

DTIC FILE COPY

AD-A212 633

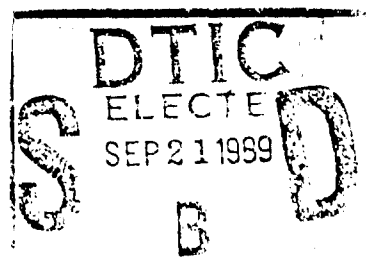
ASBESTOS ABATEMENT INDUSTRY

"A Seattle/Tacoma Study"

by

Brian M. Scott
LT, CEC, USN

**BEST
AVAILABLE COPY**



DISTRIBUTION STATEMENT A

Approved for public release
Distribution unlimited

89 9 20 158

①

ASBESTOS ABATEMENT INDUSTRY

" A SEATTLE/TACOMA STUDY "

BY

BRIAN M. SCOTT

A MAJOR REPORT SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN CIVIL ENGINEERING

1988

N00228-89-G-0574

APPROVED BY: _____

(CHAIRPERSON OF SUPERVISORY COMMITTEE)

PROGRAM AUTHORIZED

TO OFFER DEGREE _____

DATE: _____

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

[Signature]
DTIC
ELECTE
SEP 21 1989
S B D

UNIVERSITY OF WASHINGTON

ABSTRACT

ASBESTOS ABATEMENT INDUSTRY

"A SEATTLE/TACOMA STUDY"

BY BRIAN M. SCOTT

Chairperson of the Supervisory Committee:

Professor J. Hinze, Department of Civil Engineering

This report focuses on unique aspects of the Seattle/Tacoma asbestos abatement industry, that have a direct impact on the future of removal operations. Topic Areas include; standardized contract documentation, abatement procedures not adequately covered by regulations, analytical testing considerations, liability insurance, special worker concerns and other related topics.

The data used for analysis was generated through the use of telephone interviews with nine analytical testing laboratories and thirteen asbestos abatement contractors operating in the Seattle/Tacoma area. Findings of this report include; contractors are becoming more standardized in their approach to abatement; the cost of liability insurance has decreased slightly over the past three years; and contractors generally share a good working relationship with local regulatory agencies.

ACKNOWLEDGMENTS

I wish to express my deep gratitude to Professor Jimmie Hinze whose helpful suggestions and criticisms contributed greatly to the completion of this report.

I also wish to thank the Testing Laboratories and Abatement Contractors that participated in this study, for their courteous cooperation in the production of this work.

To my children--Stefanie and Jason--thank you for the love and enthusiasm you generate when I needed it most.

Lastly, and above all, I wish to thank my wife--Susan--for her cheerful encouragement in spite of the demands made by this research on my time.

Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By <i>per Form 50</i>	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
<i>A-1</i>	

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE #</u>
1. INTRODUCTION	1
2. LITERATURE REVIEW	4
3. RESEARCH METHODOLOGY	9
4. RESULTS	15
5. SUMMARY	48
6. BIBLIOGRAPHY	54
7. APPENDIX A: TELEPHONE QUESTIONNAIRE FOR ASBESTOS TESTING LABORATORIES	56
8. APPENDIX B: TELEPHONE QUESTIONNAIRE FOR ASBESTOS ABATEMENT CONTRACTORS	58

9.	APPENDIX C: COMPILED LABORATORY DATA	63
10.	APPENDIX D: COMPILED ABATEMENT CONTRACTOR DATA	70
11.	APPENDIX E: PARTICIPATING LABORATORIES	78
12.	APPENDIX F: PARTICIPATING ABATEMENT CONTRACTORS	80

INTRODUCTION

Asbestos is the generic name for a group of naturally occurring silicate mineral fibers of the serpentine and amphibole series. Modern industrial use of asbestos dates from 1880 and, since that time, has been used to create thousands of commercial products, many of which are found in the building and construction sector. Asbestos, in its many forms, has been found in most structures built prior to the mid 1970's, and in some unique cases, as late as the early 1980's. Insulation and fireproofing products are the major source of asbestos containing materials being removed today. Other common forms include asbestos cement products and sound proofing materials. Of particular concern are the sprayed-on asbestos products and pipe insulation material, which over time deteriorates and becomes a potential health hazard.

The primary factor responsible for the recent display of public "hysteria" concerning asbestos is the realization that asbestos causes cancer, and particularly that it may be endangering the lives of innocent school children by its presence in school facilities. In response to this, the Environmental Protection Agency published "The final Asbestos-Containing Materials in Schools Rule and Notice". This final rule is a comprehensive approach to dealing with the asbestos problem in

schools and is considered a major source of revenue for today's abatement industry, specifically asbestos removal contractors and testing laboratories.

The asbestos problem in the schools is not the only source of abatement work. In fact, there are numerous other public and private facility owners who are expending considerable funds to

eliminate their own asbestos problems. It is estimated that during the next 20 years, between \$50 billion and \$100 billion will be spent on asbestos abatement in the U.S. (Ponder, 1988). For this reason, the asbestos abatement industry has been deemed a growth industry and a seemingly lucrative one. To date, research in this growth industry has focused primarily on health effects and exposure assessment, types and performance of removal equipment, removal methods, and analytical testing techniques. This type of research has generated improvements to almost every facet of the industry, along with fostering a greater understanding of the associated problems and challenges. What other issues effect the industry on a day to day basis?

This report focuses on unique aspects of the Seattle/Tacoma asbestos abatement industry that have a direct impact on the future of removal operations. Findings from this report will most likely apply to other geographical areas throughout the U.S. as well. Topic areas include; standardized contract

documentation, abatement procedures not adequately covered by regulations, analytical testing considerations, liability insurance, special worker concerns and other related topics.

LITERATURE REVIEW

INTRODUCTION

A tremendous volume of material has been written about asbestos during the past 15 years. Two computer searches were conducted in an effort to focus on the specific topics being researched in this report. The engineering data bases were investigated first and resulted in over 200 articles being identified as possible sources. None of these focused exclusively on the topics under consideration. The second search utilized the business data bases as a means of identifying information on the abatement industry from a non-technical viewpoint. The result was eight publications that dealt, in varying degrees, with the liability insurance aspect of the abatement industry. A thorough review of these materials generated only moderate results. The most current OSHA and EPA regulations and guidelines were also sources of useful information.

LIABILITY INSURANCE

There are essentially two kinds of liability insurance available to the asbestos abatement contractor. A "per occurrence" policy, which covers those claims arising out of

occurrences that have taken place during the policy's term and the "claims-made" policy, which covers any claim made during the term of the policy regardless of when the underlying occurrence took place. However, most "claims made" policies specifically exclude claims resulting from occurrences that predate the policy period. Any claims filed after a policy has been cancelled are not covered. Until recently, "claims made" policies were the only form of liability coverage available to abatement contractors. Asbestos removers have struggled with this liability issue for many years, but it was not until 1985 that this issue became a major problem area. In March of 1985, there were only two major underwriters who would do business with asbestos removers (ENR, 1985). Today, the problem has not gone away, but due to advances in industry standards, improved contractor qualifications and requirements for worker training, the insurance industry is making a cautious re-examination of the risks. Total relief is not on the horizon, due to people in the insurance industry and government saying that liability risks, related to asbestos abatement, have been overlooked (Mackin, 1988).

REGULATORY BACKGROUND

In May of 1971, OSHA began regulating asbestos with the promulgation of a 12 fibers per cubic centimeter (f/cc) permissible exposure limit (PEL). Soon after, in response to

industry concern, OSHA issued an emergency temporary standard in December of 1971 of 5 f/cc per 8-hour time-weighted average (TWA), and a peak exposure level of 10 f/cc. In June of 1972, this emergency standard became a final standard. The next asbestos standard was promulgated by OSHA in 1976. This standard reduced the PEL to 2 f/cc as an 8-hour TWA. The 1976 standard remained in effect until June of 1986, when OSHA published the standard which remains in effect today. The current standard sets the PEL at .2 f/cc as an 8-hour TWA, and an action level of .1 f/cc as an 8-hour TWA.

Prior to 1982, The Environmental Protection Agency (EPA), was essentially providing technical assistance to facility owners who required guidance in dealing with asbestos containing materials (ACM). It was not until May of 1982 that the EPA began its full scale regulation of asbestos, with the promulgation of the Asbestos-in-Schools Rule. This rule required school officials to inspect their facilities for the presence of friable asbestos materials by June of 1983 and notify employees and parent organizations of their findings. In August of 1986, the EPA issued an advance notice of a proposed rule entitled "Asbestos-Containing Materials in Schools: Inspection, Notification, Management Plans and Technical Assistance." The purpose of this notification was to gather comments to assist the EPA in dealing with the "hysteria" of the general public in response to possible adverse health effects of asbestos exposure

to school children. In October of 1986, the Asbestos Hazard Emergency Response Act (AHERA) was signed into law. This law required the EPA to propose rules covering asbestos abatement in school buildings by April of 1987 and issue final rules by October 1987. On October 30, 1987, the EPA published its final Asbestos-Containing Materials in Schools Rule and Notice.

ASBESTOS MINERALOGY

The term asbestos refers to a number of hydrated silicate minerals that have been crystallized in the form of long, strong and flexible fibers that can be separated easily (Rajhans; Sullivan, 1981). There are six varieties of asbestos that can be categorized as either a serpentine group mineral or an amphibole group mineral. Chrysotile, the only serpentine group mineral, is the most common variety of asbestos. The major source of chrysotile for the U.S. market is from open pit mines located in Quebec Canada. The other five varieties of asbestos; amosite, crocidolite, tremolite, actinolite and anthophyllite, are amphibole group minerals. The amphibole group minerals are far less common than chrysotile and originate from such places as South Africa, Bolivia, Australia and New Zealand, to name a few. The structure of chrysotile differs from that of amphibole minerals. Chrysotile appears as short spiral fibers, compared to the amphiboles which appear as long and straight fibers of larger diameter.

HEALTH EFFECTS

The adverse health effects of asbestos are well documented through numerous epidemiological studies. These studies have shown that asbestos exposure by inhalation can cause lung cancer, asbestosis, mesothelioma and other cancers, typically following a twenty year latency period. It is estimated that between 2 and 5 million U.S. building and construction workers are at risk from secondary exposure to asbestos containing materials (Zenze, 1988).

RESEARCH METHODOLOGY

INTRODUCTION

The primary goal of this research was to investigate those areas of the asbestos abatement industry which have received little or no attention in the past, and to evaluate the results to determine if any significant conclusions can be drawn.

In order to achieve this goal, it was first necessary to define the boundaries of the study in terms of the data base selection, study format, data collection, and data analysis.

