.gov/superfund/heatlh/contaminants/asbestos/noa.factsheet.pdf

In addition to these Federal authorities, State or local government entities may be in a position to provide for public health and welfare by implementation and application of local controls, such as zoning and construction restrictions and fugitive dust control ordinances.

3.0 Recommended Framework

Given the unique issues associated with evaluating exposures and potential health risks resulting from exposure to asbestos, a recommended asbestos site assessment framework (Figure 1) was developed to help promote a standardized, consistent, step-wise approach for investigating and evaluating asbestos under Superfund authority. Consistent with the National Contingency Plan (NCP) and other EPA guidance, the recommended framework may be applied to the assessment and evaluation of sites that are presently under investigation, and sites that had been formerly addressed using the 1% rule. The recommended asbestos site assessment framework can also be used when conducting five-year reviews (consult the five year review policy—Comprehensive Five-Year Review Guidance, EPA, 2001b). For sites in which some consideration of asbestos exposure has already occurred, the recommended site assessment framework may be entered from a step other than Step 1, depending upon the data that are available for the site. The bullets under the header in each Step of the recommended framework provide considerations or examples pertinent to that Step. The discussion in the following sections provides more details regarding proceeding through the flowchart.

Figure 1. Flow diagram of the recommended asbestos site assessment framework.



Step 1 – Review historical and current data

The first step in the recommended asbestos site assessment framework is to review all existing information available at a site in order to determine whether asbestos may require evaluation. The types of information that should be reviewed include data on past operations at the site as well as any collected past or current measurements or visual observations. In general, the information should be reviewed to determine if asbestos may be present from one or more of the following sources:

- Asbestos-containing materials or asbestos-contaminated sources. This includes the presence of manufactured products that intentionally included asbestos as an ingredient, but also includes products or processes that utilized materials in which asbestos is present as a contaminant (e.g., vermiculite from the Libby mine). It may also include sites where asbestos-contaminated or asbestos-containing materials were being transported to or transferred from other locations for processing.
- ACM in on-site buildings. Prior to the 1970s, asbestos was used in a wide variety of building materials. Thus, if the site contains buildings constructed prior to 1970, it is likely that some ACM may be present.
- Hazardous air emission addressed under the authority of NESHAP. EPA established emission standards for hazardous air pollutants (including asbestos). Among the NESHAP regulations are work practices to minimize the release of asbestos fibers during activities involving processing, handling and disposal of asbestos, including when a building is being demolished or renovated that contains ACM.
- Presence of "naturally occurring asbestos" (NOA). Asbestos occurs in natural mineral deposits at a number of locations around the country. Information on the presence of NOA deposits may be gained from numerous sources, including USGS, State geological offices, BLM, or DOI, local agencies charged with cataloging or regulating NOA, or by consulting a properly trained and experienced geologist.

If a thorough review of available site data provides a clear indication that asbestos is not present, then no further action to address asbestos is needed. If the available information indicates that asbestos is, or may reasonably be expected to be, present (and it is not being addressed by another authority, see Section 2), or if the data are insufficient to form a clear conclusion then proceed to Step 2.

Step 2 – Has there been (or is there a threat of) a release to the environment?

In recommended Step 2, all available information should be reviewed to determine if a release of asbestos to the environment has occurred or could occur due to human activities, or if a release may be likely in the future (see Appendix D, Land Use Considerations). This may include asbestos releases at on-site or off-site locations.

- With regard to commercial operations that involved use or transport of asbestos-containing or asbestos-contaminated materials, the releases of chief concern to EPA generally include release of asbestos-containing materials or airborne fibers to the outdoor or indoor environment, as well as, the disposal of various solid wastes at on-site or off-site locations. Under normal conditions, one or both of these types of release should be considered to be of potential concern unless strong evidence exists to indicate that neither type of release has occurred.

- With regard to other asbestos-contaminated areas such as residential properties, roadways, or public areas, the releases of chief concern to EPA generally include release of ACM or airborne fibers to the outdoor or indoor environment, as well as the disposal of various solid wastes at on-site or off-site locations. These types of release should be considered to be of potential concern unless strong evidence exists to indicate that neither type of release has occurred.

The use of ACM in buildings and the presence of NOA are two special situations that can affect EPA response actions.

- With regard to ACM in buildings, CERCLA contains a qualified limitation on response authority for releases or a threat of release "from products which are part of the structure of, and result in exposure within, residential buildings or business or community structures". If a building that contains asbestos is demolished, this demolition must be performed in accord with the requirements of NESHAP (40CFR part 61, Subpart M; Section 1.1), and this will normally preclude the release of asbestos to the environment. If a building has been demolished or is destroyed (e.g., by fire) and asbestos-containing debris is found to remain at the site, this should be considered a release of potential concern to Superfund. This is true even if the ACM is buried, since it may be uncovered if the site is developed in the future (see Appendix D, Land Use Considerations).

- With regard to NOA, Section 104(a)(3)(A) of CERCLA contains a qualified limitation on response authority for a release or a threat of release "of a naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes, from a location where it is naturally found." This limitation does not affect EPA's authority to address a release or a threat of release of NOA that has been altered by anthropogenic activities. State and local authorities may be appropriate for NOA response and management, especially in locations where NOA is found to be widespread in native soils.

If it is determined that there has been a release and a response is appropriate, then one may either proceed directly to a response action (see Step 6), or proceed to Step 3 to further characterize potential exposure. If there has not been a release, but there is a threat of release, then further evaluation (Step 3) should be performed under either the removal or remedial program, depending on the magnitude and/or severity of the potential future release.

Step 3 – Is human exposure likely under current or future site conditions?

Recommended Step 3 is intended to help evaluate whether a complete human exposure pathway exists at or near the site under current or reasonably anticipated future site conditions. This should be achieved by developing a conceptual site model and performing an exposure pathway assessment (that may involve review or collection of PLM soil data[3]) consistent with the National Contingency Plan and existing Superfund guidance. For example, current and potential future accessibility of the site, as well as community awareness of exposure to potential hazards at the site, are also factors that may be considered. Typical exposure pathways for asbestos include inhalation of asbestos fibers released from disturbed soil or disturbed settled dust. As always, the evaluation of potential future risks should be based on an assessment of reasonably anticipated changes in land use (see Appendix D, Land Use Considerations).

If a complete human exposure pathway does not exist, typically no further evaluation of asbestos would be necessary. If it has been determined that a complete exposure pathway to contaminated outdoor soil or contaminated indoor dust exists under current conditions, or may reasonably be expected to occur in the future, it may be appropriate either to undertake a response action (see Step 6), or to proceed with further investigation of potential exposures at the site (Step 4).

Step 4 – Preliminary (screening level) environmental sampling

This recommended step is a preliminary screening step intended to help evaluate if human exposure levels are likely to be below a level of concern or LOC even under high-end exposure conditions. If exposures are judged to be below an asbestos air action level (see Section 5.8), then generally no further investigation would be needed under present site conditions. If exposures from this high-end evaluation are of potential concern (i.e., exceed the air action level), then a response action may be taken or more detailed investigation may be appropriate to more accurately and completely characterize the magnitude of the exposure.

Screening Procedure for Outdoor Soil Sources

As noted earlier, releases of asbestos to air from disturbances of soil sources may vary widely as a function of many factors. The purpose of this recommended step is to select a source area that is judged to have asbestos contamination that is at the high end of the range observed on-site (determined by site information or professional judgment), and to disturb the soil in a way that is likely to result in an air concentration that is at the high end of what could occur. This normally requires that the disturbance activity be vigorous, and that the disturbance occur under conditions

[3] When the asbestos content of soil is low (e.g., <1% PLM), the fraction of particles that are asbestos is small, and accurate quantification is generally very difficult. Thus, the results from these methods should generally be interpreted semi-quantitatively. Sampling at multiple sites has shown that even when soils are non-detect by PLM, concentrations of asbestos in the air via ABS may result in unacceptable health risks.

that favor release. To this end, an aggressive (high-end) soil disturbance, such as raking the soil, is recommended as a surrogate for high-end disturbance activities. For the raking scenario, a 10' x 10' foot area is raked to remove debris such as rocks, leaves, thatch and weeds using a leaf rake with a rake width of approximately 20 to 28 inches. Participants should strive to disturb the top half-inch of soil with an aggressive raking motion. This depth will vary based on the objective of the scenario. Each raking participant donning appropriate PPE will be fitted with a personal sampling pump contained in a backpack with the cassette secured to the shoulder straps near the operator's lapels in the breathing zone. Personnel will rake a lawn or garden area to remove debris for a minimum of 2 hours (flow rate and sensitivity level dependent). Raking will occur in a measured area with vegetation, soil or rocks/gravel and will occur in an arched motion raking from the left of the participant to the right. The participants will rake the debris towards themselves facing one side of the square for 15 minutes then the participant will turn 90 degrees clockwise and begin a new side. Participants will continue to rake each side of the square and rotate 90 degrees. Once several small piles of debris have been made, the participant shall pick up the debris and place it in a trashcan. The sequence of raking, rotating and picking up debris shall be repeated for the duration of the sampling period. The participant should stay in the same plot for the entire sampling period. Additional information on ABS activities, including description, duration, and sampling considerations is available in the Standard Operating Procedures (SOP) via the ERT web site (www.ert.org/products/2084.PDF). The disturbance scenario should be performed when environmental conditions are favorable to produce maximum releasability and airborne exposure concentrations (e.g., the soil is dry and the wind is relatively calm for the location).

Screening Procedure for Indoor Sources

The benefits of ABS to assess asbestos exposure also may be useful for the indoor environment. If exposure to asbestos in indoor air is a concern, Agency and/or OSWER indoor policies may provide useful guidance (e.g., EPA, 2006b). The purpose of this recommended step is to select an indoor area that is judged to have asbestos contamination of dust that is at the high end of the range for the location and to disturb the settled dust in a way that is likely to suspend the dust and result in an air concentration of asbestos that is at the high end of what could occur during activity in the building. Selection of the location that is likely to have asbestos contamination of dust that is at the high end of the range may be determined by site information or professional judgment. The disturbance activity should be vigorous to maximize the likelihood of suspending any asbestos particles in the settled dust. The specific type and duration of disturbance activities used may be influenced by site-specific considerations (see www.ert.org/products/2084.PDF for additional details). If asbestos is detected in settled dust or wipe samples (see Appendix C), it may be appropriate to conduct a response action.

Considerations for ABS Sampling

When preparing a sampling plan and considering a strategy for ABS sampling at individual sites, site teams should consider the following questions to be addressed by the plan:

- What type(s) of ABS activities should be employed?
  - Consider:
    - current use and potential future use of the site;

        - evaluation if trespasser scenarios are appropriate for basing some ABS sampling types;
        - eliciting local official and community input.
- Should different areas of the site require separate ABS sampling types?
    - Consider:
        - differences in property use scenarios;
        - previous waste disposal practices in different areas of the site, e.g.,
            - Is ACM closer to the surface in some areas?
            - Are different asbestos types present (or previously disposed of at that site)?
            - Are there soil type or moisture differences?
            - Note proximity of different areas to the general public.
            - Note geographic acreage of the site.
- Given the above, how many ABS samples should be collected during any one ABS event?
- How many repetitions of ABS sampling should be collected over a specified time period?
    - Consider:
        - weather conditions [e.g., is there a need to sample at least once during driest conditions],
        - changes in soil moisture,
        - community concerns over the short or long term.

Because OSCs and RPMs may be unfamiliar with ABS sampling, assistance can be sought from EPA-ERT personnel and members of the TRW Asbestos Committee, if needed. See Section 6.0 for additional information on sampling and analytical considerations.

EPA workers and contractors with potential airborne exposure to asbestos should have appropriate training and use appropriate personal protective equipment (PPE), consistent with a properly developed health and safety plan (HASP) that follows EPA policies and OSHA (Occupational Health and Safety Administration) regulations. An appropriate Quality Assurance Project Plan (QAPP) and a Sampling and Analysis Plan (SAP) will be followed as required. Consultation with the Regional human subjects review board representative is generally recommended when ABS plans are developed (EPA, 2002a).

Risk Management Decision Point #1

After completing Step 4 of the recommended framework, risk managers and risk assessors should compare the air sampling results from Step 4 (the screening-level ABS exposure assessment) to the risk-based action level for asbestos in air (see Section 5.8) to determine the appropriate next step. Typically, there are two basic outcomes possible:

- Outcome 1: Asbestos is not detected
  Asbestos is not detected in the screening-level ABS air samples at concentrations that exceed the air action level. In this case, if there is reasonable confidence that the ABS samples represent the upper end of exposures that might occur at the site, and the analytical results have been obtained using the appropriate methods with an appropriate analytical sensitivity,

then no further evaluation of asbestos should be necessary. If confidence in the ABS results from Step 4 is not high (the area evaluated might not represent the high end of the concentration range at the site, the tests might have been done under conditions when release was not maximal, etc.), then it may be appropriate to proceed to Step 5.

- Outcome 2: Asbestos is detected
  Asbestos is detected in at least one or more ABS samples at concentrations at or above the air action level. In this case, it may be appropriate to conduct a response action (see Step 6) or collect additional data to further quantify the magnitude of exposure and risk, as well as the extent of contamination.

Step 5 – Environmental sampling: Site-specific activity based sampling (ABS) for indoor and outdoor scenarios

Recommended Step 5 is intended to provide sufficient information about exposures from indoor and outdoor sources that reliable risk assessment and risk management decisions can be based on the most informative and appropriate data. As discussed previously, the recommended approach for obtaining such data is normally ABS. The chief difference between ABS data obtained in Step 5 and the preliminary ABS data obtained in Step 4 is that, in Step 5, the samples should be representative in time and space, and should be representative of the range of different disturbance activities that may occur at the site over the duration of the exposure scenarios.

Collecting multiple ABS samples to capture the variability in airborne asbestos concentrations as a function of time, location, and disturbance activity can be important because estimates of exposure and risk from asbestos should be based on the average exposure concentrations that are experienced during each exposure scenario of concern, rather than on the values of individual samples (which may be either higher or lower than the average). The number and type of different ABS samples, air sampling approach, and analytical method needed to adequately characterize exposure for a specified scenario will vary from site to site and from scenario to scenario. As noted above, it is for this reason that the data collection effort performed under Step 5 should be based on a QAPP and a SAP developed in accord with standard EPA procedures. See Section 6.0 for additional information on sampling and analytical considerations. Because ABS sampling will be a new venture for many OSCs and RPMs, assistance can be sought from experienced EPA-ERT personnel and members of the TRW Asbestos Committee, if needed.

Recommended SOPs (standard operating procedures) for ABS for several outdoor soil and indoor dust disturbance scenarios are provided at www.ert.org/products/2084.PDF.

As noted in Step 3, EPA workers and contractors with potential airborne exposure to asbestos should have appropriate training and use appropriate PPE, consistent with a properly developed HASP that follows EPA policies and OSHA regulations. For some sites, it may be appropriate to consult with the Regional human subjects review board representative when sampling plans are developed.

Risk Management Decision Point #2

The analytical results obtained from the air samples following site-specific ABS may be used in the risk calculation for a baseline risk assessment considering both current and future risk. The baseline risk assessment and other criteria can then be used to make a risk management decision on appropriate response actions at the site (see Step 6). Three basic outcomes typically are possible:

1. Estimates of exposure and risk are below the site-specific risk management criteria and the level of uncertainty[4] in the exposure and risk estimates is acceptable to the risk manager. In this case, a no further action alternative normally is appropriate.

2. Estimates of exposure and risk are above the site-specific risk management criteria, and the level of uncertainty in the exposure and risk estimates is acceptable to the risk manager. In this case, proceed to Step 6.

3. In some circumstances, estimates of exposure and risk at individual sites have too much uncertainty to solely support reliable risk management decisions. For example, under the National Contingency Plan, response to a release of hazardous substances also includes response to the threat of a release and, in cases where a threat is posed but not an actual release, exposure or risk estimation can be more challenging. In these and similar situations, the risk manager should assess whether additional site assessment or investigation will likely be sufficient to reduce uncertainty to acceptable levels, or whether the collection of this data will provide minimal value and merely prolong a risk management decision. In all cases, however, justification of a response action (Step 6) must meet the criteria specified in the NCP.

Step 6 – Response Action and/or Institutional Controls

Response actions may be implemented either under removal or remedial authority, and may include a wide variety of different activities to reduce the potential for exposure (e.g., remove, cap, fence, etc.). Superfund removal and remedial actions undertaken pursuant to the CERCLA and NCP are based on a number of factors (see EPA, 2000b) and criteria (see EPA, 1988c).

If asbestos present at a site will not be addressed using CERCLA authority (www.epa.gov/superfund/policy/index.htm), an effort should be made to identify other programs or regulations that may have the authority and capability of addressing risks. Additional guidance is available for developing a risk management-based response strategy that is protective of human health and the environment (EPA, 1988b).

[4] EPA is presently working to develop guidance for characterizing the statistical uncertainty in the long-term average concentration value based on a set of measured concentration values, and will issue guidance on this process in the future.

