United States
Environmental Protection
Agency

National Risk Management
Research Laboratory
Cincinnati, OH 45268

Research and Development EPA/600/SR-97/063 July 1997

EPA

Project Summary

Evaluation of the Implementation of Operations and Maintenance Programs in New Jersey Schools

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Abstract

The Asbestos Hazard Emergency Response Act (AHERA) required all schools to develop and implement an asbestos management plan (AMP). The key component of the AMP is the operations and maintenance (O&M) program. A study was conducted to evaluate the implementation of O&M programs at ten sites representing eight New Jersey schools. The evaluation included aspects required by AHERA as well as those recommended in the Environmental Protection Agency's (EPA) guidance. Each school's O&M program and compliance with their program during past O&M activities were documented. In addition, ten ongoing O&M activities were documented to determine the impact of the activities on airborne asbestos levels and to determine compliance with the O&M program during these activities. Overall, schools were not implementing all the elements of the O&M program. Schools performed more O&M program elements required by AHERA than those recommended in EPA guidance. The percentage of performance responses given by the schools indicating that the elements of the O&M programs were performed (52%) was higher than those provided by the worker or contractor performing the activity (35% and 22% respectively). Increases in area asbestos levels (by transmission electron microscopy [TEM]) were observed during five of the ten O&M activities evaluated, however, none of the total fiber levels (by phase contrast microscopy [PCM]) exceeded the Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL). This study underscores the importance of a thorough O&M program and the effective communication and implementation of all program elements.

This Project Summary was developed by the National Risk Management Research Laboratory's Sustainable Technologies Division, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering infomration at back).

Introduction

The concern for asbestos-containing materials (ACM) in buildings started in the late 1970s in the U.S. In 1978 the EPA issued a two-volume guidance document to schools for identification and evaluation of in-place asbestos. Subsequently, three additional guidance documents were issued by the EPA in 1983, 1985, and 1990.

Although removal was encouraged over alternative approaches of asbestos management in the past, in-place management and O&M programs are currently viewed by the EPA as the most appropriate overall strategy for management of asbestos in buildings. In-place management involves the use of building O&M work practices and control measures that minimize the release of airborne fibers from ACM, thereby reducing exposures and associated risks to workers and other building occupants.

Operations and maintenance programs must be prepared and implemented when-

ever friable ACM is present or assumed to be present in school buildings. An O&M program is an administrative framework that prescribes specific work practices and training to maintain friable ACM in good condition, ensure cleanup of asbestos fibers previously released, and prevent future release by minimizing and controlling friable ACM disturbance during installation, repair, maintenance, and cleaning activities. A well-developed O&M program is ineffective unless it is implemented properly. The O&M program's success is contingent upon the commitment of all personnel involved in developing, conscientiously implementing, and conducting O&M activities.

Although these O&M programs have been prepared for schools, no representative field studies have been conducted to evaluate the implementation and effectiveness of these programs in controlling the release of asbestos fibers into a building. The purpose of this study was to evaluate the implementation of O&M programs in selected schools in New Jersey.

Objectives

The objectives of this study were to (1) document and assess each school's O&M program and other related components in the AMP; (2) document and assess each school's compliance with their O&M program during previously conducted O&M activities; (3) observe and document the conduct of selected O&M activities involving ACM or in the vicinity of ACM; and (4) determine the impact of selected O&M activities on airborne asbestos levels.

Site Selection

An "O&M Activities Survey Form" was distributed to 26 candidate schools representing 14 different school districts that planned to perform O&M activities involving ACM or activities in the vicinity of ACM during the summer of 1994. This form solicited information regarding three types of O&M activities: (1) Operations (custodial/service); (2) Maintenance (heating, ventilation, and air-conditioning, plumbing, electrical/communications, fire protection, and other building systems or components); (3) and Renovation (general space modifications, ceiling tile replacement, carpet removal, and roofing repair).

Eight schools, representing ten distinct O&M activities, were selected based on the type of planned activity and the schedule for conducting the planned activity. The results obtained from the different schools studied were used to document the implementation of the O&M programs at these schools and to identify common factors that may influence airborne asbestos levels during O&M activities on or near ACM.