DATA BASE SELECTION

The selected data base, or source of data, consisted of analytical testing laboratories and asbestos abatement contractors working in and around the Seattle/Tacoma area. This data base was selected for the following reasons. The first reason being the close proximity of the Seattle/Tacoma area to the University of Washington, where the study was being generated. The second reason was the fact that the State of Washington is one of 25 states which has state-level EPA and OSHA components within the State's organizational structure. This was considered to be advantageous, due to the availability of information from these organizations and the potential for

increased regulatory influence on the abatement industry. The Department of Labor and Industries (L & I) is the state OSHA component. L & I was contacted to provide a listing of contractors who employ certified asbestos workers, as required by chapter 296-65 of the Washington Administrative Code (WAC). This list provided the names of 30 abatement contractors in the targeted area. L & I also provided a partial list of testing laboratories. The remaining testing laboratories used in the study were identified through the local telephone directory. The Department of Ecology is the EPA counterpart in the state of Washington and is divided into regional organizations. The Puget Sound Air Pollution Control Agency (PSAPCA) is the office responsible for operations in the study area.

STUDY FORMAT

Telephone questionnaires were utilized as the data gathering tool for this report. It was felt that a mailed survey was not an adequate method for data collection because it does not allow for expansion, or discussion in greater detail, of the issues raised in some of the topic areas. The telephone also provided a medium for expanding discussions into areas not covered by specific questions. This allowed the interviewer to tailor discussions based upon the unique experiences of the respondents.

DATA COLLECTION

The testing laboratory questionnaire, included in Appendix A, was developed first. The testing laboratory was assumed to be the best source of information concerning quantities and types of asbestos containing materials being tested, problems encountered in the taking of samples, and methods used in analyzing samples. In this study, the term asbestos includes the following varieties of asbestos: chrysotile, amosite, crocidolite, tremolite, actinolite, and anthophyllite.

Each laboratory was contacted by telephone, asking if someone in the organization would be willing to participate in a study. If a negative response was given, the laboratory was thanked for their time and the contact was terminated. For those willing to participate, a brief explanation of the research topic was offered, highlighting those areas pertaining to testing laboratories. The respondent was asked if there were any further questions that needed answering before proceeding with the interview. Upon satisfactory completion of this introductory phase, the interview progressed into the questionnaire phase. After completing the questionnaire and any related discussions, the laboratory representative was thanked for participating in the study and the interview was terminated. A total of 15 laboratories were contacted, 9 of which were willing to participate.

It was hoped that the data generated from the laboratory interviews would provide information on an aspect of the industry which has been virtually unregulated in the past. This is not to say that the laboratory's role is viewed as unimportant, in fact, the opposite is true. Without a positive finding of asbestos in a bulk sample, a contractor would be without abatement work. Without a favorable report in a clearance air sample, the contractor would not be released from a project. It is for this very reason that the role of the testing laboratory was considered an integral part of this study.

The next phase of data collection focused on the contractors. The listing of abatement contractors provided by L & I contained both names and phone numbers of contact persons and was extremely helpful in conducting the study. The same techniques used in contacting the testing labs were also used for the contractors.

The questionnaire, included in Appendix B, was formatted so that a variety of specific topics were addressed instead of attempting to address all asbestos areas in a comprehensive fashion. The intent of this approach was to concentrate on those areas of the asbestos abatement contractor's profession that are most likely to cause problems or be of greatest concern. The initial questions dealt with identifying the abatement market and possible differences between public and private contracts. Other topics addressed in each interview

include disposal practices, exterior removal considerations, sampling and testing requirements, laboratory selection criteria, project inspections by regulatory agencies, liability insurance, worker protection, glove bags, and unique experiences of the contractor. A total of 30 contractors were questioned, 13 of which participated in the interview process. All raw data generated through interviews with the laboratories and contractors is included in Appendix C and Appendix D, respectively. Additionally, Appendix E and Appendix F contain the names of those laboratories and contractors that participated in this research.

RESULTS ANALYSIS

Following the completion of the final telephone interview, all surveys were checked for completeness and accuracy. The individual responses for each survey were also checked for clarity and understanding. Following this data verification, it was necessary to focus on determining the best method for data presentation. The primary goal was to present the results in a clear and concise manner. Additionally, it was desired that the responses be reported in such a way that the individuality of each respondent input would be accurately reflected in the results summary. In keeping with these goals, it was decided that the survey questions would best be presented in the same order and format as they appeared during the telephone

interviews. This was done in an effort to approximate the same thought flow process that occurred during the actual telephone conversations. In presenting the results, all questions used in the survey are given. After each question, the results are presented in the form of summarized answers for all respondents. Lastly, the discussion section is included for the purpose of commenting on aspects of the results that are worthy of note. This pattern, of question, results and discussion, is repeated for each question in each survey, until all questions and their associated responses and discussions have been presented.

RESULTS

TESTING LABORATORIES

Of the fifteen testing laboratories contacted in this research, nine were willing to participate. The responses of these nine laboratories to the survey questions are presented in the following pages.

Question 1. Of the samples tested at your facility, what percent are chrysotile, amosite, crocidolite, tremolite, actinolite or anthophyllite ?

The responses are summarized below. Note that the mean values for chrysotile and amosite are inflated due to some laboratories reporting the occurrence of samples containing both varieties.

<u>type</u>	<u>median</u>	<u>mean</u>	<u>standard deviation</u>
chrysotile	90 %	84 %	12.7 %
amosite	10 %	21.9 %	21.9 %
crocidolite	1 %	2.9 %	4.6 %
tremolite	0 %	.6 %	1.6 %
actinolite	0 %	.1 %	.3 %
anthophyllite	0 %	.6 %	1.7 %

These results are consistent with what one would expect from asbestos containing materials (ACM). For example, chrysotile can be found in approximately 95 % of all commercially produced ACM (EPA, 1985). The other types of asbestos can be found in varying amounts depending upon the applications for which they were intended. The testing laboratories in the Seattle/Tacoma area are analyzing typical amounts and types of ACM.

Question 2. Have you found any pure forms of the previous types of asbestos ? If so, which ones and in what types of applications ?

There were no 100 % pure forms mentioned, however, there were some samples encountered that were nearly pure. Examples given were, chrysotile used in boiler gaskets, wire insulation, flex gaskets, woven fabrics, insulation duct tape and railroad engine boiler liners; tremolite in a crucible liner and amosite as blown-in insulation in the attic of a pre-1920 home.

The legal definition of an asbestos containing material is; any material that contains 1 % or greater by weight asbestos. The examples given above, of materials that contain high concentrations of asbestos, show that although few, if any, products are actually pure asbestos, some nearly pure forms

exist. The possibility of fiber exposure is not necessarily higher from sources of this type, however, exposure from any ACM must be avoided and extreme care should be taken during its removal. The value of an experienced person who can spot potential ACM can not be over stated as a means of early detection.

Question 3. What % of the bulk analysis tests are on pipe or boiler insulation ?

Responses ranged from 0 to 80 %, with a mean value of 29 % and a standard deviation of 26 %.

Various sources have indicated that pipe and boiler insulation have historically made up a large percentage of ACM being removed by facility owners, due in part to its friability. The numbers presented here might lead one to conclude that pipe and boiler insulation removal has either slowed or the amounts still to be removed have steadily decreased over time and are no longer as major a factor as they used to be. It is believed that a more reasonable explanation for a possible decrease in the percentage is due to the recent "hysteria" surrounding asbestos and its adverse health effects. This hysteria has resulted in many facility owners choosing to remove all, and any form, of ACM

regardless of friability. Additionally, a considerable amount of pipe insulation abatement work is possibly occurring in such facilities as paper mills. These mills are not located in the immediate Seattle/Tacoma area, and may not be "contracting out" all of this work due to possible in-house capabilities. These facility owners were not included in this study, making the percentage of pipe and boiler insulation removal appear to be less than what it actually may be.

Question 4. What % is blown or sprayed material ?

Responses ranged from 0 to 100 %, with a mean of 45 % and a standard deviation of 34.5 %.

Blown and sprayed material, as with pipe and boiler insulation, has been a major ACM being removed by facility owners. The numbers presented here give no real indication that an increase or decrease in percentage has occurred.

Question 5. Can you recall any unusual materials that you have analyzed that contained asbestos, i.e., materials that are not commonly known as ACM ?

The responses are summarized as follows;

- asbestos in ceiling tiles installed after 1980
- window putty
- cove base (baseboard)
- school chalkboard
- plaster/plaster-board
- mastic used in stained glass windows
- fireplace mortar
- spackling compound
- paint
- ash from Mount St. Helens eruption

Considering that asbestos is estimated to be contained in over 3000 common commercial materials (EPA, 1985), it is not surprising that its existence can be found almost anywhere. The examples given above are a good reminder of this.

Question 6. Have you ever tested for the presence of asbestos from household dust, laundered clothing or earth (dirt) ?

Five of the nine Laboratories had tested dust samples. Some samples had tested negative, while others had typically contained small amounts of asbestos from known sources. Two of the laboratories had given examples of residential locations where

dust had been tested and found to contain less than 1 % asbestos. It was speculated that this contamination was from an asbestos containing "popcorn" ceiling.

Three of the laboratories had each conducted a single test for asbestos in clothing and two of those samples contained only trace amounts of unknown fibers. The third sample turned out to be quite interesting. Rock wool dust, from the ceiling of an old home in Tacoma, had fallen into the wardrobe of a famous model and this laboratory was contacted to determine if the clothing could be cleaned. The laboratory, after determining what the material was, found that normal laundering only worsened the situation by allowing the fibers to become more entrapped in the fabric. The final solution was to use a very powerful high efficiency particulate air vacuum to draw out the fibers.

Six of the nine laboratories had tested earth samples. The results were either negative, or in some cases positive through contamination by a known ACM. Typical examples given were, soil samples from crawl spaces where deteriorated asbestos on insulated pipes was present and soil from project sites where facilities that contained ACM had been demolished.

The testing for the presence of asbestos, from materials that typically do not contain asbestos, as an indicator of a potential problem, has not yet been a focus of attention. It was hoped that this line of questioning would uncover some concern

about instances of fiber exposure from secondary sources. For example, possible fiber concentrations existing in laundered clothing being worn by asbestos removal workers. The results are inconclusive for this determination. A noteworthy concern that comes to light here, is the potential for asbestos exposure in the residential setting. A home owner, or perspective home buyer, may have a dust sample tested for the presence of asbestos as a means of determining the existence of a bigger problem. The dust sample may contain less than 1 % asbestos and therefore be reported as a non-ACM. This could instill in an individual a false sense of security by the impression being given that there is no asbestos present, when in fact there is. Given the ability of small asbestos fibers to remain airborne for hours, seemingly harmless household tasks, such as dusting and vacuuming, can become hazardous to an unknowing resident by inhalation exposure to asbestos. In addition to this, a dust sample that contains only trace amounts of asbestos can point to a bigger asbestos problem within the structure that may require immediate attention. The most common example of this would be the presence of a "popcorn" ceiling. Here, a home owner may mis-interpret a dust sample analysis result and conclude that there is no asbestos present, when in reality there are asbestos contaminated materials somewhere in the home that are releasing dangerous fibers into the air and posing a potential health threat to the occupants.

Question 7. What is the biggest problem people make in taking bulk and air samples ?

For bulk samples, the most common response was that people do not know how to take a representative sample. Other responses include, not keeping the sample free from contamination, not taking care to prevent accidental fiber release, and not knowing what region of an ACM is most likely to contain the highest concentrations of asbestos.