This recommended framework leaves discretion to the site manager and technical experts to evaluate whether a particular response action is appropriate for the site and to determine the proper method of implementation (EPA, 2006b). In some cases, a variety of institutional controls (ICs) may also be used to help limit current or future exposure and risk (for more information see www.epa.gov/superfund/action/ic/). Post-response site control actions and operation and maintenance activities should ensure the effectiveness and integrity of the remedy after the completion.

Finally, the response should include consideration of the current and reasonably anticipated future land use. For more information, please refer to the following:

"Land Use in the CERCLA Remedy Selection Process" (OSWER Directive 9355.7-04);
"Policy on Management of Post-Removal Site Control" (OSWER Directive 9360.2-02);
"Guidance on Implementation of the 'Contribute to Remedial Performance' Provision" (NTIS PB93-963413); and
"Superfund Removal Procedures: Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA" (OSWER Directive 9360.0-32).

4.0 Background

There are a number of special issues associated with the characterization and evaluation of asbestos exposures and risks which should be understood in order for risk managers to make informed site-specific management decisions. These issues are discussed in the sections below.

4.1 Mineralogy

Asbestos is a generic name applied to a variety of naturally-occurring, fibrous silicate minerals. Detailed descriptions can be found at the following two web sites:

- USEPA site: www.epa.gov/asbestos/pubs/asbe.pdf
- USGS site: minerals.usgs.gov/minerals/pubs/commodity/asbestos/

The commercial use of asbestos is based on a number of useful properties such as thermal insulation, chemical and thermal stability, high tensile strength, and flexibility. Asbestos is divided into two mineral groups—serpentine and amphibole. The division between the two types of asbestos is based upon the crystalline structure: serpentine asbestos has a sheet or layered structure, whereas amphiboles have a chain-like structure. The serpentine group contains a single asbestiform[5] variety (chrysotile), while the amphibole group contains a number of asbestiform varieties.

Asbestos is a CERCLA-listed hazardous substance (see 40 CFR 302.4-Designation of Hazardous Substances). Asbestos is also addressed by other EPA statutes and regulations (i.e., Toxic Substances Control Act [TSCA § 2642], Asbestos Hazard Emergency Response Act [AHERA] [1986], National Emissions Standards for Hazardous Air Pollutants [NESHAP § 61.141]) as well as other occupational regulations (e.g., 29 CFR Parts 1910, 1915, and 1926). Issues regarding

[5] Refer to Appendix A (Glossary and Acronym List) for more information.

the regulatory definition of asbestos may be important at certain sites (especially those involving the amphibole group) and legal counsel should be consulted where this may raise an issue. The term "asbestos" has often been applied to the fibrous habit of six minerals that have been commonly used in commercial products:

1. chrysotile (serpentine)
2. crocidolite (riebeckite)
3. amosite (cummingtonite-grunerite)
4. anthophyllite
5. tremolite
6. actinolite

It is important to recognize that these asbestiform minerals have been regulated chiefly because they have been preferentially mined for commercial applications, or have been seen as contaminants in commercially mined materials and recognized as asbestos. There are other forms of asbestos minerals, primarily of the amphibole group, that are not on this list which may be subject to CERCLA authority. Further, it is well established that exposures to certain groups of mineral fibers not regulated under TSCA, NESHAP, or OSHA can produce adverse health effects in humans (ATSDR, 2001 [www.atsdr.cdc.gov/toxprofiles/tp61.html]; Carbone et al., 2004; Sullivan, 2007). **This recommended framework is intended for Superfund sites, and for purposes of this framework the term asbestos is intended to cover all mineral forms of asbestos that may be subject to CERCLA authority and are associated with health effects in humans.** Additionally, this recommended framework may be useful for site assessment of other durable mineral fibers where health effects similar to asbestos are expected (e.g., erionite; Emri et al., 2002).

With regard to NOA, Section 104(a)(3)(A) of CERCLA provides a qualified limitation on response authority for a release or a threat of release "of a naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes, from a location where it is naturally found". However, this limitation does not prohibit EPA from responding in otherwise appropriate circumstances to a release or a threat of release of NOA that has been altered by anthropogenic activities. State and local authorities may be appropriate for NOA response and management, especially in locations where NOA is found to be widespread in native soils.

4.2 Basic Strategy for Investigation

When the exposure pathway is asbestos released to the air from disturbance of contaminated soil or dust, the primary concern is inhalation exposure. When exposure to asbestos occurs via other media (such as drinking water) assessing other exposure pathways (such as ingestion of contaminated media) may be appropriate. Inhalation exposure to asbestos increases the risk of both carcinogenic effects (e.g., lung cancer, mesothelioma, laryngopharyngeal cancer, and possibly gastrointestinal tumors) and non-carcinogenic effects (e.g., asbestosis, pleural disease) (EPA, 1986 [cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=35551]; Hodgson, 2000; ATSDR, 2001; ATS, 2004; EPA, 1988a).

Asbestos fibers occur in air as the result of the disturbance of some source material (e.g., outdoor soil, indoor dust) by forces such as wind, weathering, or human activities. Thus, the key objectives during the investigation at any asbestos site generally are: (1) the identification of locations of asbestos contamination via source sampling, and (2) characterization of the levels of asbestos that may occur in air when the source is disturbed. The specific recommended approach emphasized here can then be used by risk assessors to estimate the level of human health risk attributable to the source, which in turn may be used by risk managers to determine whether use of a response action (source cleanup, ICs, etc.) may be appropriate in order to protect human health.

Currently available methods are not always sufficiently reliable to predict the airborne exposures of asbestos that may result from disturbance of asbestos-containing source materials such as contaminated soils or other bulk materials. Ongoing investigations by EPA and other researchers have revealed that airborne exposures associated with disturbance of contaminated soil depend on a number of factors including environmental conditions, soil composition, releasability or friability of the asbestos materials present, and the nature of the disturbance activities. Further, disturbance of contaminated soils and other bulk materials at concentrations below the level of detection of currently available methods (i.e., PLM) may still result in potentially hazardous airborne exposures (Addison, 1988; EPA, 2001a, 2006a; ATSDR, 2006). Therefore, this recommended framework emphasizes an empiric approach in which airborne concentrations of asbestos that occur when the source material (soil or dust) is disturbed are measured rather than predicted or modeled, commonly referred to as ABS. The use of ABS is a well-established approach widely utilized by industrial hygienists for exposure assessment in complex occupational environments (NIOSH 7400; www.cdc.gov/niosh/nmam/pdfs/7400.pdf). The use of personal air monitoring is also required by OSHA (www.osha.gov; OSHA 1910.1001(d)(1)(i); 29CFR1915(f)(1)(ii); 29CFR1926.1101(f)(1)(ii); 29CFR1926.1101) and recommended by MSHA (www.msha.gov/REGS/FEDREG/FINAL/2006finl/06-4494.pdf) regulations where these agencies have jurisdiction to assess compliance with their asbestos exposure limits. This recommended approach has also been generally accepted as an appropriate means of assessing the potential for airborne exposure to particulate contaminants in soil or dust. For more information on ABS see Williams et al. (2003); Ferro et al. (2004a,b); NRC (2004); Wallace and Williams (2005); Wallace et al. (2006a,b). Detailed methods for the performance of various ABS scenarios that may be appropriate to various environmental situations and conditions are provided at www.ert.org/products/2084.PDF.

One potential limitation to the ABS approach is the inability to generalize knowledge about the airborne levels of asbestos found in areas where ABS has been performed to areas of a site where information on source contamination exists, but ABS has not been performed. This is because the concentration of asbestos that occurs in air when a particular source is disturbed by some specified activity is likely to depend on several factors that might differ among areas, including the amount of asbestos that is present in the source at that location, the "releasability" of the asbestos from the matrix (e.g., soil, dust, ACM), and the environmental conditions (e.g., soil type and moisture content). Similar to what is done in developing a site conceptual model at any Superfund site, spatial representativeness of an ABS sampled area to a larger area requires consideration of several factors, e.g., site or facility historical operations, depth and details of asbestos waste disposal, soil characteristics, uniformity of soil cover, uniformity of fiber

distribution depending on asbestos source, and other factors that would affect extrapolation from one area to another. The following subsections discuss these issues in greater detail.

4.2.1 Variations in Amount

In this recommended framework, ABS is used to determine whether fibers in soil or solid material can be released to the breathing zone of human receptors. ABS may need to be done at different areas of the same site if different levels of asbestos are present or site conditions vary by location. ABS results and associated risk should only be extrapolated to other portions of the site after careful consideration of the factors that would likely influence exposure and risk.

4.2.2 Variations in "Releasability"

ABS results can differ among locations, depending on the physical attributes of the asbestos or site-specific factors such as soil type and moisture content. Thus, even if the amount of asbestos is the same in two locations, the amount released to air by a specified disturbance may not be similar.

Furthermore, it is important to recognize that the releasability of asbestos at a location may change over time. For example, under present site conditions, asbestos in outdoor soil might exist primarily as large particles (i.e., large "chunks" of ACM or large lumps), which will tend to have low releasability of respirable asbestos fibers. Over time, however, these large non-respirable materials may become broken down by weathering and/or by mechanical forces (including the disturbance associated with a vigorous activity), thereby increasing the fraction of the material that exists as readily releasable fibers without altering the amount of asbestos that is present. Thus, in cases where data suggest that a substantial fraction of the asbestos present in soil exists in a poorly releasable form, it may be appropriate to interpret the results of ABS measurements to reflect current, but not necessarily future, site conditions (see Appendix D, Land Use Considerations). In cases where asbestos contamination is present in subsurface media, ABS may have limited utility to predict potential future risks if that contamination is exposed.

Releasability of asbestos from settled dust to the air cannot be modeled using a validated method; hence, activity-based sampling is recommended for assessing indoor exposures and ABS scenarios are provided at www.ert.org/products/2084.PDF.

At present, there is no established and validated technique for modeling or adjusting for differences in "releasability" of asbestos across different locations. EPA is actively pursuing the development and validation of several alternative methods for assessing releasability of asbestos from solid matrices such as soil, and when validated, these field or laboratory-based releasability devices may become valuable tools for use in conjunction with field-based ABS.

4.2.3 Methods for Collection of Air Samples

In the past, a wide variety of different techniques were used to measure the amount of asbestos in air. Since about 1970, nearly all samples have been collected by drawing air through a filter that

traps airborne particles on the filter. In general, such samples may be divided into two broad categories: (a) those using a fixed ("stationary") air sampling device, and (b) those where the sampling device is worn by a person ("personal monitor"). Studies at several sites have shown that, in cases where asbestos-contaminated source material is being actively disturbed by an individual, the personal air samples consistently yield higher and more representative measurements of exposure than stationary air samples in the same vicinity (e.g., Doll and Peto, 1985; HEI, 1991; Lang et al., 2000; EPA, 2003; Sakai et al., 2006). Both have their advantages depending on the objective of the sampling (evaluation of personal exposure vs. characterization of ambient concentrations). Use of personal monitoring is consistent with National Academy of Science (NAS) recommendations concerning the assessment of personal exposures (NRC, 2004).

Therefore, this framework recommends the collection of personal air samples during active source disturbance activities. Collection of this type of sample can be essential in properly characterizing the levels of airborne asbestos exposure which may be expected to occur when a source material is disturbed. Recommended procedures for collection of ABS air samples are available (www.ert.org/products/2084.PDF). ABS may be employed to assess asbestos exposure in both outdoor and indoor environments. Stationary air monitors are useful in assessing exposures of a person when the person is not actively engaged in a source disturbance activity (e.g., indoor sitting on a couch watching television, inhalation of outdoor ambient air).

4.2.4 Methods for Analysis of Air Samples

As noted above, asbestos is not a single chemical entity, but includes fibers that may differ with respect to mineral type and particle sizes. There is general consensus among asbestos researchers that both mineral type (serpentine, amphibole) and fiber dimensions (length, width, and aerodynamic diameter) are likely to influence the toxicity of asbestos fibers (ATSDR, 2001). While the literature provides general indications of the influence of length on some toxic responses, there is no strong consensus on how the relative toxicity varies as a function of mineral type. For this reason, it is desirable that the analytical procedure used to analyze samples capture information concerning the specific mineralogy of asbestos fibers that are present at the site. (For some sites cost may limit the number of samples sent for full characterization, so it is recommended that a representative number of samples be fully characterized.) Such fiber characterization should allow for improved risk assessment at sites as new risk models become available. To this end, EPA is currently developing a standardized TEM method for measuring asbestos at Superfund sites. Until this method is available, a modification of the International Organization for Standardization (ISO) Method 10312-*Ambient air - Determination of asbestos fibres - Direct-transfer transmission electron microscopy* method is recommended for use at all remedial sites, as detailed in Appendix C, Analytical Methods for Determination of Asbestos in Air, Soil, and Dust. This method is also recommended for use at removal sites, but may not be appropriate for emergency responses at sites of natural or man-made emergencies or disasters due to resource limitations and time constraints.

4.2.5 Methods for Analysis of Dust Samples

ASTM (1995) has developed a standardized method for the collection of indoor dust samples using a micro-vacuum filter technique that may then be analyzed for asbestos by TEM using an

indirect preparation. This method is generally capable of providing quantitative data on asbestos levels in dust (usually expressed as fibers per unit area, typically f/cm²), with analytical sensitivity in the range of 100–1000 f/cm^2 being achievable in most cases.

4.2.6 Methods for Analysis of Soil Samples

Current analytical methods for asbestos in soil rely primarily on PLM. Two common techniques are NIOSH 9002 (NIOSH, 1994) and CARB 435 (CARB, 1991). The method required by the California Air Resources Board (CARB) reports data using point counting principles as 'percent point count', whereas the NIOSH method is based on an estimation of the asbestos fraction of the viewed area. The CARB method is undergoing revision (revision anticipated spring 2009) to align it with the risk management strategy objectives of the CARB. When the asbestos content of soil is low (e.g., <1% PLM), the fraction of particles that are asbestos is small, and accurate quantification is generally very difficult. Thus, the results from these methods should generally be interpreted semi-quantitatively. These methods, however, do allow for a comparison among samples, and are typically sufficient to allow grouping samples into similar levels for the purpose of extrapolation of ABS results across locations. In some instances, soil methods may fail to identify levels of asbestos that produce air asbestos concentrations that are potentially of concern. Sampling at multiple sites has shown that even when soils are non-detect by PLM, concentrations of asbestos in the air via ABS may result in unacceptable health risks. See Appendix C, Analytical Methods for Determination of Asbestos in Air, Soil, and Dust, for more information on sampling.

5.0 Cancer Risk Calculation

Calculation of excess lifetime cancer risks (ELCRs) can be used to determine whether airborne concentrations of asbestos are associated with unacceptable risks to human receptors at a given site. Although ingestion of asbestos can contribute to an increased cancer risk, EPA has not established a dose-response relationship for these endpoints. Likewise, EPA has not established a dose-response relationship for non-cancer effects at this time. Consequently, risk calculations from asbestos exposure are based solely on prediction of excess cancer risk for inhalation exposures.

The general equation for estimating risks from inhalation of asbestos is:

$$ELCR = EPC \bullet TWF \bullet IUR$$

where:

ELCR = Excess Lifetime Cancer Risk, the risk of developing cancer as a consequence of the site-related exposure

EPC = Exposure Point Concentration, the concentration of asbestos fibers in air (f/cc) for the specific activity being assessed

IUR = Inhalation Unit Risk $(f/cc)^{-1}$

TWF = Time Weighting Factor, this factor accounts for less-than-continuous exposure during a one-year exposure[6], and is given by:

$$TWF = \frac{Exposure\ \ time\ (hours\ \exp osed\ /\ day)}{24} \bullet \frac{Exposure\ \ frequency\ \ (days\ /\ year)}{365}$$

There are two points to emphasize in the application of this equation:

1. The exposure point concentration (EPC) must be expressed in the same units as the inhalation unit risk (IUR). The units of concentration employed in the current EPA approach for estimating cancer risks (EPA, 1986) are fibers per cubic centimeter (f/cc) as measured by phase contrast microscopy or PCM-equivalent (PCMe) concentrations measured using TEM[7].
2. The concentration-response function on which the asbestos IUR is based varies as a function of time since first exposure (EPA, 1986). Consequently, estimates of cancer risk depend not only on exposure frequency and duration, but also on age at first exposure. Therefore, it is essential to use an IUR value that matches the exposure period of interest (duration and age of first exposure).

The following procedure is recommended for calculating ELCR for asbestos and discussed in the following Sections 5.1 through 5.5.

5.1 Identification of Exposure Pathways of Potential Concern

The first step in developing a sampling plan or approach is to determine the exposure pathways of potential concern. The use of a conceptual site model is recommended for this effort. Sites evaluated by EPA to date have exhibited:

- asbestos in indoor dust,
- asbestos in soils around a home (e.g., in gardens, driveways, etc.),
- asbestos in fill/soil in recreational areas of a community, and
- recreational activities in areas where asbestos naturally occurs (native asbestos).

As with other site assessments, there may be multiple pathways and distinct receptor populations to consider. This is especially important as age and duration of exposure will impact the risk estimate. Therefore, the exposure pathway, receptor (age), and exposure duration must be linked.

[6] See EPA (1994) and pending update to RAGS inhalation guidance (RAGS, Part F).

[7] See Appendix C, Analytical Methods for Determination of Asbestos in Air, Soil, and Dust, for more information about these analytical techniques.