Evaluation of O&M Programs

A "Site Evaluation/Assessment Documentation Form" was used to standardize the evaluation of each school's O&M Program. To prevent any ambiguity regarding the questions or recording of the responses, the form was administered by an Environmental Health Services-New Jersey Department of Health (EHS-NJDOH) representative who was thoroughly instructed on the basis of each question, as well as its application to the various parts of the evaluation (i.e., Parts 1, 2, and 3 as described below). To ensure data consistency the same persons completed the Site Evaluation/Assessment Documentation Form.

Each school's O&M program evaluation included three primary parts. Part 1 involved a review of each school's O&M program and other related components in the AMP on file with the NJDOH to determine the overall comprehensiveness of the O&M program. Part 2 involved an on-site interview with the school's AHERA Designated Person to assess each school's compliance with their O&M program during previously conducted O&M activities. Part 3 involved interviewing the school's AHERA Designated Person and observing and interviewing the worker (school employee or contractor) performing an actual O&M activity.

Part 1 - Each school's AMP, which was on file with the EHS-NJDOH, was evaluated by an EPA-accredited Inspector and Management Planner prior to initiating the planned activity. The Inspector/Management Planner completed the Site Assessment/Documentation Form during the review of the school's O&M program. The evaluation included the program elements required by AHERA as well as those elements recommended by EPA in issued guidance. Therefore, the evaluation was based on three categories of program elements: those program elements required by AHERA; those program elements recommended in EPA guidance documents; and all of the program elements (i.e., those required by AHERA and those recommended in EPA-issued guidance). A "Site Evaluation/Assessment Documentation Form" was used to standardize the evaluation of the respective O&M programs. Each school's O&M Program was evaluated regarding the following elements:

- Comprehensiveness: The program should be developed by a qualified Asbestos Management Planner and implemented by a qualified Asbestos Program Manager/Designated Person following a comprehensive building inspection to identify and assess the condition of all ACM in the building. The written O&M Program should be site-specific and take into account function and building design. The program should address specific activities and procedures related to use, cleaning, maintenance, repairs, equipment service, and fiber release episodes.
- Administration/Awareness: The written AMP should be available at the school and updated to keep it current with ongoing O&M, periodic surveillance, inspection, reinspection, and response action activities. Additionally, maintenance and custodial personnel must be made aware and have reviewed the AMP and O&M Program prior to conducting activities.
- Notification: AHERA requires that workers (school employees and contract workers), tenants, and building occupants be notified where ACM is located, and how and why to avoid disturbing the ACM. All persons affected should be properly informed.
- Surveillance: AHERA requires regular 6-month ACM surveillance and 3-year reinspections to note, assess, and document any changes in the condition of the ACM.
- Controls: The program should include a work control/permit system to control activities that might disturb ACM.
- Work Practices: The program should describe O&M work practices to avoid or minimize fiber release during activities affecting ACM.
- Recordkeeping: AHERA requires specific documentation of O&M activities.
- Worker Protection: AHERA requires medical and respiratory protection programs, as applicable.
- Training: AHERA requires proper training of custodial and maintenance staff who may deal with activities involving ACM.

Part 2 - Information regarding previously conducted O&M activities at the school was obtained by interviewing each school's designated person using the "Site Evaluation/Assessment Documentation Form." This information included the type and location of the O&M activity, the date of the activity, whether key elements of the O&M program were followed, etc. This information was used to assess the school's perception of compliance with their O&M program during previously conducted O&M activities.

Part 3 - Selected O&M activities involving ACM, or in the vicinity of ACM, were observed and documented at each school by using the Site Evaluation/Assessment Documentation Form. The school's AHERA Designated Person was observed and interviewed. In addition, the school employee or contract worker performing the O&M activity was also interviewed regarding use of the elements (e.g., work practices and procedures) specified in the school's O&M program. This information was used to determine the extent of actual compliance with their O&M program during the activity.