For air samples, the most common answer was that people do not sample at least 3000 liters of air per sample for a clearance air sample. Other answers include taking an undisturbed clearance sample and not having enough experience.

Proper sampling techniques are essential for accurate analysis in the laboratory. Techniques of sampling are not difficult, but they require training and experience. The errors presented above apparently stem from the inexperience of those taking samples, rather than a lack of training. This is believed true because these finer points of sample taking are learned on the job, not in the classroom. The problem with people taking an undisturbed clearance sample is a good example of this point. The purpose of a clearance air sample is to provide reasonable evidence that a contractor has sufficiently removed all ACM and its residue from an abatement project location. Since asbestos

fibers will settle over time, an experienced sampler knows that the area to be sampled must be adequately disturbed by the use of fans, or other similar means, in order to provide an aggressive or worst case air sample. This process insures that erroneous results are avoided. The quality of training available today has vastly improved over that which was available before the Asbestos-in-Schools Rule. Now that there is a sizable market that has a need for trained samplers, the problems given above should begin to diminish.

Question 8. Is wetting of the bulk samples a problem for analysis and if so, why ?

All of the nine laboratories surveyed said that wetting is not a problem, as long as careful drying techniques are employed prior to analysis. It was pointed out that problems can arise when laboratory personnel try to take short-cuts when drying samples. For example, if a sample is dried at too high a temperature, the optical characteristics of the fibers can change. A second example is when acid leaching is used on a sample, resulting in the lowering of the refractive indices of asbestos types. The task of drying samples increases the turn around time for results to the owner/contractor.

Sample wetting is a safe working practice to avoid unnecessary fiber release. In an effort to reduce turn-around time, a contractor should not take dry samples, especially since wetting does not interfere with the analysis protocol. However, the problems associated with improper drying techniques can be serious when it is considered that the end result can be a mis-identification of asbestos samples. Therefore, quality assurance must be the watchdog of this area. With the upcoming lab accreditation programs being developed by the Bureau of Standards, recurring problems in laboratories will either go away, or some laboratories will lose their accreditation.

Question 9. What measures of personal protection do you recommend for a person taking samples ?

Responses to this question varied widely, depending upon where the sampling was to take place. In residential settings, two respondents recommended that no protective measures be taken, while one respondent recommended the use of wetting and extreme care. Three respondents recommended full personal protective clothing and a respirator be worn in any situation to avoid the possibility of exposure. The other three respondents recommended

protective measures be taken that are commensurate with the exposure potential. If any uncertainty existed, the local EPA or OSHA representative should be contacted for advise.

The results of this question cause one to believe that there is no consensus concerning the care that should be taken during sampling. Individual susceptibility to the adverse effects of asbestos varies widely from person to person and evidence points to the possibility that even small exposures can measurably increase one's risk of contracting cancer. As a minimum, a sampler should employ wetting of areas of interest and more probably dawn a respirator in addition to wetting. The bottom line, is why take the chance of possible exposure, when it is not necessary? The answer is simple, adequate protection should always be used when taking any sample.

Question 10. What methods of testing are used to analyze bulk and air samples?

For bulk samples, all laboratories primarily use polarized light microscopy (PLM), either with or without dispersion staining depending upon personal preference. X-ray diffraction

(XRD), transmission electron microscopy (TEM) and scanning electron microscopy (SEM) were also mentioned as techniques used, but less frequently than PLM.

For air samples, all laboratories contacted use phase contrast microscopy (PCM), as prescribed by the National Institute of Occupational Safety and Health (NIOSH) 7400 method.

The methods given above are very typical of those performed in a testing laboratory. The PLM method for bulk sample analysis can be a very reliable technique in the hands of an experienced microscopist. XRD is usually employed as a check for samples that give inconclusive results from the PLM method. PCM is still the primary means of testing air samples, however, TEM is becoming more and more popular due to its ability to detect asbestos specific fibers. The PCM method is not asbestos specific and therefore tends to detect all fibers regardless of origin. The use of TEM for clearance air sampling is required by the Final Asbestos in Schools Rule and is being used more extensively by other facility owners as well.

Additional comments: After completing the question portion of the interviews, the laboratories were asked if there were any other areas that they thought were significant or particularly interesting. One laboratory made two very interesting observations about asbestos use today. The first comment dealt

with the laboratory's first-hand knowledge of recent contract documents that specify the use of asbestos , less than 1 % by weight, in steel beam insulation. As long as the legal definition of an asbestos containing material remains 1 % asbestos or greater by weight, there will be owners and designers who specify its use. The second observation made by this laboratory was in an area where packing materials were being stored in a warehouse. These individual packing materials contained less than 1 % by weight asbestos and were therefore classified as non-ACM. The problem found by this laboratory surfaced when air samples were taken inside the storage area. An analysis showed asbestos concentrations as high as 17 f/cc, well above the OSHA .2 f/cc permissible exposure limit. This shows a problem with the assumption that 1 % asbestos content in individual materials is not a risk to workers. The final product taken by itself may not be outwardly hazardous, but there can be times when one must look beyond the obvious and take necessary precautions when dealing with any material that contains asbestos (legal definition aside).

ASBESTOS ABATEMENT CONTRACTORS

Of the 30 abatement contractors contacted in this research, 13 were willing or able to participate and another 8 were either out of the abatement business or out of the contracting business all together. Thus the effective response was actually 59 %, or 13 respondents out of a possible 22. The responses of these thirteen contractors are presented in the following pages.

Question 1. What percent of your work is federal, state, local and private ?

The responses are summarized below;

<u>type</u>	<u>median</u>	<u>mean</u>	<u>standard deviation</u>
federal	15 %	11.3 %	8.9 %
state	15 %	16.7 %	17.3 %
local government.	30 %	26.8 %	21.6 %
private	40 %	45.2 %	26.2 %

The results of this question indicate that despite the lack of urgency for the private sector when compared to the public sector, the private sector is providing a substantial work load

for this sample group. The public sector, made up of federal, state and local entities, when combined into one group, make up a majority of the abatement projects being completed in the Seattle/Tacoma area. Under the heading of "local government" is found all the school projects, which explains why local government work makes up the highest percentage of public projects. It would be expected that as more schools execute their asbestos management plans, as required by the Final Asbestos-in-Schools Rule, the local government percentage will increase even more. The same will most likely be true for the state and federal agencies, considering many experts speculate that these facilities will follow the same course as the schools. It appears that the availability of abatement work will not be a problem in the future, making this market a lucrative one for many contractors.

Question 2. For private work, do you use a standard contract document ?

All but two contractors said that they did use a standard contract document. Of the two that did not, one usually performed as a sub-contractor and the other was a smaller contractor who utilized a letter of proposal for each project.

The preferred document of the contractors who use their own standard form, was either a modified, internally generated form, or a modified AIA document.

The need for standardized contract documents can not be over stated. It serves as the legal framework that binds two parties together in what is probably the oldest type of written business agreement. A contract is not only a way of clearly defining responsibilities among two parties, it is also a showing of good faith which states that each side will perform as promised. A standardized way of doing business is also an indicator to insurance companies, bonding companies and lenders that a stable and consistent operation exists.

Question 3. What are the key differences, in how the procedures for abatement work are prescribed, between public and private contracts ?

All respondents commented that the actual procedures for abatement work vary little between public and private jobs. The major difference lies in the quantity of paperwork that is involved in public projects. One contractor pointed out, that the requirement to use prevailing wage rates coupled with the need for numerous submittals, is the reason that bids are between

25 and 40 percent higher on public jobs than private ones. Another contractor observed that most of the private work in this area is for the removal of siding, while public projects typically involve materials which require the use of glove bags and/or full enclosures. In the few cases where procedures were more stringent than current regulations, the projects were always public.

The finding that procedures for abatement work are relatively standard for the Seattle/Tacoma area, is encouraging for local asbestos removers. Standardization of practice improves both project estimating procedures and project execution techniques utilized by contractors. The paperwork requirements and wage guidelines that exist with public projects is not likely to go away. Contractors will have to either operate under the current structure or seek work exclusively from the private sector.

Question 4. How are you generally required to dispose of asbestos ? Are the requirements clearly stated in the contract documents ?

All contractors provided the same response to this question. Asbestos material is to be double bagged, marked as asbestos, transported in a covered vehicle and taken to a

licensed landfill. A majority of the contractors stated that this procedure is always clearly outlined in public documents. However, it is rarely used in private work, since the procedure must be followed anyway, as required by local regulations.

The contractors are well versed concerning asbestos disposal requirements. The existence of disposal requirements in the contract documents has little or no bearing on how the contractor will properly dispose of the asbestos.

Question 5. What is done with shower water ? Is it filtered, or is it disposed of unfiltered ? If filtered, to what fiber size ? Is it required ?

On most contracts, the shower water is required to be filtered prior to disposal. This requirement is typically specified in the contract documents. Fiber size filtration requirements were given as 5 microns for the majority of contracts and the most stringent requirement, of .3 microns, being levied by contracts awarded by the University of Washington. Although the filtration method may not always be specified in the contract, 8 respondents used a sediment tank with three filters of decreasing size, most commonly ranging from 25 microns to 5 microns. When there were no requirements for

filtering, most contractors commented that they would either dispose of the asbestos containing water in sealed drums, or use a double bagging system. Only two of the contractors surveyed said that they would dispose of the water as is, usually down the drain.

There currently exists no federal, state or local regulation prohibiting the disposal of water containing asbestos into the sewage or storm drainage systems. The requirements mentioned above are the result of individual owners taking the initiative to control the release of asbestos fibers from shower water into the environment. This type of environmental concern shows that most owners want asbestos removed in a proper and safe manner.

Question 6. Have you ever contracted for any exterior removal work ? If so, how was the containment problem addressed ? Was wetting used ?

All but one of the contractors surveyed had, on at least one occasion, contracted for the removal of exterior asbestos. Most exterior removal projects were for cement asbestos board (siding) and required nothing more than wetting to be used as the control measure. However, six of the contractors had, on occasion, removed friable asbestos from the exterior of a facility. In all

but one instance, a negative air enclosure was constructed to control fiber release and in the instance where this was not done, a glove bag arrangement was used to remove pipe lagging on the exterior of a building. The only difference between an interior enclosure and the exterior version is that exterior applications require a sturdier structure for protection against the elements.

Local regulatory agencies require the same measures be taken for control of fiber release regardless of the location of the removal operation. When siding is to be removed, PSAPCA requires that the area to be removed be wetted, the nail heads holding the siding in place be clipped off and the individual pieces be carefully slid off and placed in a 6 mil plastic bag. Exterior removal projects do not appear to cause the contractor any major problems.

Question 7. What are typical requirements for clearance air samples in terms of fibers per cubic centimeter, required testing method and required third party samplers ?

The most common requirement for clearance air samples is .01 fibers per cubic centimeter. Some of the contractors surveyed said that they use a pre-abatement concentration as the base-line

level to be used for final clearance. PCM is the most commonly required test method being specified in abatement contracts, with TEM being second and becoming more common. Only one contractor mentioned the use of SEM being required by the Department of Defense on an armory job. Most projects are requiring the use of a third party to take all samples, however, when this requirement is not specified, most contractors are conducting the sampling themselves.