One of the main objectives of this document is to establish the use of ABS as the preferred approach for assessing asbestos exposure at Superfund and other sites where personal activities in and around a site vary and a generalized sampling approach using fixed monitors would not adequately capture personal exposure. Once an exposure pathway of concern has been identified, sampling plans can be developed to characterize exposure for different activities.

Example pathways from recent EPA risk assessments at asbestos-contaminated sites have included simulating the following activities:

1. Gardening, weeding, and rototilling in asbestos-containing soil
2. Children playing in asbestos-containing soil
3. Organized sporting events (e.g., baseball, soccer) in parks with asbestos-containing soil
4. Walking, pushing a stroller, jogging, biking, and ATV use in asbestos-containing soil.

5.2 Determination of Pathway-Specific EPCs (Exposure point concentrations)

EPCs for each activity of potential concern can be determined from the results of sampling and analysis of airborne fiber concentrations at the site. As discussed in Section 3, ABS should be used for assessing risk from exposures associated with disturbance of asbestos-contaminated soils. Assessment of ambient air exposure concentrations during quiescent activities (those that do not involve active soil disturbance) should be assessed by air monitoring with stationary samplers. Ideally, selection of the sampling approach will be determined by the nature of the activity being assessed.

Once a set of measurements is collected to represent the exposure level for the scenario being evaluated, the EPC that would normally be used is the 95% upper confidence limit (UCL) of the mean of all of the relevant and representative measurements. While methods for computing the UCL are well-established for non-asbestos analytes using EPA's ProUCL software, computing the UCL of a set of asbestos measurements is more complicated because variability in the observed mean is contributed from two sources (authentic inter-sample variation and random Poisson counting variation), and methods for estimating the UCL for asbestos are not yet established. Thus, until methods are developed and approved by EPA, it is suggested that calculations be based on the simple mean of the data accompanied by a clear statement that this value is an uncertain estimate of the true mean and that actual risks might be either higher or lower. When computing the mean of a set of asbestos measurements, samples that are "non-detect" should be evaluated using a value of zero, not ½ the analytical sensitivity[8]. Taking site-specific characteristics into consideration, risk estimates based on other EPCs (e.g., maximum

[8] Use of ½ the sensitivity as a surrogate for asbestos non-detects may lead to a substantial overestimate of the true mean of a group of samples. Rather, the mean of a set of microscopy sample results is computed by treating non-detects as a zero. For example, consider the case where the true concentration is 0.001 s/cc, and the sensitivity is 0.010 s/cc. If this sample were analyzed 10 times, the expected result would be that 9 of the 10 analyses would yield a count of zero, and one of the samples would yield a count of 1, which would correspond to a concentration estimate of 0.010 s/cc (10-times the correct value). When averaged, the mean is 0.001 s/cc, which is the expected value. If ½ the sensitivity were assigned to the 9 NDs, the resulting average would be 0.055 s/cc, nearly six-times higher than the correct value. This alternative to the standard approach (assigning a surrogate value of ½ the analytical sensitivity; U.S. EPA, 1989) for computing the average of multiple sample results derived using microscopic counting methods has been reviewed and validated by EPA as part of the rulemaking process for microbial contamination in drinking water (U.S. EPA, 1999).

and minimum in addition to the central tendency) may be used to illustrate the range of risks and associated uncertainties (an example discussion of uncertainty is available in the Clear Creek Management Area Risk Assessment; available online at www.epa.gov/region09/toxic/noa/clearcreek/risk.html).

5.3 Calculation of TWFs (Time weighting factors)

Time weighting factors (TWFs) are used to determine the proportion of time (e.g., hours per day, days per year) over which specific exposure activities may occur. TWFs are combined with EPCs for each activity and an appropriate IUR value (see Section 4.4) to estimate excess lifetime cancer risks associated with activity-based exposures to asbestos.

In accordance with Risk Assessment Guidance for Superfund, Volume I (RAGS, Section 6.4.1, EPA, 1989), the exposure frequency and duration assumptions made in developing TWFs should represent reasonable maximum exposure (RME) scenarios.

It is generally recommended that an EPA risk assessor be part of the site assessment team for asbestos sites. The following sections are primarily geared toward risk assessors, although the concepts presented should be understood by site managers. Several example scenarios are included in Table 1 below. These scenarios are appropriate for a wide variety of sites and could be used at some sites without modification. Generally, however, exposures should be determined from activity-based sampling conducted during actual activities that occur or are likely to occur at the site in question.

TABLE 1. Time Weighting Factors (TWFs) for Example Exposure Scenarios.

Exposure scenario	Hours per day	Days per year	TWF[†]
Continuous	24	365	1
Baseline Residential	24	350	0.96[‡]
Gardening	10	50	0.057
Recreational	1	156	0.018
Child playing in soil	2	350	0.080

[†] $TWF = \frac{hours}{24\ hours} \bullet \frac{days}{365\ days}$

Years are not included in the TWF calculation, but are used to select the appropriate unit risk value from the lifetable.

[‡] Note if the resident also exercises and gardens, then the TWF for the baseline residential scenario should be adjusted downward accordingly.

TABLE 2. Lifetime Inhalation Unit Risk (IUR) $(f/cc)^{-1}$ and Less-than-Lifetime Inhalation Unit Risk (IUR_{LTL}) $(f/cc)^{-1}$ Values for Various Continuous Exposure Scenarios

Age at first exposure (years)	Duration of exposure (years)									
	1	5	6	10	20	24	25	30	40	LT
0	0.010	0.046	0.055	0.084	0.14	0.147	0.15	0.17	0.19	0.23*
5	0.0085	0.039	0.046	0.070	0.11	0.13	0.13	0.14	0.16	
10	0.0068	0.031	0.038	0.058	0.094	0.098	0.10	0.11	0.13	
20	0.0046	0.021	0.027	0.038	0.063	0.065	0.066	0.075	0. 83	
30	0.0031	0.014	0.018	0.025	0.042	0.043	0.045	0.048	0.052	

* LT in this table means continuous lifetime exposure beginning at birth and lasting until death of the individual. Continuous means that exposure occurs 24 hours/day, 365 days/year.

Some values are extrapolated from the risk estimates provided in the AAHAU (EPA, 1986), as detailed in Appendix E. All values are shown to 2 significant figures.

Complete Less-than-Lifetime Inhalation Unit Risk (IUR_{LTL}) values are available in Appendix E (Table E-4).

Each of these exposure scenarios also has a defined set of exposure durations and age at first exposure (Table 2), which is needed to select the appropriate less-than-lifetime IUR.

For comparison to activity-based exposures, a continuous exposure is included in the table to show that the TWF for 24 hours per day, every day of the year is 1 (unity). Exposure scenarios that are intermittent would result in TWFs that are <1. For example, gardening is a common soil-disturbing activity that may occur at a site. The gardening exposure scenario (shown in Table 1) results in a TWF value of 0.057. This gardening TWF is based on the 95th percentile value for hours per month that adults garden as provided in EPA's Exposure Factors Handbook (EPA, 1997), Table 15-62.

A recreational scenario also is included in Table 1 to account for activities such as walking, running, or biking, which may occur in areas of the site that may have asbestos contamination. The recreational scenario was developed based on best professional judgment. For an adult

recreational receptor an individual was assumed to exercise for 1 hour per day, 3 days per week for the entire year. For this scenario, a 24-year exposure duration was assumed (age 20-44).

The child scenario assumes some type of regular outdoor activity that would disturb soil (i.e., playing on or in the dirt). The exposure time for this activity is assumed to be 2 hours per day, based on the 90th percentile value in the Exposure Factors Handbook, Table 15-58. The exposure frequency for this activity was assumed to be 350 days per year, assuming that for 2 weeks each year, the child may be on vacation or otherwise away from home. In some locations, a lower exposure frequency may be warranted if conditions (e.g., snow cover, cold temperatures) prevent direct contact with soil.

5.4 Selection of Less-than-Lifetime IURs

In accord with Superfund guidance (OSWER Directive 9285.7-53 "Human Health Toxicity Values in Superfund Risk Assessments"), the Integrated Risk Information System (IRIS) is the generally preferred source of human health toxicity values (EPA, 1988a). The inhalation unit risk (IUR) value on IRIS for continuous exposure over a lifetime is 0.23 $(f/cc)^{-1}$. This value represents the combined risk of lung cancer and mesothelioma.

This recommended framework provides guidance on how to assess exposures at Superfund sites that may likely be shorter than a lifetime. For example, the default exposure duration for a resident at a Superfund site is 30 years (EPA, 1989. 1997). The Airborne Asbestos Health Assessment Update (EPA, 1986), which was used to derive the IRIS IUR, has been used to identify IUR values for a number of continuous, but less-than-lifetime, exposures. This approach is consistent with the current EPA Guidelines for Carcinogen Risk Assessment (EPA, 2005), which addresses risk from less-than-lifetime exposures where a lifetime average daily exposure or dose may underestimate risk. See Appendix E, Derivation of Cancer Unit Risk Values for Continuous and Less-Than-Lifetime Inhalation Exposure to Asbestos, for more details on these less-than-lifetime IUR values.

Selection of a less-than-lifetime IUR should consider: (1) age at first exposure and (2) the duration of the exposure for the receptor being evaluated. Table 2 presents the lifetime IUR and less-than-lifetime inhalation unit risk (IUR_{LTL}) for a set of exposure durations and population ages at the beginning of the exposure.

Note that the use of IUR_{LTL} values in Table 2 account for differences in risk associated with time of first exposure and exposure duration, but do not address the additional uncertainties that may be inherent in the less-than-lifetime exposure scenario (e.g., life stage or biological susceptibility).

For purposes of illustration, Table 3 presents IUR and IUR_{LTL} values for the exposure scenarios presented in Table 1.

TABLE 3. Inhalation Unit Risks (IURs) for Example Exposure Scenarios

Exposure Scenario	Age at first exposure (years)	Exposure duration (years)	IUR $(f/cc)^{-1}$
Continuous Lifetime	0	lifetime	0.23 (IRIS IUR)
Baseline Residential	0	30	0.17
Gardening	20	30	0.075
Running/Walking	20	24	0.068
Child playing in soil	1	5	0.045

5.5 Calculation of Excess Lifetime[9] Cancer Risks (ELCRs)

As noted in the general equation presented in Section 5.0, the basic equation for estimating ELCR resulting from exposure to asbestos is:

$$\text{Risk (ELCR)} = EPC \bullet TWF \bullet IUR \qquad \text{(As presented in Section 5.0)}$$

As noted above, when applying this equation to a less-than-lifetime exposure, TWF_i and IUR_{LTLi} values specific to the exposure scenario(s) must be used to calculate the appropriate $ELCR_i$ as follows:

$$ELCR_i = EPC_i \bullet TWF_i \bullet IUR_{LTLi}$$

Where:

$ELCR_i$ = excess lifetime cancer risk for less-than-lifetime scenario i
EPC_i = the scenario-specific exposure point concentration generated from activity-based sampling
TWF_i = the scenario-specific time weighting factor
IUR_{LTLi} = the Inhalation Unit Risk corresponding to the age at first exposure and exposure duration for the exposure scenario

Because CERCLA risk assessors may also need to characterize the cumulative risk to an individual resulting from exposure to several environments (e.g., different operable units across a site) or several scenarios (e.g., playing in the dirt, mowing the lawn, and indoor exposures), the cumulative excess lifetime asbestos cancer risk can be summarized as follows:

$$ELCR_c = \sum_i EPC_i \bullet TWF_i \bullet IUR_{LTLi}$$

[9] Note that in this context, "lifetime" refers to the risk of developing cancer sometime during one's lifetime from an exposure of duration specific to the activity being assessed; it does not refer to risk from a lifetime of exposure.

Where

$ELCR_c$ = the cumulative excess cancer risk attributed to exposure to multiple environments or multiple scenarios over the course of the exposure duration of the individual.

Examples: The following examples are intended to illustrate how TWF and IUR_{LTL} values are used in conjunction with ABS air monitoring data to estimate ELCRs for various exposure scenarios. These examples are provided to illustrate how the life table information can be used and how time-weighting can be incorporated into the risk calculation. These examples are not intended to be prescriptive or to cover all exposure scenarios.

Example 1: Recreational Exposure - Adult

In this scenario, an adult receptor is exposed to asbestos only while running or walking in a contaminated recreational area (e.g., a park) and is assumed to have no residential asbestos exposure. Under an RME scenario, the adult is assumed to run/walk 1 hour per day, 156 days per year over a 24-year period from ages 20 to 44 years old. The airborne asbestos concentration in the breathing zone measured during ABS was 0.04 f/cc, which is used as the EPC.

$$TWF = \frac{1\,hour}{24\,hours/day} \bullet \frac{156\,days}{365\,days/year} = 0.018$$

$IUR_{LTL} = 0.068\ (f/cc)^{-1}$

(Table 3; 24-year exposure starting at age 20)

$ELCR = EPC \bullet TWF \bullet IUR_{LTL}$

$= 0.04\ f/cc \bullet 0.018 \bullet 0.068\ (f/cc)^{-1}$

$ELCR = 4.9 \times 10^{-5}$

Example 2: Recreational Exposure - Child

In this scenario, a child receptor is exposed to asbestos only while playing in the dirt in this recreational area (e.g., a park) and is assumed to have no residential asbestos exposure. Under an RME scenario, the child is assumed to play 2 hours per day, 350 days per year over a 5-year period from ages 1 to 6 years old. The airborne asbestos concentration in the breathing zone measured during ABS was 0.02 f/cc, which is used as the EPC. The IUR_{LTL} for this scenario is determined by interpolation as shown in Appendix E, Table E-4.

$$TWF = \frac{2\ hours/day}{24\ hours/day} \bullet \frac{350\ days/year}{365\ days/year} = 0.080$$

$IUR_{LTL} = 0.045\ (f/cc)^{-1}$

(Table 3; 5-year exposure starting at age 1)

$ELCR = EPC \bullet TWF \bullet IUR_{LTL}$

$= 0.02\ f/cc \bullet 0.080 \bullet 0.045\ (f/cc)^{-1}$

$ELCR = 7.2 \times 10^{-5}$

Example 3: Combined Residential Ambient Air Exposure and Gardening Exposure- Adult

In this scenario, an adult receptor is exposed due to disturbance of asbestos-contaminated soil while gardening and to asbestos in ambient air during quiescent activities. Under a residential RME scenario, the period of exposure is assumed to be 30 years, starting at age 20. The gardening scenario is assumed to be 10 hours per day, 50 days per year. Similarly, RME exposure to asbestos in ambient air is assumed to occur at all times that gardening is not occurring (14 hours per day for 50 days per year and 24 hours per day for 300 days per year). The asbestos concentration in the breathing zone while gardening during ABS was 0.02 f/cc, which is used as the EPC_G. The ambient air concentration measured in the community by stationary air monitors was 0.0007 f/cc, which is used as the EPC_{Amb}. The IUR_{LTL} for this scenario can be read directly from Table 2. ELCR is calculated as the sum of risk from exposure to asbestos from gardening and risk from ambient exposure to asbestos.

$$TWF_G = \frac{10}{24\ hours/day} \bullet \frac{50}{365\ days/year} = 0.057$$

$$TWF_{Amb} = \frac{14}{24\ hours/day} \bullet \frac{50}{365\ days/year} + \frac{24}{24\ hours/day} \bullet \frac{300}{365\ days/year} = 0.90$$

(14 hours/day while gardening plus 24 hours/day other days while at home.)

$IUR_{LTL} = 0.075\ (f/cc)^{-1}$

(Table 3; 30-year exposure starting at age 20)

$ELCR = [(EPC_G \bullet TWF_G) + (EPC_{Amb} \bullet TWF_{Amb})] \bullet IUR_{LTL}$

$= [(0.02\ f/cc \bullet 0.057) + (0.0007\ f/cc \bullet 0.90)] \bullet 0.075\ (f/cc)^{-1}]$

$ELCR = 8.5 \times 10^{-5} + 4.7 \times 10^{-5} = 1.3 \times 10^{-4}$

5.6 Uncertainties in the Current Cancer Risk Assessment Method

It is standard assessment practice in EPA to describe the underlying assumptions and the uncertainties. Detailed information can be found in the Risk Characterization Handbook (EPA, 2000a) and Risk Assessment Guidance for Superfund (EPA, 1989). EPA is also currently developing additional guidance on the assessment and communication of risks and uncertainties when evaluating sites involving naturally occurring asbestos.

The IUR_{LTL} (Table 2) and IRIS IUR (0.23 per f/cc) values are based on airborne fiber measurements using PCM, and no distinction is made between different mineral forms of asbestos. All fibers longer than 5 µm with an aspect ratio ≥3:1 and a width ≥0.25 µm and ≤3 µm are used to estimate exposure and risk (see Appendix C for more information). There are a number of variables that may potentially influence risk that are not accounted for by using exposure measurements based on this definition of a PCM fiber. For example, the IRIS Health Assessment (EPA, 1986) specifically recognizes the potential importance of different mineral forms of asbestos, but the data were not sufficient at that time to support the derivation of mineral specific potency factors. More recently there have been proposals that fiber dimension can be used to develop more refined potency estimates. Other variables such as fiber morphology and surface charge may also influence potency, but little information is currently available.