Impact of O&M Activities on Airborne Asbestos Levels

The impact of the selected O&M activities on the exposure of custodial workers, maintenance workers, and/or building occupants was evaluated by air monitoring for asbestos structures and total fibers. Characterization of the ACM or source of asbestos structures potentially involved in the O&M activity or near the O&M activity was determined by collecting bulk samples of the material(s).

Sampling Methods

Fixed-Station Area Air Samples

The fixed-station area air samples were collected on open-face, 25-mm diameter, 0.45-µm poresize, mixed cellulose ester (MCE) filters with a 5-µm poresize MCE diffusing filter and cellulose support pad contained in a three-piece cassette. The labeled filter cassettes were positioned on tripods approximately 5 feet above the floor with the filter face at a 45° angle toward the floor. The filter assembly was attached to an electric-powered (110 VAC) 1/6-horsepower vacuum pump operating at a flowrate of approximately 9 liters per minute (L/min).

Personal Breathing Zone Samples

One personal breathing zone air sample was collected on an open-face, 25-mm diameter, 0.8-µm poresize MCE filter and cellulose support pad contained in a three-piece cassette with a 50-mm conductive extension cowl. This sample was collected in accordance with NIOSH Method 7400 for analysis by PCM for comparison to the OSHA PEL. Two additional personal breathing zone air samples were collected on open-faced, 25-mm-diameter, 0.45-µm poresize MCE filters with a 5-µm poresize MCE diffusing filter and a cellulose support pad contained in a three-piece cassette. These two samples were collected for analysis by TEM. The three labeled filter cassettes were positioned in the breathing zone of the individual performing the O&M activity. Each filter was attached to approximately 50 feet of Tygon tubing that was attached to an electric-powered (110 VAC) 1/6-horsepower vacuum pump operating at a flowrate of approximately 9 L/min. Traditional battery-powered, personal sampling pumps could not be used because of their limited airflow rates (approximately 2 L/min with the 0.45-µm poresize MCE filter with a 5-µm poresize MCE diffusing filter and a cellulose support pad contained in a three-piece cassette).

Analytical Methods

Area Air Samples

The MCE filters were prepared and analyzed in accordance with the nonmandatory TEM method specified in the AHERA Final Rule (October 30, 1987; 52 CFR 4826). In addition to the requirements of the AHERA nonmandatory TEM method, the specific length and width of each structure were measured and recorded. A sufficient number of grid openings were analyzed to ensure a sensitivity (the concentration represented by the finding of a single structure) of no greater than 0.005 asbestos structures per cubic centimeter of air sampled, unless the degree of loading made this impractical. On heavily loaded samples, counting stopped after completion of the grid square in which the 100th asbestos structure was found.

Personal Breathing Zone Samples

The 0.8-µm poresize MCE filters were analyzed by PCM. These samples were prepared and analyzed according to the NIOSH 7400 protocol (Revision 3, June 5, 1989, NIOSH Manual of Analytical Methods). All fibers > 5 µm in length and with an aspect ratio of ≥ 3:1 were counted using the "A" counting rules. The analytical sensitivity was approximately 0.01 fiber per cubic centimeter of air sampled.

Bulk Samples

The type and percentage of asbestos in bulk samples was determined by polarized light microscopy (PLM) and X-ray diffraction (XRD) in accordance with the "Interim Method for Determination of Asbestos in Bulk Samples" (EPA-600/M4-82-020).

Statistical Methods

Airborne asbestos levels measured before and during each O&M activity were characterized for each site by the use of descriptive statistics. The descriptive statistics included the arithmetic mean, minimum and maximum concentrations, and sample size. A one-factor analysis of variance (ANOVA) was used to examine overall differences between baseline concentrations, area air concentrations measured during the O&M activity, and personal breathing zone concentrations measured during the activity. The transformation ln(x + 0.002), where ln is the natural logarithm and x is the mean airborne asbestos concentration, was applied to each measurement before the ANOVA was performed. The transformation was used to make variances more equal and to provide data that are better approximated by a normal distribution. The constant 0.002, a value chosen to be smaller than the majority of analytical sensitivities, was used because some zero values were present (the natural logarithm of zero is undefined). The transformation was used only for the ANOVA analysis; it was not used for any other part of the data analysis (e.g., plots or descriptive statistics). The data were transferred back to the original scale for reporting purposes. The Tukey multiple comparison procedure was used to distinguish pairwise differences between mean concentrations. All statistical comparisons were conducted at the 0.05 level of significance.