In the EPA 40 CFR part 763, Appendix A, the clearance requirement stipulates that 5 air samples from within a containment area be compared against 5 air samples from just outside the containment area to verify project completion. If the average concentration of the 5 inside samples is below .01 f/cc, then the response action is considered complete. If the average concentration of the inside samples is not significantly higher than that of the outside samples, as determined statistically, the response action is considered complete. If the average concentration of the inside samples is significantly higher than the outside samples, re-cleaning is required and the area must be re-evaluated. The EPA reasons that an asbestos removal contractor can not be expected to clean an abatement area to an airborne asbestos concentration that is lower than the concentration of the air entering the abatement area from outdoors or from other parts of the building. This three step process will most likely become the standard for all asbestos

removal projects. PCM is an inexpensive and simple method of determining fiber concentrations from air samples, but it does not distinguish between asbestos fibers and non-asbestos fibers. For this reason, the use of the asbestos specific TEM method will most likely become the standard test protocol, industry wide. The Final Asbestos-in-Schools Rule ultimately requires the use of TEM for all air samples, following a three year phase-in period. The third party approach to sample taking delineates liability and will likely be the most common means of sampling from a liability point of view. Contractors should avoid taking their own samples, in order to improve qualifications for liability insurance by reducing liability risks.

Question 8. Who analyzes your samples ?

Answers from the thirteen contractors sampled, generated the names of nine different testing laboratories being used. Most contractors did not use just one laboratory and none of the laboratories were named by more than three of the contractors.

This question was used to determine if any laboratories were being used by a majority of the respondents. A response of this type would indicate that certain laboratories were doing business

better than others. The actual responses clearly indicate that this premise is false and that contractors are selecting laboratories for more equivocal reasons.

Question 9. How did you come to select this lab ?

The overwhelming considerations for laboratory selection by a contractor were cost and performance. Performance, as viewed by the contractors, was defined as a laboratory's ability to generate fast turn-around times and provide service on short notice. Other considerations cited include; experience, close proximity to the project and references by others.

As mentioned in question 8 and supported here, is the finding that no one laboratory is doing anything better than any other laboratory when judged by the parameters given by those contractors using their services. It is interesting to note that none of the contractors considered a laboratory's ability in performing the required analysis techniques.

Question 10. Are you familiar with either the EPA Round Robin or the National Voluntary Lab Accreditation Program (NVLAP)?

Six of the contractors had heard of both, while five had not heard of either one. Two of the contractors had heard of just the EPA Round Robin.

In 1980, EPA initiated a quality assurance program for laboratories capable of performing PLM on bulk samples. The primary goals of this program, were to assist laboratories in developing their analytical capabilities and to provide a public listing of competent testing laboratories. The program entailed the sending of EPA pre-evaluated samples to participating laboratories for analysis. The laboratory would then send their analysis results to the EPA for scoring. The EPA would then compile all the results and publish a report with their findings. This program was voluntary and the results did not lead to accreditation or endorsement by the EPA. The program continued until mid-1988, just prior to the NVLAP program making its debut. NVLAP was established by the National Bureau of Standards (NBS) in response to the requirements set forth in AHERA. Participation, by a laboratory, in the accreditation program requires that an on-site visit be conducted by NVLAP personnel. The visit will include a complete facility inspection and proficiency testing on sampling methods. Based upon a successful site visit and technical evaluation, accreditation is

granted. There are fees associated with accreditation and participation is mandatory for laboratories involved in testing at schools.

It might be assumed that contractors would use the EPA round robin as a selection criteria for laboratories. As shown in the previous question, this is not the case. The NVLAP program, due to begin this fall, will force all contractors involved in school abatement programs to know the qualifications of the laboratory they select to do their sampling.

Question 11. On your projects, have you ever been inspected by L & I or PSAPCA ? If so, how often ?

For the contractors surveyed in this study, L & I inspects 16.5 % of the projects, with a standard deviation of 14.7 % and PSAPCA inspects 31.6 % of the projects, with a standard deviation of 31.9 %. Two of the contractors interviewed said that as a normal business practice, both agencies are invited to inspect each project site. The inspection frequency for these contractors averaged 33 % for L & I and 80 % for PSAPCA. The remaining 11 contractors, who did not request inspections, averaged 14 % for L & I and 23 % for PSAPCA.

The results indicate that L & I inspectors do not get on the projects very often, and when they do visit, it tends to be with a contractor who has requested their presence, or who they have visited before. The same is true for PSAPCA inspectors, except to a lesser degree. It is interesting to note, that approximately 70 to 80 % of abatement projects, represented by responding contractors, are completed without inspections. It could be argued that a manpower shortage exists within the state regulatory organizations.

Question 12. What is your impression of the inspections, in terms of reasonableness and the conduct of the inspectors ?

Of the 13 contractors interviewed, 11 stated that the inspections were reasonable and the conduct of the inspectors was good. Only two of the contractors talked of problems stemming from inspectors being perceived as too critical of minor infractions. Some contractors noted a marked improvement in the inspections by PSAPCA following a recent change in the top leadership.

The results here generally speak highly of the actual on-site project inspections performed by regulatory personnel. This type of "report card" shows that an atmosphere of

cooperation exists between inspectors and contractor personnel. This atmosphere will go far in easing any tensions that may arise out of new regulatory advances that may come about in the future.

Question 13. When you are faced with a really tough problem, whose assistance do you seek to solve the problem? Do you ever ask the regulatory agencies? If so, which ones?

Of the 13 contractors contacted, 11 stated that PSAPCA was consulted from time to time about how to proceed on various situations. L & I was contacted less frequently and one contractor mentioned that the Oregon Department of Environmental Quality was contacted on one occasion.

As with the previous question, the results presented here generally indicate a good relationship exists between regulatory agencies and abatement contractors. The consultation services offered by the regulatory bodies are widely used and necessary for good communication between regulators and those being regulated.

Question 14. Who is your liability insurance carrier ?

NOTE: Questions 14 and 15 were presented to the contractors as possibly being proprietary, and an answer was not expected unless given freely.

Seven of the contractors gave this information. The names of the underwriters are listed below.

NATIONAL UNION BUYERS

INDIANA LUMBERMANS

NORTHERN STATES

UNITED CAPITAL (3 responses)

AMERICAN EMPIRE

The results show an indication that there exists a wide variety of liability insurance underwriters doing business with the local abatement industry. On the surface, this appears good from a competitive market viewpoint, but all the facts are not known about the differences that might or might not exist in the terms of each policy. The fact that every contractor surveyed had liability insurance, indicates that the insurance void of 1985 has been relaxed somewhat. A further relaxing trend can only be speculated upon, and will certainly depend on many factors. The type of insurance policy is also important, however, this study did not seek this information.

Question 15. About what percent of your project costs are paid towards liability insurance ?

Considering all responses, taken together, the mean value was 14 %, with a standard deviation of 2.5 %. There were two small volume contractors that reported paying 18 and 19 %, respectively.

This result shows a slight decrease in the percentage paid for liability insurance today as compared to just three years ago. At that time, 18 % was not uncommon, and in fact as the results show, this is not entirely unusual today. This trend would be expected given the results of the previous question and assuming the existence of a freely fluctuating competitive market. However, it is important to remember that 14 % is still a major cost item, especially when considered in light of the fact that most contractors are fortunate to see even a three percent profit margin. This downward trend is generally good news for the contractors and a continuing of this trend will serve to lighten the already heavy financial burden placed on them.

Question 16. In the area of worker protection, how many suits will an employee use during a normal day ?

Responses varied from 1 suit, for small jobs lasting less than 4 hours, to 6 suits per day for jobs where employee fatigue is an issue. The most frequently cited response was 3 suits per day, equating to approximately 3 hours of use per suit, before disposal.

The results presented here appear to be consistent, with that which one would expect given normal circumstances.

Question 17. What is the typical length of time that an employee will remain in the containment area, before exiting for a break ?

Six of the respondents answered 3 hours on the average, and six answered 4 hours on the average. One contractor only performed small projects where containment work was rarely encountered. Therefore, the question did not apply for this contractor.

The results given here compliment those responses given to the previous question. Most workers will remain in containment between 3 and 4 hours before exiting for a break. In situations

of extreme heat or humidity, one would expect the length of time in containment to decrease to an amount commensurate with the stress being experienced by the worker.

Question 18. Do you use glove bags ? When are they not recommended ?

Of the 13 contractors questioned, 11 stated that they use glove bags on a regular basis. Two of the contractors stated that they do not perform removal with glove bags. There were four instances given when glove bags are not used by contractors. The first is when pipes are hot (157 degrees or more). The second was when piping systems are too complicated for effective glove bag applications. The third situation is when piping runs exceed 30 linear feet, or in the case of the University of Washington, when pipe runs exceed 10 linear feet. The last situation was when any project can be done more efficiently with an enclosure.

Glove bags are an excellent tool for use in removing small amounts of ACM from piping, or in applications where a business must remain operational throughout the duration of removal. The use of glove bags can be as stressful on an employee, per unit time, as working in an enclosure. The reason this is true, stems

from the fact that a glove bag worker must remain relatively immobile for a period of time and must concentrate on the work through a plastic enclosure. Glove bags appear to be useful primarily on small piping jobs, or when other methods of containment are not cost effective.

Question 19. Have you ever encountered any particularly interesting abatement projects, especially any unique problems and how were they overcome ?

One contractor told of a project where the humidity was so high, that a very large air change system had to be located before the project could proceed. Another contractor mentioned that a project was being advertised for the removal of asbestos siding from the top of the University of Washington's Husky football stadium, which was going to require the design of a safety harness system for use by removal workers. A third example shared, involved a situation where air, contaminated with asbestos, was being drawn into un-contaminated areas of a building by the flue effect. Once the problem was uncovered, the contaminated area was sealed off and the ACM removed. The last comment presented here, was not necessarily a unique problem, but rather a common solution to an access problem applied to an abatement project. The specific project was one in which a large

indoor structure had a friable asbestos ceiling that required removal. The contractor installed access scaffolding throughout the structure, allowing work to progress rapidly and safely.

The results of this question were interesting from the standpoint that the removal procedures employed by abatement contractors can be adapted to virtually any situation. The only real obstacles are the result of safety concerns, or the exterior environment exerting its influence on a situation. Contractors appear to be able to overcome any problem presented to them.

SUMMARY

INTRODUCTION

The goal of this research was to investigate the existence of current problem areas facing the asbestos abatement industry in the Seattle/Tacoma area. The preceding discussions of results have identified aspects of the industry which are both interesting and informative. The key findings of this research are presented in the following text.

CONCLUSIONS

Chrysotile is by far the most common form of asbestos being evaluated by testing laboratories in materials being removed by abatement contractors in the Seattle/Tacoma area. Asbestos containing materials are being found in a tremendous variety of applications throughout the building and construction industry. The most common forms of asbestos containing materials are pipe or boiler insulation and sprayed or blown insulation. Asbestos is still being used today in applications where its content does not exceed the legal definition of ACM of 1 % by weight asbestos.