Because the less-than-lifetime unit risk and IRIS methods do not differentiate risks as a function of these or other variables, it is recommended that each asbestos risk assessment include an uncertainty discussion (an example discussion of uncertainty is available in the Clear Creek Management Area Risk Assessment; available online at www.epa.gov/region09/toxic/noa/clearcreek/risk.html). Where appropriate, this discussion could include alternative exposure metrics or risk calculations based on other published, peer-reviewed methods.

Additional areas of uncertainty in the use of the IRIS dose-response assessment, not specific to asbestos (i.e., they also pertain to other pollutants), may also be appropriate to discuss in the uncertainty characterization section of the risk assessment. These uncertainties may include differences between the study on which the dose-response assessment is based from the exposure circumstances being assessed, and recognition of assumptions inherent in methods employed to derive a continuous exposure toxicity value from exposure-response data involving discontinuous exposures (EPA, 1994). These uncertainties may also include differences with regard to the exposed population (e.g., workers vs. general population), the magnitude of exposure (e.g., generally higher study levels than those being assessed), and duration and frequency of exposure (e.g., 20-30 years of five to six 8- to 10-hour days a week vs. alternate exposure scenarios). See Appendix E, Derivation of Cancer Unit Risk Values for Continuous and Less-Than-Lifetime Inhalation Exposure to Asbestos, for more information. In addition, the TRW Asbestos Committee is available for consultation for those considering presentation of additional asbestos cancer risk estimates based on other published dose response assessments.

5.7 Non-Cancer Risks

At present, there is no IRIS inhalation reference concentration (RfC) available for the assessment of non-cancer risks from airborne asbestos exposure. Nevertheless, the occurrence of non-cancer disease is an important component of the suite of adverse effects experienced by humans with excess exposure to asbestos (ATSDR, 2003). Although no quantitative assessment is available, non-cancer health effects should be discussed in any risk assessment for asbestos exposure. The uncertainty section can present the limitations imposed by the current lack of a quantitative method for non-cancer effects of asbestos (an example discussion of uncertainty is available in

the Clear Creek Management Area Risk Assessment; available online at www.epa.gov/region09/toxic/noa/clearcreek/risk.html). EPA scientists are presently working to develop an inhalation RfC for asbestos at the Libby site.

5.8 Identifying the Air Action Level

The OSWER directive (EPA, 2004), recommends the development of risk-based, site-specific air action levels to determine if response actions for asbestos in soil/debris should be undertaken. Because inhalation is the exposure pathway of concern for asbestos, an action (or screening) level for asbestos in air is an appropriate metric for site managers in making the determination of whether a response action, no action, or further, more detailed investigation at a given site is warranted (i.e., Risk Management Decision Point #1 in Step 4). The text in this section describes a range of air action values that may be useful for different site-specific circumstances. (In addition, the air action level may be useful in guiding the data collection effort for site investigations: air action levels support the identification of appropriate detection levels for establishing DQOs discussed in Section 7.0.)

It should be noted that the action level for asbestos in air is most appropriate for use with exposure point concentrations generated by ABS or ABS in combination with ambient air monitors. An air action level would not be appropriate when using the results from ambient air monitoring alone when disturbance activities are anticipated for the site. Disturbance of soil (or settled dust) has been shown to result in a significantly greater release of asbestos fibers to air than under ambient conditions (see Section 4). Activities can create personal dust clouds that result in higher asbestos exposures on personal monitors than on ambient air monitors.

A risk-based air action level for asbestos in air may be calculated by rearranging the standard risk equation to compute the concentration of asbestos in air that corresponds to a specified risk level for a specified exposure scenario of concern as follows:

$$\text{Action Level for Asbestos in Air (f/cc)} = \frac{\text{Target Risk}}{[IUR_{LTL} \bullet TWF]}$$

Using the standard Superfund residential exposure scenario (EPA, 1989), action levels for asbestos in air can be calculated using the time weighting factor for Baseline Residential Exposures (TWF = 350/365, see Table 1), the age 0-30 IUR_{LTL} (Table 2), along with the target risk levels of $1x10^{-4}$, $1x10^{-5}$, $1x10^{-6}$ (the Superfund risk range of E-4, E-5, and E-6, respectively):

Example E-4 Air Action Level for Baseline Residential Asbestos Exposures (f/cc)

$= 1x10^{-4} \div [0.17\ (f/cc)^{-1} \bullet 0.96]$

$= 0.0006$ f/cc

~ 0.001 f/cc

Example E-5 Air Action Level for Baseline Residential Asbestos Exposures (f/cc)

$= 1x10^{-5} \div [0.17\ (f/cc)^{-1} \bullet 0.96]$

$= 0.00006$ f/cc

~ 0.0001 f/cc

Example E-6 Air Action Level for Baseline Residential Asbestos Exposures (f/cc)

$= 1x10^{-6} \div [0.17\ (f/cc)^{-1} \bullet 0.96]$

$= 0.000006$ f/cc

~ 0.00001 f/cc

The selection of an appropriate target risk level ($1x10^{-4}$, $1x10^{-5}$, or $1x10^{-6}$) is a risk management decision. The three alternatives are shown to illustrate the range of air action levels that may be selected if the residential scenario is appropriate for the site. The air action level for a site may be influenced by the scenario selected and by sampling and/or analytical constraints.

It is recommended that the action level for asbestos in air be carefully considered to ensure that it is appropriate for the site. Technical and statistical issues should be carefully considered in determining whether the average air concentration from ABS can be compared to these risk-based action levels for asbestos in air (e.g., it would not be appropriate to compare air concentrations generated by a short-term ABS scenario, such as raking or lawn mowing, with an air action level which assumes a continuous residential exposure scenario).

For asbestos, because there is no economically and technically feasible analytical method available to measure asbestos in soil at levels <0.25%, this framework recommends a procedure that is economically and technically feasible (i.e., the use of ABS and TEM) to derive an action level for asbestos in air. For example, because of background asbestos levels or resource limitations, E-5 and E-6 risk levels may not be practical target risk levels for some sites. For those site assessments involving short term, intermittent exposures, it is common practice to use the E-4 baseline residential action level for asbestos in air (0.001 PCME f/cc) because of analytical costs, sampling volume limitations, and other analytical issues (i.e., analyst fatigue). When assessing only indoor residential exposures, a lower air action level (0.0001 PCME f/cc, corresponding to E-5 risk level) may be achieved, because high volume stationary monitors may be used (see Section 6).

Using this procedure allows development of a health-based screening level that is representative of actual inhalation exposures (the critical exposure route) by means of site-specific, measured (not modeled) air concentrations. Generic air action levels using a default, 30-year residential scenario are shown above. Derivation of site-specific action levels for other exposure scenarios would follow the same procedure.

6.0 Sampling and Analytical Considerations

As noted above, air action levels are among the factors to be considered in specifying DQOs for a site. That is, the approximate concentration of a contaminant that would be of potential health concern to exposed humans can guide decisions about sample collection and analysis (e.g., to determine the optimal sensitivity of the sample collection method desired for the risk evaluation).

For this purpose, the air action level is considered an LOC. The LOC is typically used in Step 5 of the recommended framework to establish analytical sensitivities required for site-specific ABS.

In brief, the LOC typically is determined by rearranging the risk equation to compute the concentration of asbestos in air that corresponds to a specified risk level for a specified exposure scenario of concern (often a *de minimis* risk level):

$$\text{LOC (f/cc)} = \frac{\text{Target Risk at LOC}}{[\text{IUR} \bullet \text{TWF}]}$$

The IUR and TWF parameters are described in the preceding Section 5, *Cancer Risk Calculation*.

Calculation of a hypothetical site-specific LOC can be illustrated using Example 1 where exposure is for 1-hour day, 156-day year for 24 years beginning at age 20:

$$TWF = \frac{1\,hour}{24\,hours/day} \bullet \frac{156\,days}{365\,days/year}$$

$$\text{TWF} = 0.018$$

$$\text{IUR} = 0.065\ (\text{f/cc})^{-1} \text{ (from Table 3)}$$

Assuming a target risk of $1x10^{-6}$:

$$\text{LOC (f/cc)} = 1x10^{-6} \div [0.065\ (\text{f/cc})^{-1} \bullet 0.018]$$
$$= 0.0009 \text{ f/cc}$$

The choice of the target level of risk to use in this equation is a risk management decision and should be consistent with CERCLA and the NCP. In general, it is expected that the value will fall within the risk range of E-4 to E-6. As discussed above, however, the choice of target risk level may be influenced by sampling and analytical constraints, as discussed below, at www.ert.org/products/2084.PDF, and in Appendix C, Analytical Methods for Determination of Asbestos in Air, Soil, and Dust. Thus the target risk level may be selected to accommodate site-specific resource constraints. It is important to note that for a site with multiple ABS scenarios, more than one LOC may be appropriate.

The LOC determined above can be used to establish the analytical sensitivity requirements, which must be determined prior to sample collection. It is defined as the concentration corresponding to the detection of one structure in the analysis. For a direct preparation, the analytical sensitivity for a sample is determined by the volume of air drawn through the filter, the

active area of the filter, the number of grid openings (GOs) analyzed by a microscopist, and the area of each GO analyzed as follows:

$$S = EFA \div [GOs \bullet A_{GO} \bullet V \bullet 1000]$$

where:

S = Analytical sensitivity (1 structure/cc)
EFA = Effective filter area (mm^2)
GOs = Number of grid openings evaluated
A_{GO} = Area of each grid opening (mm^2)
V = Volume (L)
1000 = Unit conversion factor (cc/L)

Sample volume and the number of grid openings analyzed can typically be controlled during sample collection and analysis. However, there may be several practical constraints on each of these parameters. For example, the volume of air collected is given as the product of pump flow rate (L/minute) and collection time (minutes). Most personal sampling pumps have a maximum flow rate in the range of 5–10 L/minute, and the maximum sampling time for a personal air sample associated with ABS is usually about 2–4 hours. This volume also may be constrained by the level of dust in the air, since sample collection should not exceed the point where the filter surface contains more than 5–25% particulate. Thus, the volume for personal air samples is generally no larger than 2000–4000 L. In theory, the number of grid openings can be any number, but the time and cost of analysis is directly related to the number of grid openings analyzed (see Appendix C, Analytical Methods for Determination of Asbestos in Air, Soil, and Dust).

7.0 Data Adequacy: Applying the DQO Process

In general, estimates of risk from exposure to asbestos in air should be based on estimates of the appropriate exposure concentration during the time frame of the exposure scenario rather than on the values of individual samples (see EPA, 1989). Because concentrations in air can be highly variable as a function of both time and space, it is usually desirable to collect repeated samples at multiple locations within an exposure area (or repeated samples from the same location) in order to achieve a reliable basis for estimation of the average exposure level for each exposure scenario of concern (additional guidance concerning ABS is available from ERT: www.ert.org/products/2084.PDF).

Because there is no default rule for identifying the minimum number of samples that are required to adequately characterize exposure and risk at a site (EPA, 1992), it is critical to prepare detailed QAPPs or SAPs to guide asbestos data collection activities. These plans should be prepared in accordance with existing Agency guidance including appropriate data quality objectives. For assistance in developing these documents, refer to the following:

- Guidance for Quality Assurance Project Plans, EPA/240/R-02/009 [www.epa.gov/quality/qs-docs/g5-final.pdf] and
- EPA Requirements for Quality Assurance Project Plans, EPA/240/B-01/003 [www.epa.gov/quality/qs-docs/r5-final.pdf] or

- Guidance on Systematic Planning Using the Data Quality Objectives Process EPA QA/G-4, EPA/240/B-06/001 [www.epa.gov/quality/qs-docs/g4-final.pdf]

QAPPs and SAPs may be modified as necessary in consultation with Regional risk assessors and risk managers to meet project-specific DQOs. Proper application of the DQO process will help maximize the probability that data collected will be adequate to support reliable risk assessments and management decisions, or to alert the risk manager when collection of adequate data may be cost prohibitive relative to the cost of a response action.

8.0 Risk Management Issues

As is true of all site investigations, risk managers balance a number of different considerations in deciding how to proceed at a site. One consideration can be the relative cost of performing a site investigation compared with the cost of site cleanup. This is often true for asbestos because of the relatively high cost of sample collection and sample analysis. Two possible scenarios that may occur include:

- High-Level Sources are Present
  In some cases, available information may be sufficient to conclude that sources present are very likely to be of concern, even though detailed exposure and risk estimates are not yet available. For example, if data indicate high levels of asbestos are present in soil (e.g., >1% PLM) or indoor dust (e.g., >10,000 s/cm^2)[10], a risk manager may determine that a response action should be undertaken, and that further efforts to characterize the source or potential airborne exposures before action is taken are not needed.

- Further Investigation is Not Cost Effective
  In cases where available data are not sufficient to clearly determine if a source is or is not of significant health concern, the risk manager may consider whether the cost of further investigation to characterize the magnitude of the exposure and risk is likely to approach or exceed the cost of performing a response action. If at any point in the use of the recommended framework the cost of investigation is anticipated to be greater than the cost of an appropriate response action, it may be reasonable to proceed directly to a decision concerning a response action without further site characterization (assuming that the site poses an unacceptable risk to human health as defined by the NCP). However, if it is determined that site investigation may be helpful in narrowing the scope (and hence reducing the cost) of a response action, then further investigation to define the location and extent of sources requiring response action normally should be pursued.

8.1 Consideration of "Background"

In some cases, it may also be important to consider "background" levels of asbestos for site assessment and risk management, since "background" concentrations may, in some cases, contribute significantly to the total concentration of asbestos measured in site media (soil, air, dust).

[10] Microvacuum testing results should be compared with results obtained from the same as well as similar structures or sites to be able to conclude there are significantly elevated concentrations of asbestos in the test building.

The definition of "background" may differ from case to case, but is often taken to refer to the concentration of asbestos in outdoor or indoor air under conditions when there is no known local disturbance that results in a significant release. The level of "background" asbestos in outdoor air has been investigated in numerous studies (see ATSDR, 2001 for a summary; EPA, 2002b). In general, except for areas of NOA, levels tend to be highest in urban environments, and lower in rural or "pristine" environments. For indoor air, ATSDR (2001) reports that “measured indoor air values range widely, depending on the amount, type, and condition (friability) of ACM used in the building”. In its review, ATSDR notes that the available data suffer from lack of common measurement reporting units. When characterization of "background" levels of asbestos in outdoor or indoor air are needed to support risk management decisions, the data should be collected using the same sampling methods and analytical procedures as are used for on-site data, except that this type of sample is generally collected using stationary air monitors with high flow rates and a long sampling period in order to achieve high sample volumes (and hence low analytical sensitivity). In addition, as is true for all efforts to characterize background, it is important to collect multiple samples that are representative over time and space, and which are sufficient in number to provide a proper basis for statistical comparison of site data with background data.

9.0 Limitations

Although this guidance provides information concerning assessing asbestos exposure at Superfund sites, some asbestos sources may not be addressed under the authority of CERCLA. Site assessors should consult their management and legal counsel when evaluating whether to use the authority of CERCLA at a particular site. Ultimately, the site assessors should strive to address any unacceptable current or potential future asbestos exposure risks (see Appendix D, Land Use Considerations).