Quality Assurance

During the study, sample chain-of-custody procedures were an integral part of both the sampling and analytical activities and were followed for all air and bulk samples collected. The field custody procedures documented each sample from the time of its collection until its receipt by the analytical laboratory. Internal laboratory records then documented the custody of the sample through its final disposition. Specific quality assurance procedures outlined in the AHERA rule were used to ensure the precision of the collection and analysis of air samples, including filter lot blanks, open and closed field blanks, and repeated sample analyses.

Results and Discussion

Site Descriptions

Eight schools representing seven school districts were surveyed during this study. All eight of these schools have participated in past asbestos-related studies conducted cooperatively by EPA and EHS-NJDOH. A total of ten O&M activities were evaluated at these eight schools; two activities were evaluated at two of the schools (Sites F and G) and one activity was evaluated at each of the other six schools. A summary matrix of each study site and

the O&M activity evaluated is presented in Table 1.

Assessment of O&M Programs

The evaluation of the data for each school's O&M program was grouped into three categories: *AHERA Elements*, including those program elements required by AHERA; *Guidance Elements*, including those program elements recommended in EPA-issued guidance; and *All Elements*, including all of the program elements (i.e., the first two categories combined). Each school's O&M program evaluation was also divided into three primary parts: *Part 1* (AMP), which included the information contained in the school's AHERA AMP filed with the EHS-NJDOH; *Part 2* (previous O&M activities), which included the previously conducted O&M activities information obtained by interviewing each school's AHERA Designated Person; and *Part 3* (observed O&M activities), which included the information obtained by direct observation of O&M activities.

Comparison By Category

Table 2 summarizes the individual performance responses for each site by part and category. It also presents the overall average percentage of performance response for all sites by part and category. The responses to questions on the Site Assessment/Documentation Form are termed "performance responses" in this report. A "yes" indicates an affirmative response to the respective question, as well as indicates that the particular activity or function had been accomplished.

AHERA Elements - Overall, the performance responses were highest for elements required by AHERA. The AMP performance responses ranged from 69.6% to 95.7% with an average of 88.3%. At seven of ten sites, the AMP's indicated greater than 90% performance response. Only one site's AMP had less than 70% performance response. It should be noted that for the evaluation of the information required by AHERA in the AMP, it is possible to have less than 100% performance for the purpose of this study. Some O&M program elements could not be verified because they would not be performed until a future date, i.e., a date beyond the time when the AMP was reviewed by the EHS-NJDOH inspector. In previous O&M activities, performance responses in eight of ten sites were less than those noted in the AMP. In the observed O&M activities, performance responses in all sites were less than those documented in the AMP and averaged 58.9%.

Guidance Elements - Overall, in all three parts, the performance responses noted in this category were the lowest. The AMP performance responses ranged from 7.1% to 71.4% with an average of 41.4%. At eight of ten sites, the AMP indicated less than 70% performance response. The lower responses could be attributed to some of the guidance information (particularly the "Green Book") not being available when the AMP's were prepared in 1987 to 1989. The performance responses averaged only slightly higher in previous O&M activities (54.1%) and during the observed O&M activities (44.0%).

Although all of the guidance was available for approximately five years prior to this evaluation, the most recent EPA guidance (the "Green Book") is not geared specifically toward schools, but for buildings in general. Therefore, the schools may not be aware of the guidance or may choose not to implement the guidance recommendations since it's not a regulatory requirement. A comparison of the data contained in the AMP, with the performance responses from previous O&M activities and a comparison with the observed O&M activities and a comparison suggest a trend in decreasing percentage of performance responses. The AMP's documented an average performance response of 70.6%, whereas the school stated that it performed 57.6% of the O&M elements during previous O&M activities, and performed 49.2% of the elements during the observed O&M activity. In the observed O&M activities, performance responses in eight of ten sites were less than those noted in the AMP.