Analytical testing laboratories are experiencing problems with samples brought in for analysis. A small number of sample takers are showing a lack of experience and general knowledge of the proper procedures to follow when taking representative bulk or air samples. Additionally, indications are that there are persons taking samples that are not adequately protecting themselves from accidental asbestos exposure during the sampling process. This is especially true in the residential sector.

Transmission electron microscopy, as an analysis protocol for air samples, is growing in its use by analytical testing laboratories for the determination of the presence and quantity of asbestos. The use of TEM will increase as more schools execute their asbestos management plans.

All analytical testing laboratories that are involved in sample testing for schools are now being required to gain accreditation through the National Voluntary Lab Accreditation Program being administered by the National Bureau of Standards. This program entails a comprehensive on-site inspection of facilities, laboratory proficiency testing, and an initial administrative fee of about \$3500.00. A published listing of accredited laboratories will be made available to the public. Currently, testing laboratories in the Seattle/Tacoma area are showing relatively equal shares of business from abatement

contractors. This share may shift in the near future, as only some laboratories may pass the accreditation process, making the selection process more restrictive on the contractor.

In the past, contractors have selected a testing laboratory based upon their low cost and dependable, fast service. As more and more owners desire, or are required to use the services of an accredited laboratory, selection criteria used by contractors and owners will in the short term focus on the accreditation issue.

When comparing public and private projects, procedures for abatement do not differ significantly. However, the additional administrative requirements of a public job can increase the project cost by as much as 40 %.

Work practices of the abatement contractors are becoming more standardized. Contractors are more often using a standard contract for abatement projects. Contractors are also standardizing methods and procedures for the removal and disposal of asbestos, regardless of the owner's requirements. Shower water disposal is a good example of this. There is no regulation governing the procedure to follow. Since some owners require filtering and others do not, the majority of the contractors in this study have chosen to filter all shower water regardless of the project requirements. This move to standardize will assist

not only facility owners, but the contractors as well, based upon standardization being a favorable consideration as seen through the eyes of insurance underwriters.

The number of insurance underwriters doing business with abatement contractors has increased over the past three years, giving at least some relief from the near void that existed in 1985. The percent of project costs paid for liability coverage has, on the average, decreased slightly from around 18 % just one year ago, to approximately 14 % in this study. Of course, this sample may not be representative, but a clear trend is being observed in the reduction of insurance premiums.

With regard to glove bags, contractors generally prefer other containment methods, unless the use of glove bags are required by the contract. The glove bag can be stressful on the workers and is limited to specific applications.

On the topic of project inspections, the Department of Labor and Industries and the Puget Sound Air Pollution Control Agency inspectors were found to visit approximately one third of abatement projects represented in the study area. Contractors who requested the presence of inspectors, understandably had more inspections.

Contractors generally share a good working relationship with the regulatory agencies. The contractors in this study regularly sought advice and direction from regulatory personnel and are generally pleased with the conduct and reasonableness of inspection personnel.

Considering all the data gathered in this study, some general perceptions are noted about the contractor population in the Seattle/Tacoma area. The first is that contractors appear to be making an honest effort to complete abatement work safely and in accordance with federal, state and local regulations. They are highly innovative and capable of overcoming any obstacles encountered. Contractors in this area are generally knowledgeable of all aspects of the abatement business and take great pride in doing a good job. The U.S. asbestos abatement industry is at the threshold of a major growth period, spurred on by required abatement actions. The Seattle/Tacoma abatement industry will have little trouble in meeting the challenge.

RECOMMENDATIONS

One of the underlying goals of this research was to identify any areas of concern not covered, or inadequately covered by the regulations. There are three areas that are felt to require further investigation and are summarized below.

The first area is liability insurance. It is recommended that a study be conducted on this little known aspect of a contractors business, with the goal of comparing various companies on the basis of policy terms offered. Many of the contractors interviewed in this study showed a kind of frustration with the insurance issue and a nation-wide study of this kind would be very beneficial to the industry.

The next area in need of further study is contractor bonding. Although this is not a topic specific for the asbestos abatement industry, more than one contractor involved in this study, mentioned that acquiring the necessary bonding is a constant and expensive battle. The approach would be similar to that of a study about insurance companies. However, this would be a study of the entire construction industry with an analysis being made on the basis of the type of work being bonded.

The third and last recommendation for further research would involve repeating this study in a different population. For instance, the same research methodology could be followed in a state that does not have a state-level OSHA and EPA counterpart. Another variation would be to repeat this study at a later date, using the same sample area, in an effort to uncover industry trends that may have developed.

BIBLIOGRAPHY

1. Civil Engineering, Asbestos Insurance Crisis Eases, volume 56, page 18, Aug 1986
2. Department of Labor, Occupational Exposure To Asbestos, Tremolite, Anthophyllite, and Actinolite; Final Rules, 29 CFR Parts 1910 and 1926, Jun 1986
3. Engineering News Record, Insurers Leave Vacuum For Asbestos Removers, volume 214, page 10, Mar 1985
4. Environmental Protection Agency, Asbestos-Containing Materials in Schools; Final Rule and Notice, 40 CFR Part 763, Oct 1987
5. Environmental Protection Agency, Guidance For Controlling Asbestos-Containing Materials in Buildings, EPA No. EPA/560/5-85-024, Jun 1985
6. Environmental Protection Agency, Asbestos Waste Management Guidance, EPA No. EPA/530-SW-85-007, May 1985
7. Environmental Protection Agency, Interim Method for the Determination of Asbestos in Bulk Insulation Samples, EPA No. EPA-600/M4-82-020/ Dec 1982
8. Fairweather, Virginia, The Asbestos Impasse, Civil Engineering, volume 56, page 43-45, Feb 1986
9. Friedman, Amy, Red tape Fortunes, Financial World, volume 156, Pages 122,124, Nov 1987
10. Hinze, Jimmie; Hinze, Maxine Mueller, Problems Associated with Removal of Asbestos, Journal of Construction Engineering and Management, volume 112, no. 2, pages 211-219, Jun 1986
11. Humpstone, Charles, Insuring an Asbestos Removal Project, Journal of Property Management, volume 53, pages 74-76, Jan/Feb 1988
12. Journal of the Air Pollution Control Association, Insurance Limited for Asbestos Removers, volume 35, pages 595-597, May 1985
13. Keyes, D.L.; Breen, J.J.; Beard, M.E., Measuring Airborne Asbestos Following an Abatement Action, EPA No. EPA/600/4-85/049, Jul 1985

14. Land, Robert D., Danger in Classroom: Asbestos in the Public Schools, Columbia Journal of Environmental Law, Winter 1985
15. Mackin, Robert E., Asbestos Abatement, Thinking It Through, National Underwriter, volume 92, pages 53-54, May 1988
16. Ogden, Julia K., Asbestos in School, Trial, April 1987
17. Ponder, Thomas C., Jr., Estimating Costs of Asbestos Abatement, American Association of Cost Engineers Transactions, Pages S.2.1-S.2.4, 1988
18. Rajhans, G.S.; Sullivan, J.L., Asbestos Sampling and Analysis, Ann Arbor Science, Ann Arbor MI, 1981
19. Stevens, Catherine, A Breath Of Fresh Air, Financial World, volume 155, page 21, Sep 1986
20. Stoffman, D., Fear and Loathing: The Sad Tale Of How The Asbestos Industry Went Very, Very Wrong, Canadian Business, volume 57, pages 15-16, 18, Dec 1984
21. Tuttle, Kathleen J., EPA'S Asbestos Rule in Schools, The Los Angeles Lawyer, Jan 1988
22. U.S. Department of Commerce, NVLAP Bulk Asbestos Handbook, National Bureau of Standards, No. NBSIR 88, Jul 1988
23. Washington Administrative Code, Title 296, Chapter 65 WAC, 1986 and 1987 supplement
24. Westbrook, S.H.; Perkins, R.L.; Starner, K., Asbestos-Containing Materials in School Buildings: Bulk Sample Analysis Quality Assurance Program, EPA Contract No. 68-02-4125, Jul 1987
25. Zenze, Carl, Occupational Medicine, Principles and Practical Application, second edition, Year Book Medical Publishers, Chicago, 1988
26. Zurer, Pamela S., U.S. Asbestos Removal Mania Checked by Insurance Crunch, Chemistry and Industry, volume 12, page 389, Jun 1985

APPENDIX A
TELEPHONE QUESTIONNAIRE FOR ASBESTOS TESTING LABORATORIES

TELEPHONE QUESTIONNAIRE FOR ASBESTOS TESTING LABORATORIES

DATE: _____

COMPANY NAME: _____

PHONE NUMBER: _____

PERSON CONTACTED: _____

DATA

1. OF THE SAMPLES THAT ARE TESTED AT YOUR FACILITY, WHAT PERCENT ARE;

CHRYSTILE _____% AMOSITE _____% CROCIDOLITE _____%

TREMOLITE -----

ACTINOLITE ----- _____%

ANTHOPHYLLITE -----

- ARE THESE LAST THREE TYPICALLY FOUND BY THEMSELVES OR WITH OTHER FORMS OF ASBESTOS ?

2. HAVE YOU FOUND ANY PURE FORMS OF THE PREVIOUS TYPES OF ASBESTOS ? IF SO, WHICH ONES AND IN WHAT TYPES OF APPLICATIONS ?

3. WHAT % OF THE BULK ANALYSIS TESTS ARE ON PIPE OR BOILER INSULATION ?

_____%

4. WHAT % IS BLOWN OR SPRAYED MATERIAL ?

_____%

5. CAN YOU RECALL ANY UNUSUAL MATERIALS THAT YOU HAVE ANALYZED THAT CONTAINED ASBESTOS ? (IE; MATERIALS THAT ARE NOT COMMONLY KNOWN AS ACM)

6. HAVE YOU EVER TESTED FOR THE PRESENCE OF ASBESTOS FROM THE FOLLOWING SOURCES;

COMMENTS, IF YES

HOUSEHOLD DUST

Y N

LAUNDERED CLOTHING

Y N

EARTH (DIRT)

Y N

7. WHAT IS THE BIGGEST PROBLEM PEOPLE MAKE IN TAKING;

- BULK SAMPLES ?

- AIR SAMPLES ?

8. IS WETTING OF THE BULK SAMPLES A PROBLEM FOR ANALYSIS ? IF SO, WHY ?

9. WHAT MEASURES OF PERSONAL PROTECTION DO YOU RECOMMEND FOR A PERSON TAKING SAMPLES ?

10. WHAT METHODS OF TESTING ARE USED TO ANALYZE BULK AND AIR SAMPLES ?

APPENDIX B
TELEPHONE QUESTIONNAIRE FOR ASBESTOS ABATEMENT CONTRACTORS

TELEPHONE QUESTIONNAIRE FOR ASBESTOS ABATEMENT CONTRACTORS

DATE: _____

COMPANY NAME: _____

PHONE NUMBER: _____

PERSON CONTACTED: _____

DATA

1. WHAT PERCENT OF YOUR WORK IS;

FEDERAL	%
STATE	%
LOCAL	%
PRIVATE	%

2. FOR PRIVATE WORK, DO YOU USE A STANDARD CONTRACT DOCUMENT ?

3. WHAT ARE THE KEY DIFFERENCES, IN HOW THE PROCEDURES FOR ABATEMENT WORK ARE PRESCRIBED, BETWEEN PUBLIC AND PRIVATE CONTRACTS ?