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Appendix A – Glossary and Acronym List For Purposes of this Guidance

AAHAU	**Airborne Asbestos Health Assessment Update (1986)**
ABS	**Activity-based sampling** An empiric approach in which airborne concentrations of asbestos are measured during an event where the source material (soil or dust) is disturbed rather than predicted or modeled from source material concentration.
ACBM	**Asbestos-containing building materials**
ACM	**Asbestos containing material**
Actinolite	A mineral in the amphibole group. It is generally not used commercially, but is a common impurity in chrysotile asbestos.
AHERA	Asbestos Hazard Emergency Response Act of 1986 In 1986, the Asbestos Hazard Emergency Response Act (AHERA) was signed into law as Title II of the Toxic Substance Control Act. Additionally, the Asbestos School Hazard Abatement Reauthorization Act (ASHARA), passed in 1990, requires accreditation of personnel working on asbestos activities in schools, and public and commercial buildings. See applicability discussion (Section 2).
Amosite	A type of asbestos in the amphibole group; it is also known as brown asbestos.
Amphibole	A group of double chain silicate minerals.
Analytical sensitivity	The sample-specific lowest concentration of asbestos the laboratory can detect for a given method.
Anthophyllite	A type of asbestos in the amphibole group; it is also known as azbolen asbestos.
Asbestiform	Fibrous minerals possessing the properties of commercial grade asbestos (e.g., flexibility, high tensile strength, or long, thin fibers occurring in bundles).
Asbestos	The generic name used for a group of naturally occurring mineral silicate fibers of the serpentine and amphibole series, displaying similar physical characteristics although differing in composition.
Asbestosis	A non-cancerous disease associated with inhalation of asbestos fibers and characterized by scarring of the air-exchange regions of the lungs.
Aspect ratio	Length to width ratio of a particle or fiber.
ASTM	**American Society for Testing and Materials**
ATSDR	**Agency for Toxic Substances and Disease Registry** A principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of Center for Disease Control and Prevention which is part of the U.S. Department of Health and Human Services.
Bulk sample	A sample of suspected media (e.g., soil or dust) is obtained from a site to be analyzed microscopically for asbestos content. Bulk sample analysis can be part of a process to assess the hazard from asbestos at a site.
CARB 435	**California Air Resources Board analytical method 435** A specialized polarized light microscopy (PLM) method used for testing asbestos content in the serpentine aggregate storage piles, on conveyer belts, and on covered surfaces such as roads, play-yards, shoulders and parking lots. The method includes reporting the asbestos content by performing a 400 point count technique which has a detection limit of 0.25%. Many agencies and laboratories also use this method for measuring asbestos in soil. The method is undergoing revision (completion anticipated in 2009).
Carcinogen	Any substance that causes cancer.
CERCLA	**Comprehensive Environmental Response, Compensation, and Liability Act**

Chrysotile	A fibrous member of the serpentine group of minerals. It is the most common form of asbestos used commercially, also referred to as white asbestos.
Cleavage Fragment	Fragments that may be formed by crushing, mining, or breaking massive materials.
Contaminant	A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.
Continuous Exposure	Exposure that occurs 24 hours/day, 365 days/year.
Crocidolite	A type of asbestos in the amphibole group; it is also known as blue asbestos.
Detection limit	The minimum concentration of an analyte in a sample, that with a high level of confidence is not zero.
Direct preparation	In direct preparation, the filter is examined by microscopy. In contrast with indirect preparation, where a filter with too much material undergoes a separation step (commonly dispersion in water) to allow for analysis.
Dose	The amount of a substance to which a person is exposed (air, soil, dust, or water) over some time period.
DQO	**Data Quality Objectives**
ED	**Electron diffraction** A specialized technique used to study matter by firing electrons at a sample and observing the resulting interference pattern. See Appendix C.
EDX	**Energy Dispersive X-Ray Analysis**
ELCRs	**Excess lifetime cancer risks**
EPA	**United States Environmental Protection Agency**
EPC	**Exposure point concentration**
Exposure	Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].
f/cc	Fibers per cubic centimeter. Units of measurement for asbestos in air.
Fibrous habit	Having the morphologic properties similar to organic fibers.
GOs	**Grid openings** An area that overlays a mounted sample to aid in its microscopic examination.
HASP	**Health and safety plan**
Hazardous substance	Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.
ICs	**Institutional controls** Institutional controls are actions, such as legal controls, that help minimize the potential for human exposure to contamination by ensuring appropriate land or resource use.
Indirect preparation	A method whereby a filter with too much material undergoes a separation step to allow for analysis.
Ingestion	The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].
Inhalation	The act of breathing. A hazardous substance can enter the body this way [see route of exposure].
IRIS	**Integrated Risk Information System** A compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects.
ISO 10312	**International Organization for Standardization Method 10312** See Appendix C for details.

IUR	**Inhalation unit risk** The excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration 1 µg/m³ in air.
MCE	**Mixed cellulose ester** A type of filter used for air sampling.
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.
Mesothelioma	A malignant tumor of the covering of the lung or the lining of the pleural and abdominal cavity often associated with exposure to asbestos.
Microvacuum samples	A microvacuum sample, commonly called microvacuum, as per ASTM D5755, is similar to a wipe sample with the exception that a predefined area is "vacuumed" using a low-volume (1–5 L/minute) personal air pump equipped with a sample cassette that contains a cellulose filter instead of wiping with a wet wipe.
NCP	**National Contingency Plan**
NESHAP	**National Emission Standards for Hazardous Air Pollutants** Section 112 of the Clean Air Act requires EPA to develop emission standards for hazardous air pollutants. In response, EPA published a list of hazardous air pollutants and promulgated the National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations.
NIOSH	**National Institute for Occupational Safety and Health** The National Institute for Occupational Safety and Health (NIOSH) is the federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. NIOSH is part of the Centers for Disease Control and Prevention in the Department of Health and Human Services.
NIOSH 7400	A light microscopy analytical method, also known as NIOSH Phase Contrast Microscopy [PCM] Method 7400.
NIOSH 9002	A polarized light microscopy (PLM) analytical method useful for the qualitative identification of asbestos and the semi-quantitative determination of asbestos content of bulk samples. The method measures percent asbestos as perceived by the analyst in comparison to standard area projections, photos, and drawings, or trained experience. The method is not applicable to samples containing large amounts of fine fibers below the resolution of the light microscope.
NOA	**Naturally occurring asbestos**
OSHA	**Occupational Safety and Health Administration** The Occupational Safety and Health Administration, since its inception in 1971, aims to ensure employee safety and health in the United States by working with employers and employees to create better working environments.
PC	**Polycarbonate** A type of filter used for asbestos air sampling.
PCM	**Phase contrast microscopy** A light-enhancing microscope technology that employs an optical mechanism to translate small variations in phase into corresponding changes in amplitude, resulting in high-contrast images. Historically, this method was used to measure airborne fibers in occupational environments; however, it cannot differentiate asbestos fibers from other fibers.
PCMe	**PCM-equivalent** This refers to chrysotile and amphibole structures identified through transmission electron microscopy (TEM) analysis that are equivalent to those that would be identified in the same sample through phase contrast microscopy analysis, with the main difference being that TEM additionally permits the specific identification of asbestos fibers. PCMe structures are asbestiform structures greater than 5 microns in length having at least a 3 to 1 length to width (aspect) ratio.

Personal air monitor	Also known as a low-flow or low-volume sample pump, this is an air sample pump that is portable so that it can be worn by a member of the sampling team during activity based sample collection. The air flow for a personal sample pump is typically 1 to 10 liters per minute.
Pleural fibrosis	The development of fibrous tissue in the pleura.
PLM	**Polarized light microscopy** A microscope technology that uses the polarity (or orientation) of light waves to provide better images than a standard optical microscope.
PPE	**Personal protective equipment**
Prismatic	A term commonly used in descriptions of minerals for crystals having the shape of a prism.
QAPP	**Quality Assurance Project Plan** The EPA has developed the QAPP as a tool for project managers and planners to document the type and quality of data needed for environmental decisions and to describe the methods for collecting and assessing those data. The development, review, approval, and implementation of the QAPP are components of EPA's mandatory Quality System.
RfC	**Reference concentration** An estimate (with uncertainty spanning perhaps an order of magnitude) of a continuous inhalation exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious non-cancer health effects during a lifetime. The inhalation reference concentration is for continuous inhalation exposures.
RME	**Reasonable maximum exposure**
Route of exposure	The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].
s/cc	Structures per cubic centimeter. Units of measurement for asbestos in air.
SAED	**Selected area electron diffraction** A crystallographic laboratory technique, a specialized electron microscopy technique, which can be performed inside a transmission electron microscope (TEM).
SAP	**Sampling and Analysis Plan** A plan intended assist organization in documenting the procedural and analytical requirements for a one-time or time-limited project involving the collection of water, soil, sediment, or biological samples taken to characterize areas of potential environmental contamination. It combines, in a short form, the basic elements of a Quality Assurance Project Plan (QAPP) and a Field Sampling Plan (FSP).
Serpentine	A name given to several members of a polymorphic group of magnesium silicate minerals—those having essentially the same chemistry but different structures or forms. Chrysotile asbestos is a member of the serpentine group.
SOP	**Standard operating procedure**
Stationary air monitor	An air sample monitor that is placed in a single location and is not moved during one or more sampling events.
TEM	**Transmission electron microscopy** A microscope technology and an analytical method to identify and count the number of asbestos fibers present in a sample. It uses the properties of electrons to provide more detailed images than polarized light microscopy (PLM). Capable of achieving a magnification of 20,000x.
Tremolite	A mineral in the amphibole group, that occurs as a series in which magnesium and iron can freely substitute for each other. Tremolite is the mineral when magnesium is predominant; otherwise, the mineral is actinolite. It is generally not used commercially in the United States.

TSCA	**Toxic Substances Control Act** The Toxic Substances Control Act (TSCA) of 1976 was enacted by Congress to give EPA the ability to track the 75,000 industrial chemicals currently produced or imported into the United States.
TWF	**Time Weighting Factor** This factor accounts for less-than-continuous exposure during a year.
UCL	**Upper confidence limit**
UR	**Unit Risk**
Vermiculite	A chemically inert, lightweight, fire resistant, and odorless magnesium silicate material that is generally used for its thermal and sound insulation in construction and for its absorbent properties in horticultural applications. A major source of vermiculite is the mine in Libby, Montana, which has been demonstrated to contain various amounts of amphibole minerals.
Wipe sample	A wipe sample consists of using a wipe and a wetting agent that is wiped over a specified area using a template. The wipe picks up settled dust in the template area and provides an estimate of the number of fibers per area.

Appendix B – 1% Memo

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

AUG 10 2004

OFFICE OF
SOLID WASTE AND EMERGENCY
RESPONSE

OSWER 9345.4-05

MEMORANDUM

SUBJECT: Clarifying Cleanup Goals and Identification of New Assessment Tools for Evaluating Asbestos at Superfund Cleanups

FROM: Michael B. Cook, Director
Office of Superfund Remediation and Technology Innovation

TO: Superfund National Policy Managers, Regions 1-10

Purpose

The purpose of this memo is twofold. The first purpose is to clarify that Regions should develop risk-based, site-specific action levels to determine if response actions should be taken when materials containing less than 1 percent asbestos (including chrysotile and amphibole asbestos) are found on a site. Regions should not assume that materials containing less than 1 percent asbestos do not pose an unreasonable risk to human health. The second purpose is to outline some activities underway to assist in the evaluation of asbestos risks at Superfund sites.

It is important to note that this memorandum is not a regulation itself, nor does it change or substitute for any regulations. Thus, it does not impose legally binding requirements on EPA, States, or the regulated community. This memorandum does not confer legal rights or impose legal obligations upon any member of the public. Interested parties are free to raise questions and objections about the substance of this memorandum and the appropriateness of the application of this memorandum in a particular situation. EPA and other decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from those described in this memorandum. The use of the word "should" in this document means that something is suggested or recommended, but not required.

Background

The 1 percent threshold for asbestos-containing materials was first used in the 1973 National Emissions Standards for Hazardous Air Pollutants (NESHAP), where the intent of the threshold was:

> *... to ban the use of materials which contain significant quantities of asbestos, but to allow the use of materials which would: (1) contain trace amounts of asbestos which occur in numerous natural substances, and (2) include very small quantities of asbestos (less than 1 percent) added to enhance the material's effectiveness.* (38 FR 8821)

All subsequent EPA regulations and the Asbestos Hazardous Emergency Response Act Statute included this 1 percent threshold. In the 1990 NESHAP revisions, EPA retained the threshold, stating that it was related to the phase contrast microscopy (PCM) analytical method detection limits. The Occupational Safety and Health Administration (OSHA) Standards also defined an asbestos-containing material as a material containing more than 1 percent of asbestos[1] (29 CFR Part 1910.1001 and 29 CFR Part 910.134). The wide use of the 1 percent threshold in regulations may have caused site managers to assume that levels below the threshold did not pose an unreasonable risk to human health. However, it is important to note that the 1 percent threshold concept was related to the limit of detection for the analytical methods available at the time and also to EPA's prioritization of resources on materials containing higher percentages of asbestos.

Issue

Currently, many site managers continue to employ the use of the 1 percent threshold to determine if response actions for asbestos should be undertaken. However, based upon scientific discussions and findings reported by EPA and ATSDR from the Libby, Montana Superfund site, as well as EPA's "Peer Consultation Workshop on a Proposed Asbestos Cancer Risk Assessment[2]," there may be confusion regarding the appropriate use of the 1 percent threshold at Superfund sites. This concern was discussed at EPA's "Asbestos Site Evaluation, Communication, and Cleanup Workshop[3]," and it was concluded that the 1 percent threshold for asbestos in soil/debris as an action level may not be protective of human health in all instances of site cleanups. The 1 percent threshold is not risk-based and an accurate exposure value could only be determined through site sampling techniques that generate fibers from soil and bulk samples. Therefore, we recommend the development of risk-based, site-specific action levels to determine if response actions for asbestos in soil/debris should be undertaken.

Recent data from the Libby site and other sites provide evidence that soil/debris containing significantly less than 1 percent asbestos can release unacceptable air concentrations of all types of asbestos fibers (i.e., serpentine/chrysotile and amphibole/tremolite). The most critical determining factors in the level of airborne concentrations are the degree of disturbance, which is associated with the level of activity occurring on the site, and the presence of complete exposure pathways. For example, activities such as excavation or plowing generate large amounts of dust that can result in the generation of airborne fibers that can be inhaled even from a complex soil matrix. To address this evolving issue, OSRTI will be hosting a review of methods for determining conversion of soil to air concentrations in 2004.

Future Action

OSRTI has formed three technical working groups to assist in developing guidance and policy relating to risk assessment, field sampling, and analytical methods. These working groups have already contributed to a new toolbox that is located on the EPA Intranet. The location of the tool box is http://intranet.epa.gov/osrtinet/hottopic.htm.

The toolbox will be continually updated as products are developed and will eventually contain information on risk assessments, generic site sampling, and analytical approaches for asbestos cleanup projects. In the interim, numerous site reports that discuss specific concerns and issues from current asbestos site actions are contained in the toolbox. Additionally, to facilitate the development of sampling plans, there are examples of approved site sampling plans with data quality objectives, and a list of asbestos analytical laboratories which have passed an EPA audit.

Our goal is to have the majority of the guidance and policy documents prepared by the end of this year. If you have any questions, please consult with Richard Troast of my staff, who is the lead scientist within OSRTI for asbestos. He can be reached at (703) 603-8805 or by e-mail at: troast.richard@epa.gov.

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Endnotes:

1. Pursuant to industry comments, the 1994 amendments to the OSHA Standards incorporated a definition of asbestos-containing material that included the 1 percent threshold to be consistent with EPA, and noted that the National Institute for

Occupational Safety and Health (NIOSH) had raised questions whether even one percent may be below the accuracy level for certain microscopic methods. However, OSHA's Hazard Communication Standard requires a Material Safety Data Sheet (MSDS) to be prepared by the manufacturer or importer of a chemical substance, mixture, or product containing more than 0.1 percent of any carcinogen, including asbestos. Additionally, OSHA has recently issued several letters stating that some of the requirements in the OSHA Asbestos Construction Standard (29 CFR 1926.1101) do cover materials containing less than one percent asbestos.

2. USEPA's *Peer Consultation Workshop on a Proposed Asbestos Cancer Risk Assessment* was held in San Francisco, California on February 25-27, 2003. The purpose of the workshop was to discuss the scientific merit of the proposed methodology developed for EPA by Dr. Wayne Berman and Dr. Kenny Crump. The proposed methodology distinguishes carcinogenic potency by asbestos fiber size and asbestos fiber type and advocates use of a new exposure index to characterize carcinogenic risk. Proceedings from this conference can be located at: http://www.epa.gov/superfund/programs/risk/asbestos/index.htm.

3. USEPA's *Asbestos Site Evaluation, Communication and Cleanup Workshop* was held in Keystone, Colorado on September 23-26, 2003. The purpose of the workshop was to provide an opportunity to share lessons learned from working on large sites contaminated with asbestos. The meeting was also used to identify key outstanding technical and policy issues, and to begin to develop a consistent approach to measuring "success", especially short-term impacts and long-term risk reduction. Proceedings from this conference can be located at: http://www.epa.gov/superfund/programs/risk/asbestos/workshop/index.htm.

Appendix C – Analytical Methods for Determination of Asbestos in Air, Soil, and Dust Samples

Introduction:

Characterization of potential human exposure to asbestos generally involves analytical testing using contemporary methodologies that afford: (1) accurate identification of fibrous material present in sample media, (2) accurate and precise quantitative results, (3) reproducibility among multiple testing laboratories, (4) flexibility, (5) consensus acceptance of the method among asbestos professionals, and (6) cost effectiveness. Keeping these six parameters in mind, EPA has reviewed the extensive number of published and in-house asbestos analytical methods and selected what are believed to be the most appropriate methods to use for investigating Superfund sites that may be contaminated with asbestos. EPA and others are continuing research efforts to improve upon the current analytical methods, and to develop new methods to better understand the more complex asbestos-related issues that are facing the scientific community. Each of EPA's recommended analytical methods for air, soil, and dust media are summarized below. Analysis of asbestos in aqueous media is not address in this appendix because ingestion of asbestos via drinking water has not historically been considered an important exposure route when compared to inhalation. The release of asbestos from soil and dust to the air is thought to be the primary route of exposure, and warrants inclusion of a methodology for soil and dust analyses. The methods detailed below are for Superfund investigations; their applicability to regulatory assessment (e.g., worker protection under OSHA regulations) or for natural or man-made disasters should be evaluated on a case by case basis.

Air Media:

ISO 10312:

EPA/OSWER recommends the International Organization for Standardization (ISO) method 10312:1995(E) "Ambient air – Determination of asbestos fibers – Direct-transfer transmission electron microscopy method" for sampling at Superfund sites. While this method was published for ambient air monitoring, it is applicable to general air monitoring activities (e.g., activity-based sampling (ABS), indoor air monitoring, etc.). The method includes detailed procedures to prepare and analyze air samples using Transmission Electron Microscopy (TEM). Few details are specified in the method as to how to collect samples (other than describing the types of air collection filters that are applicable to the method). ISO 10312 is similar to the method referenced in 40 CFR Part 763, referred to as the AHERA Method. However, the AHERA method differs from the ISO method in the manner in which fibers and fiber bundles are counted and measured. The ISO method also allows recording of all fibers to inform future analysis should new toxicity models be developed. For these reasons, EPA/OSWER feels the ISO method to be a better format for performing assessment on Superfund sites.