Comparisons by Part

Table 2 summarizes the individual performance responses for each site by part and category. It also presents the average percentage of performance response for all sites by part and category.

Part 1 - At all sites, the individual percentage of AHERA element performance responses was higher than those recommended in EPA Guidance elements. The number of sites with performance responses less than 70% was only one of ten for AHERA elements and eight of ten for Guidance elements. The average performance response for AHERA elements (88.3%) was 53.1% higher than the average performance response for Guidance elements (41.4%).

Part 2 - The average performance response for Guidance elements (54.1%) was 9.8% lower than the average performance response for AHERA elements (60.0%). All three categories had six of ten sites with performance responses less than 70%.

Part 3 - The average performance response for Guidance elements (44.0%) was 25.3% lower than the average performance response for AHERA elements (58.9%). Both the AHERA elements and Guidance elements categories had seven of ten sites with performance responses less than 70%.

Comparisons of School, Worker, and Contractor Performance Responses

Further evaluation was made to compare the performance responses of the school officials to those of the persons actually performing the observed O&M activity. Both the school Designated Person and the school maintenance worker

Table 1. Summary of O&M Activities Evaluated by SITE

Site	O&M Category	Description of O&M Activity
A	Operations[a]	Wet-stripping of resilient floor tile.
B	Maintenance[a]	HEPA-vacuuming of boiler interior.
C	Renovation	Space modification (demolition of plaster walls/ceilings; pipes).
D	Maintenance[a]	HEPA-vacuuming of HVAC unit in classrooms.
E	Renovation	Removal of carpet over resilient floor tile.
F_1	Maintenance[a]	HEPA-vacuuming of interior air handling unit.
F_2	Maintenance	Wiring pulled above suspended ceiling for smoke detectors.
G_1	Renovation[a]	Removal/replacement of suspended ceiling panels.
G_2	Maintenance	Romex cable pulled above suspended ceiling.
H	Maintenance	Holes drilled in acoustical plaster to install smoke detectors.

[a]Denotes that the work was performed by an employee of the school.

Table 2. Percentage of Performance Responses for Program Elements

	Required by AHERA			EPA Guidance			All Elements[d]		
Study Site	Part 1[a]	Part 2[b]	Part 3[c]	Part 1	Part 2	Part 3	Part 1	Part 2	Part 3
A	95.7	58.3	66.7	50.0	47.1	46.7	78.4	53.7	54.2
B	91.3	50.0	22.2	35.7	41.2	6.7	70.3	46.3	12.5
C	78.3	95.8	77.8	50.0	100	80.0	67.6	97.6	83.3
D	91.3	54.2	77.8	71.4	23.5	20.0	83.8	41.5	33.3
E	69.6	95.8	66.7	7.1	76.5	66.7	45.9	87.8	66.7
F_1	95.7	12.5	44.4	14.3	23.5	13.3	64.9	12.5	25.0
F_2	95.7	16.7	44.4	14.3	23.5	13.3	64.9	19.5	25.0
G_1	91.3	75.0	55.6	50.0	8.2	80.0	75.7	80.5	70.8
G_2	91.3	75.0	55.6	50.0	88.2	73.3	75.7	80.5	66.7
H	82.6	66.7	77.8	71.4	29.4	40.0	78.4	51.2	54.2
Average	88.3	60.0	58.9	41.4	54.1	44.0	70.6	57.6	49.2

[a]Part 1 involved a review of each school's Asbestos Management Plan.
[b]Part 2 involved an interview with the school's AHERA Designated Person regarding previous O&M activities.
[c]Part 3 involved information from the school's AHERA Designated Person and the individual performing the observed O&M activity.
[d]Includes the O&M program elements required by AHERA and those recommended in EPA-issued guidance.