4. HOW ARE YOU GENERALLY REQUIRED TO DISPOSE OF ASBESTOS ? ARE THE REQUIREMENTS CLEARLY STATED IN THE CONTRACT DOCUMENTS ?

5. WHAT IS DONE WITH SHOWER WATER ? IS IT REQUIRED ?

- IF FILTERED, TO WHAT FIBER SIZE AND BY WHAT METHOD ?
- IF UNFILTERED, WHAT IS METHOD OF DISPOSAL ?

6. HAVE YOU CONTRACTED FOR ANY EXTERIOR REMOVAL WORK ? IF SO, HOW WAS THE CONTAINMENT PROBLEM ADDRESSED ? WAS WETTING USED ?

7. WHAT ARE TYPICAL REQUIREMENTS FOR CLEARANCE AIR SAMPLES ?

- FIBERS PER CUBIC CENTIMETER
- METHOD OF TESTING (TEM OR PCM) IF TEM, WHICH OWNERS REQUIRE IT ?
- WHO IS REQUIRED TO TAKE THE SAMPLES ? (THIRD PARTY ?)

8. WHO ANALYZES YOUR SAMPLES ?

- BULK
- AIR

9. HOW DID YOU COME TO SELECT THIS LAB ?

- COST ?
- REFERRED ?
- PERFORMANCE ?

10. ARE YOU FAMILIAR WITH EITHER THE EPA ROUND ROBIN OR THE NATIONAL VOLUNTARY LAB ACCREDITATION PROGRAM ?

11. ON YOUR PROJECTS, HAVE YOU EVER BEEN INSPECTED BY THE DEPARTMENT OF LABOR AND INDUSTRY OR THE AIR POLLUTION CONTROL AGENCY ? IF SO, HOW OFTEN?

- L & I
- PSAPCA

12. WHAT IS YOUR IMPRESSION OF THE INSPECTIONS, IN TERMS OF REASONABLENESS AND THE CONDUCT OF THE INSPECTORS ?

13. WHEN YOU ARE FACED WITH A REALLY TOUGH PROBLEM, WHOSE ASSISTANCE DO YOU SEEK TO SOLVE THE PROBLEM ? DO YOU EVER ASK THE REGULATORY AGENCIES ? IF SO, WHICH ONES ?

THE NEXT TWO QUESTIONS DEAL WITH INSURANCE AND MAY BE CONSIDERED PROPRIETARY, SO PLEASE DON'T FEEL OBLIGATED TO ANSWER.

14. WHO IS YOUR CARRIER ?

15. ABOUT WHAT % OF THE PROJECT COST IS PAID FOR LIABILITY INSURANCE ?

16. IN THE AREA OF WORKER PROTECTION, HOW MANY SUITS WILL AN EMPLOYEE USE DURING A NORMAL DAY ?

17. WHAT IS THE TYPICAL LENGTH OF TIME THAT AN EMPLOYEE WILL REMAIN IN THE CONTAINMENT AREA BEFORE EXITING FOR A BREAK ?

18. DO YOU USE GLOVE BAGS ? WHEN ARE THEY NOT RECOMMENDED ?

19. AS A FINAL QUESTION, HAVE YOU ENCOUNTERED ANY PARTICULARLY INTERESTING ABATEMENT PROJECTS THAT YOU COULD TELL ME ABOUT, ESPECIALLY ANY UNIQUE PROBLEMS AND HOW THEY WERE OVERCOME ?

APPENDIX C
COMPILED LABORATORY DATA

COMPILED LABORATORY DATADATA

1. OF THE SAMPLES THAT ARE TESTED AT YOUR FACILITY, WHAT PERCENT ARE;

	RESPONSES(%)								
	1	2	3	4	5	6	7	8	9
CHRYSTILE	75	90	90	98	85	60	95	93	70
AMOSITE	24	10	10	1	65	39	4	4	40
CROCIDOLITE	1	1	0	1	3	1	1	3	15
TREMOLITE	0	0	0	1	0	0	0	0	5
ACTINOLITE	0	0	0	0	0	0	0	0	1
ANTHOPHYLLITE	0	0	0	0	0	0	0	0	5

- ARE THESE LAST THREE TYPICALLY FOUND BY THEMSELVES OR WITH OTHER FORMS OF ASBESTOS ?

- TREMOLITE WAS FOUND ON ONE OCCASION, BY ITSELF, IN A MASTIC MATERIAL.
- TREMOLITE HAS BEEN FOUND BY ITSELF IN SOAPSTONE, ALSO IN VERMICULITE AND TALC (USED AS A FILLER FOR PLASTER)

2. HAVE YOU FOUND ANY PURE FORMS OF THE PREVIOUS TYPES OF ASBESTOS ? IF SO, WHICH ONES AND IN WHAT TYPES OF APPLICATIONS ?

- CHRYSTILE IN WOVE! FABRIC SAMPLES.
- NO, THE HIGHEST CONCENTRATION WAS OBSERVED IN A SAMPLE OF FURNACE INSULATION WHICH CONTAINED 60% CHRYSTILE.
- THE CLOSEST MATERIAL FOUND THAT MET THIS CRITERIA, WAS IN THE FORM OF A GASKET AND CONTAINED 95% CHRYSTILE AND 5% BINDER.
- NONE PURE, HOWEVER, SAMPLES FROM BLOCK INSULATION AROUND BOILERS HAVE CONTAINED ALMOST 80% AMOSITE. ALSO, "AIR CELL" (CORRUGATED CARDBOARD IMPREGNATED WITH ASBESTOS PIPE INSULATION) WAS FOUND TO CONTAIN PURE CHRYSTILE UPON REMOVAL OF THE CARDBOARD STRUCTURE.

- NOT PURE, BUT SAMPLES OF ASBESTOS TAPE HAVE SHOWN CONCENTRATIONS OF ASBESTOS AS HIGH AS 89%.
- YES, IN A SAMPLE OF INSULATION DUCT TAPE, NEARLY PURE CHRYSOTILE.
- YES; * TREMOLITE AS A CRUCIBLE LINER
* CHRYSOTILE AS A RAILROAD ENGINE BOILER LINER AND CLOTH
* AMOSITE AS BLOWN IN INSULATION IN AN OLD ATTIC
- YES, CHRYSOTILE HAS BEEN FOUND IN BOILER GASKETS, WIRE INSULATION AND FLEX CONNECTIONS.
- CHRYSOTILE IN WOVEN FABRIC SAMPLES.

3. WHAT % OF THE BULK ANALYSIS TESTS ARE ON PIPE OR BOILER INSULATION ?

40 %, 0 %, 10 %, 20 %, 80 %, 40 %, 25 %, 0 %, 50 %

4. WHAT % IS BLOWN OR SPRAYED MATERIAL ?

5 %, 100 %, 90 %, 45 %, 20 %, 60 %, 40 %, 0 %, 50 %

5. CAN YOU RECALL ANY UNUSUAL MATERIALS THAT YOU HAVE ANALYZED THAT CONTAINED ASBESTOS ? (IE; MATERIALS THAT ARE NOT COMMONLY KNOWN AS ACM)

- CEILING TILES MANUFACTURED AFTER 1980.
- WINDOW PUTTY
- COVE BASE (BASEBOARD)
- CHALK BOARDS
- MASTIC
- FLOOR TILES
- FIRE PLACE MORTAR
- PIPE MUD
- PLASTER

- MORTAR MIXES
- SAMPLES OF PLASTER BOARD FROM THURSTON COUNTY
- MANY TYPES AND FORMS OF CEMENT AND CONCRETE (COMMONLY USED TO CONTROL THE WATER CONTENT IN MIXES)
- PLASTER, ADDED TO THE MIX TO PROVIDE A SMOOTH FINISH
- SPACKLING COMPOUNDS
- GROUTS AND PUTTEES
- PAINTS
- NATURAL OCCURRENCES SUCH AS THE MOUNT SAINT HELENS ERUPTION, WHICH EMITTED HYPERSTEIN DUST MIXED IN WITH THE ASH.

6. HAVE YOU EVER TESTED FOR THE PRESENCE OF ASBESTOS FROM THE FOLLOWING SOURCES;

HOUSEHOLD DUST

4 NO ANSWERS AND 5 YES ANSWERS

- COMMENTS:**
- LESS THAN 1%
 - IN COMMERCIAL BUILDINGS, SMALL AMOUNTS HAVE BEEN FOUND IN STORAGE ROOM DUST.
 - CONTAINED MOSTLY CELLULOSE FIBERS AND OTHER ANIMAL SUBSTANCES, BUT NO ASBESTOS.
 - GENERALLY NO ASBESTOS
 - CONTAMINATED FROM A KNOWN ACM SOURCE

LAUNDERED CLOTHING

6 NO ANSWERS AND 3 YES ANSWERS

- COMMENTS:**
- TRACE AMOUNTS ONLY.
 - ROCK WOOL DUST FROM A CEILING HAD FALLEN INTO A FAMOUS MODEL'S WARDROBE. THIS LAB WAS ASKED TO FIND A WAY TO CLEAN THE CLOTHING. IN THE FINAL ANALYSIS, IT WAS SHOWN THAT NORMAL LAUNDERING NOT ONLY DID

NOT REMOVE THE DUST FIBERS, IT CAUSED THE FIBERS TO BECOME MORE ENTRAPPED IN THE FABRIC. THE ONLY VIABLE SOLUTION WAS TO AGITATE THE CLOTHING WHILE USING A VERY POWERFUL VACUUM TO REMOVE THE FIBERS, SIMILAR TO THE HEPA MACHINES BEING USED TODAY.

- SMALL AMOUNTS

EARTH (DIRT)

3 NO ANSWERS AND 6 YES ANSWERS

- COMMENTS:
- SOIL SAMPLE FOLLOWING THE DEMOLITION OF A BUILDING THAT CONTAINED ASBESTOS SIDING.
 - SAMPLES TAKEN FROM CRAWL-SPACES UNDER DETERIORATED ASBESTOS CONTAINING MATERIALS
 - SAMPLES FROM CRAWL SPACES OF OLD BUILDINGS TYPICALLY TEST POSITIVE FOR ASBESTOS.
 - JUST A FEW SAMPLES, NONE OF WHICH CONTAINED ASBESTOS.
 - NO UNUSUAL RESULTS
 - CONTAMINATED FROM A KNOWN ACM SOURCE

7. WHAT IS THE BIGGEST PROBLEM PEOPLE MAKE IN TAKING;

- BULK SAMPLES ?