Method Specifics:

Applicability: The ISO method is used for the determination of the concentration of asbestos structures in air samples, and includes measurement of the lengths, widths, and aspect ratio (ratio

of length to width) of the asbestos structures. The method allows determination of the type of asbestos fibers present in a sample, but cannot discriminate between individual structures of asbestos and non-asbestos forms of amphibole minerals.

For this method (ISO 10312), a sample of air is collected. This is accomplished by using a pump to draw a specified volume of air across a filter to collect suspended asbestos fibers that are in the air. A key component to collecting an air sample to determine exposure is capturing airborne (suspended) asbestos from soil or settled dust. Soil can be suspended (airborne) by the activity being performed or by using an aggressive method (e.g., raking) for disturbing the soil while collecting the air sample. Settled dust can be suspended by the activity being performed or by using a modified-aggressive (e.g., fan) or aggressive method (e.g., leaf blower and fans) for disturbing the dust while collecting the air sample. When the testing is complete the sample cassette, which typically contains a mixed cellulose ester filter, is sent to the laboratory for analysis. Results are reported as the number of asbestos structures per cubic centimeter of air sampled.

Air samples can be collected using either polycarbonate (PC) or mixed cellulose ester filters (MCE), and the ISO method provides preparation techniques for both filter types. The collection efficiency of MCE filters has been questioned, even though MCE filters are used predominantly in industry. EPA is conducting studies to evaluate PC and MCE filters. The use of MCE filters for Superfund assessment will not be discouraged unless subsequent data are released indicating that MCE filters should not be used in asbestos sampling. The ISO method specifically calls for the use of MCE filters with a maximum pore size of 0.45 µm. However, many EPA sites require sampling in relatively dusty environments (e.g., ABS), and require large sample volumes to achieve sensitivity requirements. The 0.45 µm filters, due to their minute pore size, cause a high back pressure in the sampling train at flow rates above approximately 3 liters per minute that battery-operated personal sampling pumps are incapable of overcoming. Further, the 0.45 µm filters clog easily in dusty environments, and therefore cannot be used for direct analysis. Hence, EPA is recommending the use of 0.8 µm MCE filters for most Superfund applications (0.8 µm filters are specified for NIOSH Phase Contrast Microscopy [PCM] Method 7400 and may be used for the NIOSH TEM method, 7402). This recommendation is made after consultation with NIOSH and other asbestos experts as to their applicability.

Technique: There are three primary steps in a sample analysis by the ISO 10312 method: sample preparation, TEM calibration, and TEM analysis. These procedures will be briefly described.

1. Sample preparation: For MCE filters, a small area of the sample filter is placed onto a glass slide and “collapsed” with an acetic acid – dimethylformamide solution. Collapsing the filter concentrates fibers trapped in the filter on the upper surface of the filter. The slide and filter are then placed into a plasma etcher where a portion of the filter is etched away, further exposing fibers. The plasma etcher must be calibrated by the laboratory to ensure the proper amount of filter is removed. Too much etching will cause loss of fibers, and too little will result in fibers being “hidden” by filter media from view of the electron microscope. Note that the laboratory must keep accurate records of their plasma calibration processes. Following etching, the etched sample is placed in a vacuum controlled carbon coating device, where a thin layer of carbon is deposited onto the filter.

This process helps hold fibers in-place and allows for proper TEM examination. Finally, very small portions of the coated filter are cut away and individually placed onto a specially designed gold TEM grid. This grid is composed of small openings (referred to as grid openings) that are of uniform and measurable size. Each grid is composed of about 100 grid openings, the dimensions of which are to be measured and recorded by the laboratory during calibration. Each grid opening has an area of approximately 0.01 mm^2. The exact size, as measured by the laboratory, is used in the calculation of concentration of fibers on the sample filter.

2. Calibration: Three processes are used for asbestos identification by TEM; (1) electron microscopic visualization of the sample for determining dimensional measurements, (2) electron diffraction (ED) or selected area electron diffraction (SAED), where unique diffraction patterns of suspect fibers can be generated, and (3) energy dispersive X-Ray (EDX) analysis, where chemical makeup of the suspect fiber can be determined. Prior to sample analysis, the microscope and micro-analytical techniques (ED, SAED, EDX) must be calibrated or verified per the procedures detailed in the ISO method. These calibration procedures will not be discussed here (as they are in development), but it is important to understand that these calibration requirements are necessary to ensure the laboratory is reporting results accurately. The laboratory must keep accurate records of all calibration results for each TEM instrument. These records should be audited by any potential customer of the laboratory before samples are sent to the laboratory.

3. TEM Analysis: After calibration and sample preparation, sample grids can be analyzed by TEM. A grid preparation is placed into the sample chamber of the instrument and a vacuum is pulled. After instrument equilibration, the TEM analyst sets the instrument to the proper magnification (approximately 20,000 times magnification), centers the focus of the scope onto a grid opening, and begins a systematic back-and-forth visual observation of the grid opening looking for suspect asbestos fibers and fiber structures. Structures include bundles, clusters, and matrices, and are all to be recorded as described in the ISO method. This is probably the most significant difference between the ISO and AHERA methods. The AHERA method counts only the primary structures while ISO counts the components of the structures individually. Therefore, where primary structures are present in the sample, ISO provides a more comprehensive count for quantitative risk assessment purposes. Structures visually detected in a grid opening will be measured for length and width characteristics, and then will be analyzed for diffraction patterns and chemistry make-up using energy dispersive X-Ray analysis. Specifics on fiber measurement and identification are given below.

Fiber Measurement and Identification:

Under the ISO method, two specific counting schemes are detailed. The first scheme is more general and allows for the counting of fibers that are 0.5 µm in length or greater, and have aspect ratios of 5:1 or greater. In routine practice, TEM is able to resolve fibers down to approximately 0.1 µm in width, as compared to the resolution for routine PCM (0.25 µm). Therefore, short thin fibers that would not be detected using PCM will be detected using TEM under the general counting scheme. EPA recommends modification of the aspect ratio to 3:1 for this counting

scheme. The other counting scheme allows for the counting of PCM equivalent fibers, or PCMe. Under this scheme, the analyst is to count fibers that are longer than 5 µm in length with aspect ratios of 3:1 or greater. PCMe fibers and structures under the ISO method also have a defined width range of between 0.2 µm and 3.0 µm. (Note that **EPA recommends a width range between 0.25 µm and 3.00 µm**, as recommended by World Health Organization [WHO, 1986].) The purpose of counting fibers as PCMe fibers is that the method is attempting to mimic the size fraction of fibers that would be detected if the sample were being run under PCM.

For risk calculations, the inhalation unit risk for asbestos was derived for PCM measurements, and IRIS includes a statement that it should not be applied directly to any other analytical techniques. However, the IRIS summary also acknowledges that use of PCM alone in environments which may contain other fibers may not be adequate (EPA 1988). Therefore, methods for counting PCM-equivalent (PCMe) structures have been designed so that fiber counts made with the two techniques (PCM and TEM) would be approximately equal. EPA recognizes there is some uncertainty associated with using PCMe fiber counts to calculate risk with the inhalation unit risk, but the amount of uncertainty is thought to be relatively small compared to other sources. Alternatively, the use of PCM in environments where other mineral or organic fibers are present is likely to contribute a much larger source of uncertainty. Thus, TEM is preferred to PCM for characterization of environmental exposures.

The TRW Asbestos Committee acknowledges the importance of characterizing the fiber size distribution and mineralogy of air samples at sites. Fiber size distribution and mineralogy data can only be obtained using TEM. These may be important in characterizing the sources of asbestos at a site and capturing information for the future (e.g., for assessing non-cancer health effects). Nevertheless, the TRW recognizes that PCM may be used for limited screening (e.g., where there is great uncertainty about the location of the contamination). If PCM analysis is chosen for the site, the TRW should be consulted, a subset of the samples should be analyzed by TEM to characterize fiber size distribution, and all filters should be archived for possible later re-analysis. In addition, only TEM is able to differentiate asbestos from other fibers. For the PCM-based screening approach, many samples are taken from a large area of a site (PCM is a cost effective approach appropriate for screening) and a subset of samples are then confirmed by a more definitive technique (TEM). This is consistent with the current standard practice for site characterization. It is anticipated that the PCM-based screening approach will be the exception rather than the rule for most asbestos sites, particularly for pre-NPL work (SI, Removal, State collaborations) because TEM is the preferred analytical method for characterization of environmental exposures.

As a TEM analyst visually detects a structure that morphologically resembles an asbestos mineral, further identification is required for confirmation. The ISO method details the process of performing electron diffraction analysis on a structure. This is a technique by which the crystal structure of a fiber is examined. As chrysotile and many amphiboles have unique diffraction patterns, identification information can be gleaned from this analysis. The ISO method also details the use of energy dispersive X-ray analysis, which gives the chemical make-up of the fiber being analyzed. By applying visual observation, electron diffraction and X-ray analysis on a percentage of the fibers detected in each grid opening, a reasonable identification of each fiber can be obtained. It should be noted that it is extremely important that the laboratory

keep accurate documentation relative to electron diffraction and X-ray analyses. With today's techniques in digital photography, a laboratory should have the ability to photograph electron diffraction patterns and a photograph or digital representation of the fiber's X-ray pattern. A laboratory should be able to make these available upon request.

Quantitative analysis:

Results of an analysis can be reported in two ways. One is to report the number of asbestos structures found per square mm of an effective filter media. The formula for this is

[A / (B x C)] x 385 mm²

where:

A is the number of structures detected
B is the measured size of one grid opening (mm²)
C is the total number of grid openings analyzed
385 mm² is the effective area of a 25 mm sample filter

The more common way to report results is to report concentration of asbestos as structures per cubic centimeter of air sampled. For this calculation, one would take the result of the formula above and divide by 1,000,000.

Example: if 1 asbestos structure was detected in a 1000 liter air sample, and 10 grid openings, each of which is 0.01 mm², were analyzed, the concentration of asbestos in the air sample would be:

$$\frac{\frac{1}{0.01 \times 10} \times 385}{1{,}000{,}000} = 0.0039\, s/cc$$

An important thing to remember about TEM analysis is that results are statistical. Because of the extreme magnification of TEM, analysis of the entire 385 mm² area of a filter would be extremely resource intensive and costly. Therefore, a representative area of a filter is analyzed, and the final results are extrapolated to the entire filter. This interpolation is only valid if there is uniform distribution of fibers onto the sample filter. There is historical evidence that under proper air sampling procedures, asbestos fibers will be distributed relatively uniformly onto a sample filter, even though there is to be expected some variability in the number of asbestos fibers, or fiber clusters, found in separate grid openings. Because of this, the TRW Asbestos Committee recommends that for any asbestos analysis, the laboratory must analyze a minimum of 10 grid openings. The laboratory must inspect multiple grid openings to detect anomalies in particulate and fiber distribution (e.g., an analyst should generally not find 20 fibers in one grid opening and 0 fibers in an adjacent grid opening). Additionally, the ISO method requires a low magnification examination of the grid preparations to establish the acceptability of specimen grids. If anomalies in fiber distribution are detected, the laboratory should qualify the results for the sample as estimated. The ISO method can be implemented to report the results and include

detailed tables and instructions on how to calculate confidence levels for each sample analyzed. This level of detail may be important when considerations of required sensitivity levels relative to site-specific air action levels need to be made.

NIOSH/OSHA PCM:

PCM is a low magnification (up to 400 times magnification) optical microscopic technique used primarily for OSHA worker protection asbestos regulations. The regulatory guidance and details of the OSHA method are given in 29CFR part 1915.1001, Appendix A. NIOSH publishes a similar method (NIOSH 7400/7402) that may be used for OSHA compliance, as well as an analytical technique in general research on asbestos-related human health issues. These two methods are limited to analysis of air samples collected on 0.45 µm to 1.2 µm MCE filters. Typically, 0.8 or 0.45 micron filters are employed. The PCM method is limited in capability as the technique can only distinguish fibrous material from non-fibrous material. The technique cannot distinguish asbestos fibers from organic fibers (e.g., hair), and is limited in its ability to distinguish asbestos fibers from vitreous fibers (i.e., glass), as the optical characteristics (refractive index, etc.) cannot be determined by PCM. In addition, various forms of amphibole asbestos cannot be distinguished from one another, nor can chrysotile be easily distinguished from asbestiform amphibole in a complex mixed asbestos matrix. The method is also limited in the fact that only fibers that have diameters >0.25 µm can be detected. Specific method protocols mandate that only fibers that are ≥5 µm in length and that have aspect ratios of ≥3:1 are counted (NIOSH counting rules "B" do allow for using an aspect ratio of 5:1, even though 3:1 is preferred by NIOSH). Counting rules for both the NIOSH and OSHA methods usually count bundles as only one fiber, thus underestimating fiber concentrations relative to the ISO 10312 method.

Soil Media:

Currently no fully validated methods exist for accurate and precise quantitative measurement of asbestos in soil media below concentrations of about 0.25%. EPA has performed studies on soil media using a site-specific methodology incorporating both PLM[11] and electron microscopy techniques. The results indicate the PLM method to be quantitative at 0.5% and higher, and the electron microscopy technique to be unreliable. The inability to produce or obtain samples of known asbestos concentrations below 0.5%, of sufficient homogeneity to perform validated analysis renders both PLM and TEM soil analysis techniques ineffective below approximately 0.25%.

The California Air Resources Board (CARB) developed the CARB 435 method in 1991 for the analysis of asbestos fibers in aggregates, including serpentine rock aggregates. The method is undergoing revision, which includes a multi-lab validation study to examine variability among laboratories. EPA is recommending the use of the CARB 435 method as a qualitative screening method for determination of presence or absence of asbestos in soil during initial phases of a site assessment.

[11] PLM allows for rapid identification of fibrous materials; however, the resolution of the microscope limits identification of fibers finer than about 1 µm in diameter. Also, PLM suffers from significant bias for low concentration samples, especially below 1%.

The CARB method protocol incorporates crushing and grinding of rock aggregate, and then sieving (200 mesh) to generate a relatively homogeneous material of sufficient particle size to include asbestos fibers. For performing analysis on soil media, the crushing step may be omitted. Samples should not be crushed or pulverized below 250 µm. CARB has identified the Braun-type mill as the appropriate equipment for preparation. The soil sample is ground to achieve particle size consistency, sieved and dried, then analyzed for asbestos using a polarizing light microscope equipped with a specialized ocular for performing point count analyses. In EPA studies, it was found that visual estimation of asbestos concentration was more accurate than point counting; therefore, a client may have a laboratory modify the CARB method to include visual estimation or conduct the point count and require a field of view report of asbestos structures. For identification purposes, the analyst will perform various observations of potential asbestos fibers with PLM. The analyst will note morphological characteristics of fibers such as length, width, and aspect ratio (current CARB method requires counting fibers with a 3:1 and greater aspect ratio, even though minimum lengths and widths are not specified), as well as optical characteristics, such as color, birefringence, extinction angle characteristics, and refractive index. Chrysotile and the amphibole asbestos fibers have unique morphological and optical characteristics that will lend to their identification. Specific characteristics identifiable to each asbestos species are listed in the CARB 435 method.

Settled Dust Media:

For indoor measurement of asbestos collected in dust samples, ASTM Method D5755-95, Standard Test Method for Micro-vacuum Sampling and Indirect Analysis of Dust by Transmission Electron Microscopy for Asbestos Structure Number Concentrations, is recommended by EPA. The method, commonly referred to as the microvacuum method is used for general testing of non-airborne dust samples. It is used to assist in the evaluation of dust that may be found on surfaces in buildings such as ceilings, floor tiles, shelving, duct work, carpet, etc. The method provides an index of the concentration of asbestos structures in the dust per unit area sampled.

This method describes a technique in which a dust sample is collected by vacuuming a known surface area with a standard 25 or 37 mm air sampling cassette using a plastic tube attached to the inlet orifice of the cassette which acts as a nozzle. The ASTM method specifies use of an air velocity of 100 cm/s, which is calculated based on an internal sampling tube diameter of 6.35 mm at a flow rate of 2 L/minute. The amount of suction used is very minimal (i.e., 2 L/minute) and does not compare to what a normal household vacuum would create. Additionally, the area is "vacuumed" using tubing with an opening that is 6.35 mm (much smaller than a normal vacuum cleaner). ***In essence, a microvacuum sample is really an air sample that is collected over a specific area, rather than for a specific volume of air.*** Results are reported as the number of asbestos fibers per unit area.

The sample is transferred from inside the cassette to an aqueous solution of known volume. Aliquots of the suspension are then filtered through a 25 mm MCE or PC filter. The filters are then dried and a portion of each filter is prepared for TEM analysis using a procedure similar to that detailed in the ISO 10312 method. The calibration and operation of the TEM, and structure

identification procedures for the ASTM method are also similar to the ISO method. However, the counting protocols for the ASTM method are identical to those required for the AHERA protocol. Technically, one could request the laboratory to "bin" the ASTM structures according to defined structure size requirements, such as PCMe structures, even though the ASTM method does not mention the flexibility to do so.