or the outside contractor performing the activity where asked specific questions regarding the observed O&M activities. Table 3 summarizes the responses for these specific questions for the "All Elements" and "AHERA Elements" categories. The performance response for "All Elements" indicated by the school Designated Person was 52.5%, whereas the performance response indicated by the school maintenance worker was 35%. The outside contractor indicated that 22.5% of the O&M elements were performed. Approximately a 33.3% decrease in the performance response from the school Designated Person to the school maintenance worker was also observed. Similarly, a 57.1% decrease in the performance response from the school Designated Person to the outside contractor was observed. This also reflects a 35.7% decrease in performance response from the school maintenance worker to the outside contractor. The performance responses for "AHERA Elements" were very similar as was the trend of decreasing performance responses from the school Designated Person to the school maintenance worker and the outside contractor.

Comparisons by Program Elements

Table 4 presents the performance responses to the individual program elements for both the AHERA-required and EPA-recommended elements by Parts 1, 2, and 3. Generally, decreases in performance responses for each element is noted from the elements documented in the AMP (Part 1), to previous O&M activities (Part 2), and to what was actually observed during the O&M activity (Part 3). Across all sites for each program element, an overall average was calculated. When the AMP is evaluated according to the "All Elements" category; surveillance, recordkeeping, and training had the highest percentage of performance responses. Other program elements scored less, with all being less than 80%. Work practices and work permit system program elements scored the lowest with 57.5% and 38.9%, respectively.

Impact of O&M Activities on Airborne Asbestos Levels

TEM Air Monitoring Results

Airborne asbestos levels were measured before and during each O&M activity at each site. A one-way ANOVA was used to compare airborne asbestos levels measured before each activity to area and personal breathing zone levels measured during the activity at each site. Table 5 summarizes the results of these comparisons for each O&M activity. Some O&M activities were performed in the vicinity of ACM without causing elevated airborne asbestos levels. Five of ten activities (Sites A, C, F_1, F_2, and H) showed significant increases in airborne asbestos levels during the associated O&M activity when compared to baseline measurements. Additionally, when O&M activities disturbed ACM in the vicinity or were conducted on ACM, airborne asbestos levels were elevated at or above 0.02 s/cm^3 in four of ten sites (A, C, F_1, and H). The 0.02 s/cm^3 criterion was derived from the AHERA clearance criterion of 70 s/mm^2 (40 CFR 763). Another study, conducted over a 4 year period, concluded that O&M activities that disturbed ACM (including thermal system insulation and plaster, and resilient floor tile) may have contributed to elevated airborne asbestos levels at several of the sites.

The airborne asbestos levels measured during wet-stripping of the resilient floor tile were three orders of magnitude higher than the levels measured during the other O&M activities. These elevated levels during wet-stripping of resilient floor tile are consistent with those levels measured during other studies involving the same floor care maintenance practice.

Additionally, a study previously conducted on the spray-buffing of resilient floor tile demonstrated that this common maintenance procedure increased airborne asbestos levels at the majority of the study sites.

Table 3. Percentage of Performance Responses for Part 3 with Individual School Designated Person, Worker, and Contractor Responses

	Percentage of Performance Responses		
Elements	School Designated Person	School Worker	Contractor
All Elements	52.5	35.0	22.5
AHERA Elements	60.0	37.5	25.0

Table 4. Average Performance Responses for all SITES by Element and Part - All Elements Category

	Parts		
Program Elements	1[a]	2[b]	3[c]
Administration	72.3	66.4	68.0
Notification	76.7	30.0	35.0
Surveillance	100	75.0	-
Work Control/Permit System	38.9	45.6	38.9
Work Practices	57.5	44.0	33.3
Recordkeeping	97.5	70.0	75.0
Personal Protective Equipment	70.0	50.0	80.0
Training	90.0	65.0	45.0
Totals	70.6	57.6	49.2

[a]Part 1 involved a review of each school's Asbestos Management Plan.
[b]Part 2 involved an interview with the school's AHERA Designated Person regarding previous O&M activities.
[c]Part 3 involved information from the school's AHERA Designated Person and the individual performing the observed O&M activity.