- NOT OBTAINING A REPRESENTATIVE SAMPLE. AN EXAMPLE BEING AIR CELL PIPE INSULATION, WHERE THE HIGHEST CONCENTRATION OF CHRYSOTILE ASBESTOS IS RIGHT NEXT TO THE PIPE AND THE SAMPLER MAY ONLY EXTRACT THE OUTER LAYERS.
- NOT OBTAINING GOOD REPRESENTATIVE SAMPLES.
- TOO SMALL A SAMPLE AND SAMPLES THAT ARE NOT REPRESENTATIVE.
- SAMPLERS ONLY REMOVING MATERIAL FROM THE OUTER LAYERS OF, FOR INSTANCE, PIPE INSULATION, WHEN IT IS MOST DESIRABLE TO OBTAIN A FULL THICKNESS SAMPLE TO ENSURE A GOOD REPRESENTATIVE SAMPLE.
- NOT TAKING ENOUGH CARE WHEN TAKING SAMPLES TO AVOID THE POSSIBILITY OF ASBESTOS FIBERS BECOMING AIRBORNE.
- PEOPLE NOT TAKING METICULOUS SAMPLES OR NOT KEEPING THE SAMPLES FREE FROM CONTAMINATION. THIS LAB NOW SUPPLIES STERILE CONTAINERS TO ITS CUSTOMERS FOR SAMPLING.
- PEOPLE NOT KNOWING HOW TO TAKE A PROPER SAMPLE IN VARYING

CONDITIONS. AN EXAMPLE BEING POPCORN CEILINGS. THE HIGHEST CONCENTRATION OF ASBESTOS FIBERS WILL TYPICALLY BE BETWEEN THE BULB AND THE CEILING. SAMPLE TAKERS FREQUENTLY TAKE ONLY THE BULB AND LEAVE THE MOST IMPORTANT MATERIAL BEHIND.

- NOT TAKING A REPRESENTATIVE SAMPLE.

- AIR SAMPLES ?

- PEOPLE NOT TAKING A REASONABLE WORST CASE SAMPLE. FOR EXAMPLE, USING A FAN IN THE AREA TO BE SAMPLED IN ORDER TO PROVIDE NORMAL AIR DISTURBANCES.
- TOO SMALL A VOLUME (MIN. OF 1000 LITERS) AND SAMPLERS WITH TOO LITTLE TRAINING IN PROPER SAMPLE TAKING.
- OBSERVED LITTLE OR NO PROBLEMS FOLLOWING THE ONSET OF AHERA TRAINING.
- SAMPLE TAKERS LACKING CONSISTENCY AND A GOOD UNDERSTANDING OF WHAT THEY ARE DOING.
- AREAS BEING CLEARED BY TEM THAT ARE NOT ACTUALLY FREE OF ASBESTOS AT ALL. THIS HAS BEEN PROVEN TRUE BY USING TAPE TO COLLECT DUST FROM SURFACES IN A CLEARED AREA AND ANALYZING IT. IT IS ALSO NOT UNCOMMON TO HAVE AIR SAMPLES TAKEN AT TOO HIGH A VELOCITY.
- INADEQUATE VOLUMES OF AIR BEING TAKEN.

8. IS WETTING OF THE BULK SAMPLES A PROBLEM FOR ANALYSIS ? IF SO, WHY ?

- YES, WETTING LENGTHENS THE TIME REQUIRED TO ANALYZE SAMPLES DUE TO THE NEED TO DRY THE SAMPLES BEFORE THE LAB CAN PROCEED WITH THE TESTS.
- NO, BUT TRY TO GET SAMPLES PRIOR TO WETTING IN ORDER TO ELIMINATE THE NEED FOR DRYING.
- ONLY FROM THE STANDPOINT THAT THE SAMPLE MUST BE DRIED BEFORE IT CAN BE ANALYZED, THUS INCREASING TURNAROUND TIME.
- NO REAL PROBLEM OTHER THAN DRYING THE SAMPLE BEFORE TESTING.
- NOT A PROBLEM, IN FACT IT IS A MUST TO ENSURE PERSONAL PROTECTION. EVEN A SOAKED SAMPLE NEED ONLY BE DRIED BEFORE TESTING.
- NO, BUT THE SAMPLES MUST DRIED FIRST. PROBLEMS CAN ARISE WHEN PEOPLE TRY TO TAKE SHORTCUTS IN DRYING OUT THE SAMPLES. FOR EXAMPLE, IF A SAMPLE IS DRIED AT TOO HIGH A TEMPERATURE, THE OPTICAL CHARACTERISTICS OF THE ASBESTOS FIBERS CHANGE. ANOTHER EXAMPLE IS WHEN ACID LEACHING IS USED, THIS RESULTS IN REFRACTIVE INDICES DROPPING. EITHER OF THESE CASES CAN RESULT IN A MIS-IDENTIFICATION OF ASBESTOS SAMPLES.
- NO, IN FACT IT IS A SAFETY PRECAUTION. THE LAB IS RESPONSIBLE FOR SAMPLE PREPARATION BEFORE ANALYSIS.

9. WHAT MEASURES OF PERSONAL PROTECTION DO YOU RECOMMEND FOR A PERSON TAKING SAMPLES ?

- FOR BULK SAMPLES, A RESPIRATOR AND FULL SUIT IS RECOMMENDED, HOWEVER, WHEN DOING SAMPLING FOR "POPCORN CEILINGS", NO PROTECTION IS NECESSARY. FOR AIR SAMPLES, UNLESS A PERSON ENTERS A KNOWN CONTAMINATED AREA, NO PROTECTION IS NECESSARY.
- FOR RESIDENTIAL SAMPLING, NONE IS NECESSARY.
- THIS LAB DEALS PRIMARILY WITH HOME-OWNERS, AND BELIEVES THAT PROTECTION IS LESS IMPORTANT THAN THE SPEED BY WHICH THE SAMPLE IS TAKEN.
- FULL PROTECTION THAT IS AVAILABLE.
- FULL AVAILABLE PROTECTION, HOWEVER THIS IS MOST LIKELY NOT BEING DONE BY MANY SAMPLE TAKERS.
- (A) RESPIRATOR/ AIR PACK (B) NEVER USE DRY METHODS OF SAMPLING (C) CHECK WITH EPA/OSHA IF UNCERTAIN
- STRESS COMMON SENSE, ALWAYS USE PROTECTION COMMENSURATE WITH THE EXPOSURE DANGER.
- IN A RESIDENTIAL SETTING, WETTING OF THE SAMPLE AREA AND MODERATE CARE IN TAKING THE SAMPLE IS SUFFICIENT.
- 1. WETTING OF SAMPLE TO AVOID SAMPLE RELEASE.
- 2. TAKE A SMALL AMOUNT THAT IS REPRESENTATIVE OF THE SAMPLE, TAKING CARE NOT TO DISTURB THE WHOLE MATERIAL.
- 3. IF THE MATERIAL HAS DAMAGED SECTIONS, TAKE THE SAMPLE FROM THESE AREAS, RATHER THAN CREATING NEW DAMAGE.
- 4. USE A WET DROP CLOTH TO COLLECT ANY DEBRIS.
- 5. WET WIPE ALL SURROUNDING SURFACES.

10. WHAT METHODS OF TESTING ARE USED TO ANALYZE BULK AND AIR SAMPLES ?

FOR BULK SAMPLES; ALL NINE LABS USED POLARIZED LIGHT MICROSCOPY EITHER WITH OR WITHOUT DISPERSION STAINING. TEM AND XRD WERE NOTED TWICE AND SEM WAS NOTED ONCE.

FOR AIR SAMPLES; SEVEN OF THE LABS USED PHASE CONTRAST MICROSCOPY, WHILE THE OTHER TWO DID NOT DO AIR SAMPLES.

APPENDIX D
COMPILED ABATEMENT CONTRACTOR DATA

COMPILED ABATEMENT CONTRACTOR DATA

DATA

1. WHAT PERCENT OF YOUR WORK IS;

RESPONDENT	FEDERAL	STATE	LOCAL	PRIVATE
1	25	0	0	75
2	5	20	75	5
3	20	10	20	50
4	0	0	20	80
5	10	15	30	45
6	3	3	50	44
7	15	25	30	30
8	20	35	10	35
9	15	20	30	35
10	0	60	5	35
11	15	25	45	15
12	0	0	0	100
13	20	5	35	40

2. FOR PRIVATE WORK, DO YOU USE A STANDARD CONTRACT DOCUMENT ?

TWO NO ANSWERS WERE GIVEN AND ELEVEN YES ANSWERS WERE GIVEN. GENERAL FORMS OF THE DOCUMENTS INCLUDED; AN INTERNALLY GENERATED, MODIFIED DOCUMENT (10 RESPONSES), A STANDARD LETTER OF PROPOSAL (2 RESPONSES) AND A MODIFIED AIA DOCUMENT (1 RESPONSE)

3. WHAT ARE THE KEY DIFFERENCES, IN HOW THE PROCEDURES FOR ABATEMENT WORK ARE PRESCRIBED, BETWEEN PUBLIC AND PRIVATE CONTRACTS ?

- TYPICALLY, PUBLIC JOBS HAVE VARIOUS AND LENGTHY CONTRACT DOCUMENTS, NUMEROUS SUBMITTALS AND A PREVAILING WAGE REQUIREMENT THAT INCREASES THE COST OF A PUBLIC JOB 25 TO 40 % HIGHER THAN AN EQUIVALENT PRIVATE JOB. SIMPLY PUT, PRIVATE JOBS REQUIRE LESS PAPERWORK AND CAN BE ACCOMPLISHED AT A LOWER COST.
- SAME PROCEDURES, HOWEVER, PUBLIC JOBS REQUIRE LOTS OF PAPERWORK AND JOBS OVER 25K REQUIRE BONDING, WHERE MOST PRIVATE JOBS DO NOT.
- WE PERCEIVE NO DIFFERENCE.
- NO DIFFERENCE OTHER THAN THE QUANTITY OF PAPERWORK. ON THE PUBLIC SIDE, THE U OF W IS THE WORST FOR PAPERWORK AND

CONFUSION. U OF W BIDS ARE GENERALLY 10 % HIGHER THAN OTHER JOBS FOR THIS REASON.

- PUBLIC JOBS REQUIRE THE USE OF PREVAILING WAGE RATES AND THE SPECS ARE MORE STRINGENT.
- NO REAL DIFFERENCES.
- MOST OF THE PRIVATE WORK WE DO IS FOR REMOVAL OF SIDING. MOST OF THE PUBLIC WORK REQUIRES THE USE OF AN ENCLOSURE OR GLOVE BAGS.
- PUBLIC JOBS REQUIRE A TREMENDOUS VOLUME OF PAPERWORK.
- SAME FOR ALL
- PUBLIC JOBS REQUIRE ALLOT OF PAPER CHASING.
- PUBLIC JOBS USE THEIR OWN DOCUMENTS AND ABOUT 30 % MORE PAPERWORK.
- GUIDELINES ARE THE SAME, BUT PUBLIC JOBS REQUIRE ALLOT OF NEEDLESS PAPERWORK.

4. HOW ARE YOU GENERALLY REQUIRED TO DISPOSE OF ASBESTOS ? ARE THE REQUIREMENTS CLEARLY STATED IN THE CONTRACT DOCUMENTS ?