The ASTM method is referred to as an "indirect method" of analysis. This is because asbestos structures and other particles are "washed off" the vacuum filter via an aqueous transfer. Only an aliquot of the resulting aqueous wash is then transferred to the MCE or PC filter for final preparation for TEM analysis. A typical analysis using the ASTM method calls for the transfer of material from the vacuum filter with 100 mL of water. A 10 mL aliquot is taken from this for final analysis. This results in a 10–fold dilution of sample. The "on filter" concentration of asbestos for the ASTM method is calculated in the same manner as the ISO 10312 method, with the exception that the 10 times dilution factor must be incorporated into the ASTM result. Using this convention, the ASTM method would then be considered to give a result 10 times less sensitive than the ISO method. For example, if one asbestos structure were detected in 10 grid openings, each of which is 0.01 mm^2 in area, the ISO method would result in an on-filter concentration of 3850 s/mm^2, whereas the ASTM method would result in an on-filter concentration of 38500 s/mm^2. Sensitivity could be potentially increased in the ASTM method by analyzing larger aliquots of aqueous sample. However, this would also raise the amount of non-asbestos interference material in the sample and could result in a TEM grid that is overloaded and could not be analyzed. The ASTM method references the sensitivity of the method at about 1000 s/cm^2 of surface area vacuumed. The 38500 s/mm^2 on-filter concentration calculated above is equivalent to a final surface area concentration of 385 s/cm^2 of surface area vacuumed (with respect to the standard 100 cm^2 surface area). ASTM (2006) provides a statistical method to be used when counts are low (e.g., fewer than 5 structures) and recommends a method for determining asbestos detection limit. In brief, the ASTM method considers counting one asbestos structure equivalent to counting four structures. ***Note that with all indirect sample preparation techniques, the asbestos observed for quantitation may <u>not</u> represent the physical form of the asbestos as sampled. More specifically, the procedure described neither creates nor destroys asbestos, but it may alter the physical form of the mineral fibers and break up clusters and matrices.***

Conclusion:

Contemporary analytical testing methodologies should be employed in order to adequately characterize potential human exposure to asbestos at Superfund sites. The methodologies described above generally provide the following necessary information for Superfund site investigation: (1) accurate identification of fibrous material present in a sample media, (2) accurate and precise quantitative results, (3) reproducibility among multiple testing laboratories, (4) flexibility, (5) consensus acceptance of the method among asbestos professionals, and (6) cost effectiveness.

EPA and other agencies are continuing research efforts to improve current sampling and analytical methodologies, and to develop new methods to further the understanding of the more complex asbestos-related issues that are facing the scientific community. The methods presented

herein generally are intended for Superfund investigations, and not necessarily for other regulatory venues such as worker protection under OSHA regulations.

Appendix D – Land Use Considerations

One of the critical elements in development of ABS typically is determining site-specific exposure scenarios based on land use. The evaluation of probable land use scenarios normally is an iterative process. Probable land use can be selected based on the land use of the site with reference to current and currently planned future land use and the effectiveness of institutional or legal controls placed on the future use of the land (Risk Assessment Guidance for Superfund; EPA 1989). For information regarding land use determinations, refer to OSWER Directive 9355.7-04 "Land Use in the CERCLA Remedy Selection Process" and similar directives.

Land use assumptions can be based on a factual understanding of site-specific conditions and reasonably anticipated use. The land use evaluated for the assessment can be based on a residential exposure scenario unless residential land use is not plausible for the site.

The basic or primary land use exposure scenarios for evaluation may include:

- Residential
- Commercial/Industrial
- Agricultural
- Recreational
- Excavation/Remediation (Short term exposure scenario)

The basic land use may be further divided and categorized as dictated by available information.

- Future land use assumptions should be consistent with the reasonably anticipated future land use.
- A range of land uses, and therefore exposure assumptions, may be considered, depending on the amount and certainty of information supporting a land use evaluation.
- Discussions with planning boards, appropriate officials, and the public, as appropriate, should be conducted as early as possible in the scoping phase of the project.
- Federal, State, and local facilities/property may have different land use considerations than private property because the future land use assumptions (e.g., agricultural, industrial, recreational, etc.) at sites which may be transferred to the public may be different than at sites where a governmental agency will be maintaining control of the facility.
- Numerous sources of information, including planning boards, master plans, flood zones, etc., can be utilized in making educated decisions regarding potential land use for a site. Land use assumptions may take into consideration the interests of all affected parties, including the local residents and State/Local governments.
- Land use issues are to be carefully documented and all assumptions clearly defined.

For asbestos sites, the future land use considerations listed above apply; however, additional consideration must be given to how the asbestos material could change in the future. Natural weathering and changes resulting from human activities may change the nature (fiber size distribution) and extent (spatial distribution) of asbestos contamination across the site. For example, subsurface asbestos may migrate to the surface over time.

Appendix E – Derivation of Cancer Unit Risk Values for Continuous and Less-Than-Lifetime Inhalation Exposure to Asbestos

1.0 OVERVIEW

As discussed in EPA (1986), excess cancer risk from inhalation exposure to asbestos is quantified in a two-step procedure:

Step 1: Derive Cancer Potency Factors

Potency factors are derived by fitting established risk models to data from available epidemiological studies in workers exposed to asbestos in workplace air. The potency factor for lung cancer is referred to as KL, and has units of $(f/cc\text{-}year)^{-1}$. The potency factor for mesothelioma is referred to as KM, and has units of $(f/cc\text{-}years^3)^{-1}$.

Step 2: Implement Life Table Calculations

Potency factors are not equivalent to cancer unit risks. In order to compute the lifetime excess risk of lung cancer or mesothelioma to an exposed individual, it is necessary to implement a life-table approach. In brief, the exposure pattern for the exposed population is specified by indicating the concentration of asbestos in air, the age at which exposure begins and the age at which exposure ends. Based on this, the potency factors are used to compute the probability of dying from lung cancer or mesothelioma in each year of life. These probabilities of asbestos induced death are combined with the probability of death from all other causes to yield an estimate of the lifetime total probability of dying as a consequence of asbestos-induced cancer.

2.0 RISK ESTIMATES PROVIDED BY EPA (1986)

Based on epidemiological data available at the time, and expressing the concentration of asbestos in terms of PCM fibers per cc, EPA (1986) derived the following potency factors for lung cancer and mesothelioma:

Lung cancer: $KL = 1E\text{-}02\ (PCM\ f/cc\text{-}years)^{-1}$
Mesothelioma: $KM = 1E\text{-}08\ (PCM\ f/cc\text{-}years^3)^{-1}$

Because these potency factors are based on occupational exposures (8 hours per day, 5 days per week), they must be adjusted for application to non-occupational settings. For evaluation of continuous exposure (24 hours per day, 7 days per week), EPA (1986) performed this adjustment as follows:

$$Adjustment\ \ Factor = \frac{24\ hours/day}{8\ hours/day} \bullet \frac{7\ days/week}{5\ days/week} = 4.2$$

Thus, the potency factors used by EPA (1986) for computing risks from continuous exposure were:

KL = 4.2E-02 (PCM f/cc-years)$^{-1}$
KM = 4.2E-08 (PCM f/cc-years^3)$^{-1}$

EPA (1986) utilized these potency factors to implement life table risk calculations for a number of alternative exposure scenarios. These scenarios all assume exposure occurs 24 hours per day, 7 days per week, but each scenario may begin and end at different ages. The results are provided in Table 6-3 of EPA (1986), which is reproduced here as Table E-1 of this Appendix. As seen, risks (expressed as asbestos-induced cancer deaths per 100,000 people) are provided for exposure to 0.01 PCM f/cc for a range of differing ages at onset (age at first exposure) and exposure durations, stratified by cancer type (lung cancer and mesothelioma) and by gender.

In this table, the exposure duration column labeled "LT" (lifetime) should be understood to mean the risk associated with exposure from the age at onset until death, either from asbestos-induced disease, or from any other cause of death.

3.0 RE-ADJUSTMENT OF EXTRAPOLATION FROM WORKERS TO CONTINUOUS EXPOSURE

In 1988, IRIS revised the method for extrapolation from workers to continuous exposure so that the factor was based on the ratio of the amount of air inhaled per day rather than the ratio of the exposure time per day. The risks associated with occupational exposure were adjusted to continuous exposure based on the assumption of 20 m^3 per day for total ventilation and 10 m^3 per 8-hour workday in the occupational setting:

$$Revised\ Adjustment\ Factor = \frac{20\ m^3/day}{10\ m^3/day} \cdot \frac{7\ days/week}{5\ days/week} = 2.8$$

Table E-2 presents the risk values for people with continuous exposure (24 hours per day, 7 days per year) after re-adjustment of the risk values presented in EPA (1986) by a factor of 2.8/4.2. For convenience, results are also averaged across gender and summed across cancer type. All values are shown to two significant figures.

4.0 DERIVATION OF UNIT RISK VALUES

4.1 Continuous Exposure

The risk values for people with continuous exposure (24 hours/day, 7 days/week) given in Table E-2 may be converted to unit risks by dividing by a factor of 100,000 (so that risks are

expressed as cases per person), and dividing by the assumed exposure concentration of 0.01 PCM f/cc (so that risk is expressed as cases per person per f/cc). The results for the combined risk of mesothelioma and cancer in males and females combined are shown in Table E-3. As above, results are expressed to two significant figures.

Continuous Lifetime Unit Risk

Note that the unit risk for lung cancer and mesothelioma (combined) in an individual with continuous exposure from birth (age of onset = 0) for a lifetime is 0.23 $(\text{PCM f/cc})^{-1}$. This is the unit risk value that is presented in IRIS. This value is applicable only to an individual with exposure from birth to death, and should not be used to evaluate risks to people whose exposures do not span a full lifetime.

Less-Than-Lifetime Unit Risks

Table E-3 gives the unit risk values for residents for a number of less-than-lifetime exposure scenarios. These should be used whenever the continuous exposure scenario of interest (age of onset and exposure duration) is represented in Table E-3. However, there may be a number of other exposure scenarios of interest to Superfund risk assessors that are not presented in this table. For example, no unit risk value is given for a resident who is exposed starting at birth and lasting 30 years (the usual assumption for an RME resident).

Ideally, unit risk values for residential exposure scenarios not already included in Table E-3 would be derived using the life table approach. However, EPA (1986) did not include the detailed mortality and smoking data needed to exactly reproduce the unit risk values reported. Therefore, as an alternative to regenerating the original life table analysis, the residential unit risk values in Table E-3 were plotted (see Figure E-1) and were fit to an equation of the following form:

$$UR_{a,d} = k1 \cdot [1-\exp(-k2 \cdot d)]$$

where:

$UR_{a,d}$ = Unit risk for a continuous exposure beginning at age of onset "a" and extending for a duration of "d" years

k1 and k2 = empiric fitting parameters derived from the data

This equation was selected to model the data because it arises from a value of zero when duration is zero, and plateaus as exposure duration approaches lifetime.

Both k1 and k2 depend on age at onset. These relationships are well characterized equations of the following form:

$k1 = b1 + b2 \cdot \exp(-a / b3)$
$k2 = b4 + b5 \cdot \exp(-a / b6)$

where b1 to b6 are empiric fitting parameters. The resulting best-fit parameters derived by minimization of the sum of the squared errors are summarized below:

Parameter	Value
b1	-0.0176401
b2	0.2492567
b3	24.7806941
b4	0.0415839
b5	0.0039973
b6	-18.2212632

These equations fit the data well, with an R^2 value of 0.9998 and an F-value of 21306.9. The root mean squared error (the average difference between the observed and predicted unit risk value) is 0.0008. Fitting the data using a commercial surface fitting software package did not yield any solutions that were superior.

These equations may be used to estimate unit risks for any continuous exposure duration of interest for any age of onset between zero and 50. For example, the unit risk for a resident exposed from age zero to age 30 is computed as follows:

$k1 = -0.0176401 + 0.2492567 \cdot \exp(-0 / 24.7806941) = 0.232$
$k2 = 0.0415839 + 0.0039973 \cdot \exp(-0 / -18.2212632) = 0.0456$
$UR_{0,30} = 0.232 \cdot (1-\exp(-0.0456 \cdot 30)) = 0.17$

Note that multiple significant figures are carried during the calculation, but that the final result is expressed to only two significant figures.

Also note that this value is substantially higher than would be derived using a simple time-based adjustment of the lifetime residential unit risk value reported in IRIS ($0.23 \bullet 30/70 = 0.099$). This emphasizes the need to avoid simple linear interpolation in the derivation of less-than-lifetime unit risk factors for asbestos.

Table E-4 uses this mathematical approach to compute continuous (24 hours/day, 365 days/year) unit risks for a number of additional exposure scenarios of potential interest to Superfund risk assessors. In some cases there are minor differences in the value derived from the fitted equations and the values shown in Table E-3. This is due to minor discrepancies in the fitted mathematical surface (shown in Figure E-1) and the data used to define the surface. However, these differences are very small compared to the overall uncertainty in the unit risks values and should not be considered as cause for concern.

4.2 Less-Than-Continuous Exposure

As noted above, the unit risk values given in Table E-3 and E-4 are all based on the assumption that exposure is continuous (24 hours/day, 365 days/year) during the exposure period of interest. If exposure is less than continuous, this is accounted for by using the TWF approach described in Section 5.3. If exposure is continuous, the value of the TWF is, by definition, 1.0.

Example 1: Evaluation of Risks to Workers

When exposure of workers is to be evaluated, the TWF that should be used is simply the inverse of the adjustment factor of 2.8 that was used by IRIS (1988) to extrapolate from workers to continuous exposure:

$$TWF_{(worker)} = 1 / 2.8 = 0.357$$

If the worker worked for 25 years beginning at age 20, the appropriate unit risk factor (taken from Table E-4) would be:

$$UR_{20,45} = 0.069$$

Based on these two factors, the excess lifetime cancer risk would be computed as:

$$ELCR = C \bullet 0.357 \bullet 0.069$$

Example 2: Recreational Jogger

In this example, the goal is to compute the risks to an individual who is exposed by running on a jogging trail that is located in an area where the air is contaminated by asbestos from some local source. Assume that the time spent jogging through the contaminated area is 2 hours per run, and that jogging through the contaminated area occurs 80 days per year. Based on these assumed example values, the TWF for this scenario would be:

$$TWF = \frac{2\ hour/day}{24\ hour/day} \cdot \frac{80\ days/year}{365\ days/year} = 0.0183$$

Assume the person jogs starting at age 30 and continues for 30 years. The continuous unit risk for this scenario is 0.048 (see Table E-4).