Table 5. Summary of ANOVA Comparisons

Site-Activity	ANOVA p-value	Tukey pairwise comparisons[a,b,c]
Site A - Perform wet-stripping of resilient floor tile	0.0001	B(0.002) DP(3.29) DA(3.91)
Site B - Vacuum interior of boilers	0.3627	DP(0.002) B(0.003) DA(0.006)
Site C - Contact space modification	0.0102	B(0.003) DA(0.020)
Site D - Vacuum air-handling unit	0.4889	B(0.002) DA(0.003) DP(0.003)
Site F_1 - Changer filter and vacuum air-handling unit	0.0254	B(0.003) DA(0.007) DP(0.042)
Site F_2 - Install smoke detector wing	0.0059	DA(0.003) B(0.003) DP(0.009)
Site G_1 - Remove/replace ceiling tile	0.5192	DA(0.004) DP(0.006) B(0.007)
Site G_2 - Install flexible electrical conduit above suspended ceiling	0.5650	B(0.004) DA(0.009) DP(0.008)
Site H - Install fire alarm system	0.0001	B(0.003) DA(0.053) DP(0.120)

[a]B = Baseline; DA = Area samples taken during the activity; DP = Personal samples taken during the activity
[b]Parenthetical entries are geometric average airborne asbestos concentrations (s/cm^3).
[c]Average concentrations connected by a line are not significantly different.

In general, personal breathing zone levels tended to be slightly higher than area levels during the activities. This difference, however, was statistically significant during only one activity. The higher concentrations of asbestos measured by the personal breathing zone samples than the concentrations measured by the fixed-station area samples at Site F_2 are most likely attributable to differences in the proximity of the sampling cassettes to the source of the asbestos release; i.e., the O&M activity.

PCM Air Monitoring Results

None of the personal breathing zone levels exceeded the OSHA PEL of 0.1 f/cm^3, 8-hour time weighted average (TWA). The 8-hour TWA concentrations were calculated by assuming zero exposure both before and beyond that which was measured during the activity.

Conclusions

The following are the principal conclusions reached during this study:

1. Overall, schools were not completely implementing all the elements of the O&M program within the AMP as outlined in AHERA or in EPA guidance documents. The O&M programs ranged in overall comprehensiveness from 45.9% to 83.8% with an average of 70.6%.
2. School Designated Persons may not be aware of all program elements in the AMP. The overall percentage of performance responses given by the school officials during the observed O&M activities was 52.5%. The school maintenance worker indicated a performance response of only 35%, while the outside contractor indicated an even lower performance of 22.5%. All elements were not implemented and/or communicated by the school's designated person. Additionally, all program elements were not performed by the workers/contractors conducting the O&M activity.
3. Schools implemented more required items in accordance with AHERA than those additional program elements outlined in EPA guidance documents. The percentage of performance responses was highest in the management elements of AHERA and EPA guidance. The elements indicating implementation items such as notification to workers/contractors, work permit system, and work practices for the O&M activities had the least percentage of performance responses.

4. O&M activities were performed in the vicinity of ACM without causing elevated airborne asbestos levels. When O&M activities disturbed or were conducted on ACM, however, airborne asbestos levels were significantly elevated and exceeded 0.02 asbestos structure/cm^3 (School Sites A, C, and H).
5. The estimated 8-hour TWA of total fiber concentrations (0.005 f/cm^3 maximum) in the breathing zone of the individual performing the O&M activities (as determined by phase contrast microscopy) did not exceed the OSHA Permissible Exposure Limit of 0.1 f/cm^3, 8-hour TWA.

The full report was submitted in partial fulfillment of Contract No. 68-D2-0058 by Environmental Quality Management, Inc., under subcontract to Pacific Environmental Services, Inc., under the sponsorship of the U.S. Environmental Protection Agency.

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The complete report, entitled "Evaluation of the Implementation of Operations and Maintenance Programs in New Jersey Schools," (Order No. PB97-181424; Cost: $25.00, subject to change) will be available only from:

National Technical Information Service
5285 Port Royal Road
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Telephone: 703-487-4650

The EPA Technical Project Officer can be contacted at:

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