The ELCR is then computed as:

$$ELCR = C \bullet 0.0183 \bullet 0.048$$

TABLE E-1
EXCESS CANCER RISKS FOR CONTINUOUS EXPOSURES
(Excess cancer deaths/100,000 people per 0.01 PCM f/cc)
Stratified by Disease and Gender (USEPA 1986 Table 6-3)

Mesothelioma in Females

	Duration of Exposure				
Age at Onset	1	5	10	20	LT
0	14.6	67.1	120.8	196.0	275.2
10	9.4	42.6	75.5	118.7	152.5
20	5.6	25.1	43.5	65.7	78.8
30	3.1	13.3	22.4	31.9	35.7
50	0.6	2.1	3.2	3.9	3.9

Lung Cancer in Females

	Duration of Exposure				
Age at Onset	1	5	10	20	LT
0	1.0	4.6	9.2	18.5	52.5
10	1.0	4.6	9.2	18.6	43.4
20	1.0	4.6	9.2	18.2	34.3
30	1.0	4.6	9.0	16.7	25.1
50	0.7	3.1	5.5	8.1	8.8

Mesothelioma in Males

	Duration of Exposure				
Age at Onset	1	5	10	20	LT
0	11.2	51.0	91.1	145.7	192.8
10	7.0	31.2	58.2	84.7	106.8
20	4.1	17.5	30.1	44.5	51.7
30	2.1	8.8	14.6	20.4	22.3
50	0.3	1.1	1.8	2.0	2.1

Lung Cancer in Males

	Duration of Exposure				
Age at Onset	1	5	10	20	LT
0	2.9	14.8	29.7	59.2	170.5
10	2.9	14.9	29.8	59.5	142.0
20	3.1	15.0	30.0	59.4	113.0
30	3.1	14.9	29.8	56.6	84.8
50	2.5	11.5	20.3	29.1	30.2

LT = Lifetime (from age of onset until death from any cause)

TABLE E-2
EXCESS CANCER RISKS FOR CONTINUOUS EXPOSURES
(Excess cancer deaths/100,000 people per 0.01 PCM f/cc)
Adjusted by Factor of 2.8 / 4.2

Mesothelioma in Males and Females

	Duration of Exposure				
Age at Onset	1	5	10	20	LT
0	8.6	39.4	70.6	113.9	156.0
10	5.5	24.6	44.6	67.8	86.4
20	3.2	14.2	24.5	36.7	43.5
30	1.7	7.4	12.3	17.4	19.3
50	0.3	1.1	1.7	2.0	2.0

Lung Cancer in Males and Females

	Duration of Exposure				
Age at Onset	1	5	10	20	LT
0	1.3	6.5	13.0	25.9	74.3
10	1.3	6.5	13.0	26.0	61.8
20	1.4	6.5	13.1	25.9	49.1
30	1.4	6.5	12.9	24.4	36.6
50	1.1	4.9	8.6	12.4	13.0

Total (Mesotheloma + Lung Cancer) -- Population Average

	Duration of Exposure				
Age at Onset	1	5	10	20	LT
0	9.9	45.8	83.6	139.8	230.3
10	6.8	31.1	57.6	93.8	148.2
20	4.6	20.7	37.6	62.6	92.6
30	3.1	13.9	25.3	41.9	56.0
50	1.4	5.9	10.3	14.4	15.0

TABLE E-3
UNIT RISK VALUES FOR CONTINUOUS EXPOSURES
(PCM f/cc)$^{-1}$

Mesothelioma in Males and Females

Age at Onset	Duration of Exposure				
	1	5	10	20	LT
0	8.6E-03	3.9E-02	7.1E-02	1.1E-01	1.6E-01
10	5.5E-03	2.5E-02	4.5E-02	6.8E-02	8.6E-02
20	3.2E-03	1.4E-02	2.5E-02	3.7E-02	4.4E-02
30	1.7E-03	7.4E-03	1.2E-02	1.7E-02	1.9E-02
50	3.0E-04	1.1E-03	1.7E-03	2.0E-03	2.0E-03

Lung Cancer in Males and Females

Age at Onset	Duration of Exposure				
	1	5	10	20	LT
0	1.3E-03	6.5E-03	1.3E-02	2.6E-02	7.4E-02
10	1.3E-03	6.5E-03	1.3E-02	2.6E-02	6.2E-02
20	1.4E-03	6.5E-03	1.3E-02	2.6E-02	4.9E-02
30	1.4E-03	6.5E-03	1.3E-02	2.4E-02	3.7E-02
50	1.1E-03	4.9E-03	8.6E-03	1.2E-02	1.3E-02

Total (Mesotheloma + Lung Cancer) in Males and Females

Age at Onset	Duration of Exposure				
	1	5	10	20	LT
0	9.9E-03	4.6E-02	8.4E-02	1.4E-01	2.3E-01
10	6.8E-03	3.1E-02	5.8E-02	9.4E-02	1.5E-01
20	4.6E-03	2.1E-02	3.8E-02	6.3E-02	9.3E-02
30	3.1E-03	1.4E-02	2.5E-02	4.2E-02	5.6E-02
50	1.4E-03	5.9E-03	1.0E-02	1.4E-02	1.5E-02

TABLE E-4

Extrapolated Unit Risk Values for Continuous and Less-Than-Lifetime Exposures (PCM f/cc)[1]

Age at Onset	Exposure Duration (years)																		
	1	2	3	4	5	6	8	10	12	14	16	20	24	25	30	40	50	60	LT
0	1.0E-02	2.0E-02	3.0E-02	3.9E-02	4.7E-02	5.5E-02	7.1E-02	8.5E-02	9.8E-02	1.1E-01	1.2E-01	1.4E-01	1.5E-01	1.6E-01	1.7E-01	1.9E-01	2.1E-01	2.2E-01	2.3E-01
1	9.9E-03	1.9E-02	2.8E-02	3.7E-02	4.5E-02	5.3E-02	6.8E-02	8.1E-02	9.4E-02	1.0E-01	1.2E-01	1.3E-01	1.5E-01	1.5E-01	1.7E-01	1.9E-01	2.0E-01	2.1E-01	2.2E-01
2	9.6E-03	1.9E-02	2.7E-02	3.6E-02	4.4E-02	5.1E-02	6.5E-02	7.8E-02	9.0E-02	1.0E-01	1.1E-01	1.3E-01	1.4E-01	1.5E-01	1.6E-01	1.8E-01	1.9E-01	2.0E-01	2.1E-01
3	9.2E-03	1.8E-02	2.6E-02	3.4E-02	4.2E-02	4.9E-02	6.3E-02	7.5E-02	8.7E-02	9.7E-02	1.1E-01	1.2E-01	1.4E-01	1.4E-01	1.5E-01	1.7E-01	1.8E-01	1.9E-01	2.0E-01
4	8.8E-03	1.7E-02	2.5E-02	3.3E-02	4.0E-02	4.7E-02	6.0E-02	7.2E-02	8.3E-02	9.3E-02	1.0E-01	1.2E-01	1.3E-01	1.3E-01	1.5E-01	1.6E-01	1.8E-01	1.8E-01	1.9E-01
5	8.5E-03	1.7E-02	2.4E-02	3.2E-02	3.9E-02	4.6E-02	5.8E-02	7.0E-02	8.0E-02	8.9E-02	9.8E-02	1.1E-01	1.3E-01	1.3E-01	1.4E-01	1.6E-01	1.7E-01	1.7E-01	1.9E-01
6	8.2E-03	1.6E-02	2.3E-02	3.1E-02	3.7E-02	4.4E-02	5.6E-02	6.7E-02	7.7E-02	8.6E-02	9.4E-02	1.1E-01	1.2E-01	1.2E-01	1.3E-01	1.5E-01	1.6E-01	1.7E-01	1.8E-01
7	7.9E-03	1.5E-02	2.3E-02	2.9E-02	3.6E-02	4.2E-02	5.4E-02	6.4E-02	7.4E-02	8.3E-02	9.1E-02	1.0E-01	1.2E-01	1.2E-01	1.3E-01	1.4E-01	1.5E-01	1.6E-01	1.7E-01
8	7.6E-03	1.5E-02	2.2E-02	2.8E-02	3.5E-02	4.1E-02	5.2E-02	6.2E-02	7.1E-02	7.9E-02	8.7E-02	1.0E-01	1.1E-01	1.1E-01	1.2E-01	1.4E-01	1.5E-01	1.5E-01	1.6E-01
9	7.3E-03	1.4E-02	2.1E-02	2.7E-02	3.3E-02	3.9E-02	5.0E-02	5.9E-02	6.8E-02	7.6E-02	8.4E-02	9.6E-02	1.1E-01	1.1E-01	1.2E-01	1.3E-01	1.4E-01	1.5E-01	1.6E-01
10	7.0E-03	1.4E-02	2.0E-02	2.6E-02	3.2E-02	3.8E-02	4.8E-02	5.7E-02	6.6E-02	7.3E-02	8.0E-02	9.2E-02	1.0E-01	1.0E-01	1.1E-01	1.3E-01	1.4E-01	1.4E-01	1.5E-01
11	6.8E-03	1.3E-02	1.9E-02	2.5E-02	3.1E-02	3.6E-02	4.6E-02	5.5E-02	6.3E-02	7.1E-02	7.7E-02	8.9E-02	9.8E-02	1.0E-01	1.1E-01	1.2E-01	1.3E-01	1.3E-01	1.4E-01
12	6.5E-03	1.3E-02	1.9E-02	2.4E-02	3.0E-02	3.5E-02	4.4E-02	5.3E-02	6.1E-02	6.8E-02	7.4E-02	8.5E-02	9.4E-02	9.6E-02	1.0E-01	1.2E-01	1.2E-01	1.3E-01	1.4E-01
13	6.3E-03	1.2E-02	1.8E-02	2.3E-02	2.9E-02	3.4E-02	4.3E-02	5.1E-02	5.8E-02	6.5E-02	7.1E-02	8.2E-02	9.1E-02	9.2E-02	1.0E-01	1.1E-01	1.2E-01	1.2E-01	1.3E-01
14	6.1E-03	1.2E-02	1.7E-02	2.3E-02	2.8E-02	3.2E-02	4.1E-02	4.9E-02	5.6E-02	6.3E-02	6.8E-02	7.9E-02	8.7E-02	8.9E-02	9.7E-02	1.1E-01	1.1E-01	1.2E-01	1.2E-01
15	5.9E-03	1.1E-02	1.7E-02	2.2E-02	2.7E-02	3.1E-02	3.9E-02	4.7E-02	5.4E-02	6.0E-02	6.6E-02	7.5E-02	8.3E-02	8.5E-02	9.3E-02	1.0E-01	1.1E-01	1.1E-01	1.2E-01
16	5.6E-03	1.1E-02	1.6E-02	2.1E-02	2.6E-02	3.0E-02	3.8E-02	4.5E-02	5.2E-02	5.8E-02	6.3E-02	7.2E-02	8.0E-02	8.2E-02	8.9E-02	9.8E-02	1.0E-01	1.1E-01	1.1E-01
17	5.4E-03	1.1E-02	1.6E-02	2.0E-02	2.5E-02	2.9E-02	3.7E-02	4.4E-02	5.0E-02	5.6E-02	6.1E-02	7.0E-02	7.7E-02	7.8E-02	8.5E-02	9.4E-02	1.0E-01	1.0E-01	1.1E-01
18	5.2E-03	1.0E-02	1.5E-02	1.9E-02	2.4E-02	2.8E-02	3.5E-02	4.2E-02	4.8E-02	5.3E-02	5.8E-02	6.7E-02	7.4E-02	7.5E-02	8.1E-02	9.0E-02	9.5E-02	9.8E-02	1.0E-01
19	5.1E-03	9.9E-03	1.4E-02	1.9E-02	2.3E-02	2.7E-02	3.4E-02	4.0E-02	4.6E-02	5.1E-02	5.6E-02	6.4E-02	7.1E-02	7.2E-02	7.8E-02	8.6E-02	9.1E-02	9.4E-02	9.8E-02
20	4.9E-03	9.5E-03	1.4E-02	1.8E-02	2.2E-02	2.6E-02	3.3E-02	3.9E-02	4.4E-02	4.9E-02	5.4E-02	6.2E-02	6.8E-02	6.9E-02	7.5E-02	8.3E-02	8.7E-02	9.0E-02	9.3E-02
21	4.7E-03	9.2E-03	1.3E-02	1.7E-02	2.1E-02	2.5E-02	3.1E-02	3.7E-02	4.3E-02	4.7E-02	5.2E-02	5.9E-02	6.5E-02	6.6E-02	7.2E-02	7.9E-02	8.3E-02	8.6E-02	8.9E-02
22	4.5E-03	8.8E-03	1.3E-02	1.7E-02	2.0E-02	2.4E-02	3.0E-02	3.6E-02	4.1E-02	4.6E-02	5.0E-02	5.7E-02	6.2E-02	6.3E-02	6.9E-02	7.6E-02	8.0E-02	8.2E-02	8.5E-02
23	4.4E-03	8.5E-03	1.2E-02	1.6E-02	2.0E-02	2.3E-02	2.9E-02	3.5E-02	3.9E-02	4.4E-02	4.8E-02	5.4E-02	6.0E-02	6.1E-02	6.6E-02	7.2E-02	7.6E-02	7.8E-02	8.1E-02
24	4.2E-03	8.2E-03	1.2E-02	1.6E-02	1.9E-02	2.2E-02	2.8E-02	3.3E-02	3.8E-02	4.2E-02	4.6E-02	5.2E-02	5.7E-02	5.8E-02	6.3E-02	6.9E-02	7.2E-02	7.4E-02	7.7E-02
25	4.1E-03	7.9E-03	1.2E-02	1.5E-02	1.8E-02	2.1E-02	2.7E-02	3.2E-02	3.6E-02	4.0E-02	4.4E-02	5.0E-02	5.5E-02	5.6E-02	6.0E-02	6.6E-02	6.9E-02	7.1E-02	7.3E-02
26	3.9E-03	7.7E-03	1.1E-02	1.4E-02	1.8E-02	2.1E-02	2.6E-02	3.1E-02	3.5E-02	3.9E-02	4.2E-02	4.8E-02	5.2E-02	5.3E-02	5.8E-02	6.3E-02	6.6E-02	6.8E-02	7.0E-02
27	3.8E-03	7.4E-03	1.1E-02	1.4E-02	1.7E-02	2.0E-02	2.5E-02	3.0E-02	3.4E-02	3.7E-02	4.1E-02	4.6E-02	5.0E-02	5.1E-02	5.5E-02	6.0E-02	6.3E-02	6.4E-02	6.6E-02
28	3.7E-03	7.1E-03	1.0E-02	1.3E-02	1.6E-02	1.9E-02	2.4E-02	2.8E-02	3.2E-02	3.6E-02	3.9E-02	4.4E-02	4.8E-02	4.9E-02	5.3E-02	5.7E-02	6.0E-02	6.1E-02	6.3E-02
29	3.5E-03	6.9E-03	1.0E-02	1.3E-02	1.6E-02	1.8E-02	2.3E-02	2.7E-02	3.1E-02	3.4E-02	3.7E-02	4.2E-02	4.6E-02	4.7E-02	5.0E-02	5.5E-02	5.7E-02	5.8E-02	6.0E-02
30	3.4E-03	6.6E-03	9.7E-03	1.2E-02	1.5E-02	1.8E-02	2.2E-02	2.6E-02	3.0E-02	3.3E-02	3.6E-02	4.0E-02	4.4E-02	4.5E-02	4.8E-02	5.2E-02	5.4E-02	5.5E-02	5.7E-02
31	3.3E-03	6.4E-03	9.3E-03	1.2E-02	1.5E-02	1.7E-02	2.1E-02	2.5E-02	2.9E-02	3.2E-02	3.4E-02	3.9E-02	4.2E-02	4.3E-02	4.6E-02	4.9E-02	5.1E-02	5.3E-02	5.4E-02
32	3.2E-03	6.2E-03	9.0E-03	1.2E-02	1.4E-02	1.6E-02	2.1E-02	2.4E-02	2.7E-02	3.0E-02	3.3E-02	3.7E-02	4.0E-02	4.1E-02	4.4E-02	4.7E-02	4.9E-02	5.0E-02	5.1E-02
33	3.1E-03	6.0E-03	8.7E-03	1.1E-02	1.4E-02	1.6E-02	2.0E-02	2.3E-02	2.6E-02	2.9E-02	3.1E-02	3.5E-02	3.8E-02	3.9E-02	4.2E-02	4.5E-02	4.6E-02	4.7E-02	4.8E-02
34	3.0E-03	5.7E-03	8.3E-03	1.1E-02	1.3E-02	1.5E-02	1.9E-02	2.2E-02	2.5E-02	2.8E-02	3.0E-02	3.4E-02	3.7E-02	3.7E-02	4.0E-02	4.2E-02	4.4E-02	4.5E-02	4.6E-02
35	2.9E-03	5.5E-03	8.0E-03	1.0E-02	1.3E-02	1.5E-02	1.8E-02	2.1E-02	2.4E-02	2.7E-02	2.9E-02	3.2E-02	3.5E-02	3.5E-02	3.8E-02	4.0E-02	4.2E-02	4.2E-02	4.3E-02
36	2.8E-03	5.3E-03	7.7E-03	1.0E-02	1.2E-02	1.4E-02	1.8E-02	2.1E-02	2.3E-02	2.5E-02	2.7E-02	3.1E-02	3.3E-02	3.4E-02	3.6E-02	3.8E-02	3.9E-02	4.0E-02	4.1E-02
37	2.7E-03	5.1E-03	7.5E-03	9.6E-03	1.2E-02	1.3E-02	1.7E-02	2.0E-02	2.2E-02	2.4E-02	2.6E-02	2.9E-02	3.2E-02	3.2E-02	3.4E-02	3.6E-02	3.7E-02	3.8E-02	3.8E-02
38	2.6E-03	5.0E-03	7.2E-03	9.2E-03	1.1E-02	1.3E-02	1.6E-02	1.9E-02	2.1E-02	2.3E-02	2.5E-02	2.8E-02	3.0E-02	3.0E-02	3.2E-02	3.4E-02	3.5E-02	3.6E-02	3.6E-02
39	2.5E-03	4.8E-03	6.9E-03	8.9E-03	1.1E-02	1.2E-02	1.5E-02	1.8E-02	2.0E-02	2.2E-02	2.4E-02	2.7E-02	2.8E-02	2.9E-02	3.0E-02	3.2E-02	3.3E-02	3.4E-02	3.4E-02
40	2.4E-03	4.6E-03	6.6E-03	8.5E-03	1.0E-02	1.2E-02	1.5E-02	1.7E-02	1.9E-02	2.1E-02	2.3E-02	2.5E-02	2.7E-02	2.7E-02	2.9E-02	3.1E-02	3.1E-02	3.2E-02	3.2E-02
45	1.9E-03	3.7E-03	5.4E-03	6.9E-03	8.2E-03	9.5E-03	1.2E-02	1.3E-02	1.5E-02	1.6E-02	1.7E-02	1.9E-02	2.0E-02	2.0E-02	2.1E-02	2.2E-02	2.3E-02	2.3E-02	2.3E-02
50	1.5E-03	2.9E-03	4.1E-03	5.3E-03	6.3E-03	7.2E-03	8.7E-03	1.0E-02	1.1E-02	1.2E-02	1.3E-02	1.4E-02	1.4E-02	1.4E-02	1.5E-02	1.5E-02	1.5E-02	1.5E-02	1.6E-02

FIGURE E-1
UNIT RISKS FOR CONTINUOUS EXPOSURES AS A FUNCTION OF AGE AT ONSET AND EXPOSURE DURATION