- IT SHOULD BE DOUBLED BAGGED, LABELED AND TRANSPORTED TO AN EPA APPROVED LANDFILL.
- ALWAYS THE SAME, IN ACCORDANCE WITH KING COUNTY REGULATIONS.
- MUST BE DOUBLED BAGGED AND TAKEN TO AN EPA APPROVED LANDFILL.
- IT MUST GO TO AN EPA APPROVED LANDFILL. PUBLIC JOBS REQUIRE THIS IN THE SPECS, PUBLIC JOBS DO NOT, BUT WE DO IT THAT WAY ANYHOW.
- DOUBLE BAGGED AND TAKEN TO AN EPA APPROVED LANDFILL.
- WE DOUBLE BAG IT, TRANSPORT IT TO AN EPA APPROVED LANDFILL IN AN ENCLOSED VEHICLE. THIS IS USUALLY SPECIFIED IN THE DOCUMENTS.
- METHOD IS NOT USUALLY REQUIRED. THERE IS NO SUCH THING AS AN EPA APPROVED LANDFILL, ITS UP TO THE LANDFILL WHETHER TO TAKE IT OR NOT. WE REQUIRE OUR DISPOSAL PERSONNEL TO BE IN PROTECTIVE SUITS AND USE RESPIRATORS.
- DOUBLE BAGGED AND TRANSPORTED TO AN EPA APPROVED LANDFILL.
- DOUBLE BAGGED AND TRANSPORTED TO AN EPA APPROVED LANDFILL. WE DO NOT ACTUALLY DO THE DISPOSAL, WE ONLY BAG IT OR PLACE IT IN A LINED DUMPSTER. THE GENERAL ACTUALLY REMOVES IT FROM THE SITE.
- DOUBLE BAGGED, MARKED, AND TRANSPORTED TO AN EPA APPROVED LANDFILL. FEDERAL JOBS REQUIRE THE USE OF BLUE BAGS, SINCE YELLOW BAGS STAND FOR RADIATION.

ELEVEN OF THE THIRTEEN CONTRACTORS COMMENTED THAT THE REQUIREMENTS ARE CLEARLY STATED IN THE CONTRACT DOCUMENTS.

5. WHAT IS DONE WITH SHOWER WATER ? IS IT REQUIRED ?

- WE FILTER IT AND DISPOSE OF THE RESIDUE.
THIS IS USUALLY NOT A REQUIREMENT.
- WE FLUSH IT DOWN THE TOILET. IT IS NEVER REQUIRED.
- THERE ARE NO GUIDELINES FOR DISPOSAL, WE USUALLY PLACE IT IN DRUMS AND TAKE IT TO AN APPROVED LANDFILL.
- U OF W REQUIRES .4 MICRON FILTRATION.
- USUALLY FILTERED, BUT THIS IS NOT REQUIRED.
- YES IT IS TYPICALLY REQUIRED, BUT NOT REGULATED FOR FILTERING.
- IT IS FILTERED AND REQUIRED (4 RESPONSES)
- IT IS FILTERED AND NOT REQUIRED (3 RESPONSES)

- IF FILTERED, TO WHAT FIBER SIZE AND BY WHAT METHOD ?

- 5 MICRONS (7 RESPONSES)
- .3-.5 MICRONS (5 RESPONSES)

FILTERING METHOD USED: A SERIES OF FILTERS AND A SEDIMENT TANK. FILTER SIZES RANGE FROM 25 MICRONS TO 5 MICRONS.

- IF UN-FILTERED, WHAT IS METHOD OF DISPOSAL ?

- IT IS PLACED IN A SEALED BARREL OR OTHER CONTAINER AND DISPOSED OF ACCORDINGLY (3 RESPONSES)
- IT IS DUMPED AS IS (2 RESPONSES)
- PLACED IN DOUBLE BAGS FOR DISPOSAL.

6. HAVE YOU CONTRACTED FOR ANY EXTERIOR REMOVAL WORK ? IF SO, HOW WAS THE CONTAINMENT PROBLEM ADDRESSED ? WAS WETTING USED ?

- YES, USUALLY OPEN AIR REMOVAL INVOLVES NON-FRIABLE ASBESTOS WHICH IS WETTED FOR REMOVAL AND THE REMOVAL AREA IS BARRICADED OFF FOR THE PROTECTION OF THE GENERAL PUBLIC. WE DID HAVE ONE JOB WHICH INVOLVED FRIABLE ASBESTOS PAPER SHINGLES ON THE ROOF OF A HOUSE FOR WHICH AN ENTIRE ENCLOSURE WAS CONSTRUCTED TO CONTAIN ANY FIBER RELEASE.
- YES, IT HAS ALWAYS BEEN SIDING AND WE HAVE ONLY HAD TO WET IT.
- YES, MOST EXTERIOR REMOVAL IS FOR CEMENT ASBESTOS BOARD WHERE WETTING IS ADEQUATE, YET ON A JOB WHERE WE REMOVED FRIABLE ASBESTOS FROM A WATER TANK, WE HAD TO BUILD AN ENCLOSURE AROUND IT FOR CONTAINMENT.
- YES, THE FRIABLE MATERIAL WAS REMOVED USING GLOVE BAGS, AND THE NON-FRIABLE MATERIAL WAS WETTED DURING REMOVAL.
- YES, A NEGATIVE AIR ENCLOSURE AND WETTING WERE USED TO

REMOVE A ROOF.

- YES, WE HAVE HAD TO BUILD A VERY STRONG ENCLOSURE AND TAKE INTO ACCOUNT THE SOLAR HEATING EFFECT ON WORKERS. NON-FRIABLE ASBESTOS IS WETTED. PSAPCA HAS VERY STRINGENT GUIDELINES TO FOLLOW WHEN REMOVING CAB.
- YES, BUT ONLY FOR SIDING. IT WAS WETTED, NAIL HEADS CLIPPED AND WHOLE SHEETS SLID OFF.
- YES, ONLY CAB, WHICH REQUIRED WETTING.
- YES, IN TACOMA, WE REMOVED SOME ASBESTOS CONTAMINATED ROOF PAPER. WE BUILT A NEGATIVE AIR ENCLOSURE OVER THE ENTIRE ROOF.
- YES, BUT ONLY SIDING WHICH REQUIRED WETTING.
- YES, WE HAVE REMOVED CAB WHERE ONLY WETTING WAS REQUIRED.

7. WHAT ARE TYPICAL REQUIREMENTS FOR CLEARANCE AIR SAMPLES ?

- FIBERS PER CUBIC CENTIMETER
 - .01 OR LESS (13 RESPONSES)
 - PRE-ABATEMENT (2 RESPONSES)
- METHOD OF TESTING (TEM OR PCM) IF TEM, WHICH OWNERS REQUIRE IT ?
 - PCM (13 RESPONSES)
 - TEM (6 RESPONSES), SCHOOLS
 - SEM (1 RESPONSE)
- WHO IS REQUIRED TO TAKE THE SAMPLES ? (THIRD PARTY ?)
 - A THIRD PARTY (9 RESPONSES)
 - NO REQUIREMENT, CONTRACTOR DOES (8 RESPONSES)

8. WHO ANALYZES YOUR SAMPLES ?

HAZCON (2), ROBERT SCHUMACHER, NORTHWEST LABS (3), ORION (2), PITTSBURGH, MED-TOX, PREZANT (2), FRANDON.

9. HOW DID YOU COME TO SELECT THIS LAB ?

SHORT TURN AROUND TIME (2), CLOSE-BY (5), PERFORMANCE (9), COST (8), REFERRED BY OTHERS (2), EXPERIENCE (1)

10. ARE YOU FAMILIAR WITH EITHER THE EPA ROUND ROBIN OR THE NATIONAL VOLUNTARY LAB ACCREDITATION PROGRAM ?

HAD HEARD OF BOTH (6), HAD NOT HEARD OF EITHER (5), HAD ONLY HEARD OF ROUND ROBIN (2)

11. ON YOUR PROJECTS, HAVE YOU EVER BEEN INSPECTED BY THE DEPARTMENT OF LABOR AND INDUSTRY OR THE AIR POLLUTION CONTROL AGENCY ? IF SO, HOW OFTEN?

RESPONDENT	L & I (%)	PSAPCA (%)
1	2	15
2	20	20
3	10	10
4	40	50
5	10	50
6	5	5
7	30	75
8	8	10
9	50	100
10	10	1
11	15	60
12	10	10
13	5	5

12. WHAT IS YOUR IMPRESSION OF THE INSPECTIONS, IN TERMS OF REASONABLENESS AND THE CONDUCT OF THE INSPECTORS ?

- THEY APPEAR TO DO A GOOD JOB, NO PROBLEMS (11 RESPONSES)
- L & I IS TOO STRINGENT (2 RESPONSES)

13. WHEN YOU ARE FACED WITH A REALLY TOUGH PROBLEM, WHOSE ASSISTANCE DO YOU SEEK TO SOLVE THE PROBLEM ? DO YOU EVER ASK THE REGULATORY AGENCIES ? IF SO, WHICH ONES ?

- PSAPCA IS CONTACTED FOR ASSISTANCE (11 RESPONSES).
- L & I IS CONTACTED FOR ASSISTANCE (2 RESPONSES)
- NO OUTSIDE ADVISE IS SOUGHT (2 RESPONSES)
- THE OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY (1 RESPONSE)

THE NEXT TWO QUESTIONS DEAL WITH INSURANCE AND MAY BE CONSIDERED PROPRIETARY, SO PLEASE DON'T FEEL OBLIGATED TO ANSWER.

14. WHO IS YOUR CARRIER ?

- NATIONAL UNION BUYER
- INDIANA LUMBERMANS
- NORTHERN STATES
- AMERICAN EMPIRE
- UNITED CAPITAL (3 RESPONSES)
- SIX CONTRACTORS DID NOT RESPOND

15. ABOUT WHAT % OF THE PROJECT COST IS PAID FOR LIABILITY INSURANCE ?

10, 15, 19, 13, 12, 15, 12, 14, 15, 13, 18, 13 %

16. IN THE AREA OF WORKER PROTECTION, HOW MANY SUITS WILL AN EMPLOYEE USE DURING A NORMAL DAY ?

6, 5, 4 (2), 3 (5), 2 (3), 1

17. WHAT IS THE TYPICAL LENGTH OF TIME THAT AN EMPLOYEE WILL REMAIN IN THE CONTAINMENT AREA BEFORE EXITING FOR A BREAK ?

4 HOURS (6), 3 HOURS (6), 1 HOUR (1)

18. DO YOU USE GLOVE BAGS ? WHEN ARE THEY NOT RECOMMENDED ?

11 CONTRACTORS DID USE GLOVE BAGS AND 2 DID NOT.

THEY ARE NOT RECOMMENDED;

- FOR APPLICATION WHEN AN AREA CAN BE EASILY CONTAINED.
- FOR CEILING JOBS OR INTRICATE PIPING JOBS.
- HOT PIPE REMOVAL JOBS ARE NOT GOOD FOR GLOVE BAGS (157 DEGREES F WILL MELT BAGS)
- FOR HOT PIPES, AREAS OF TIGHT PIPE SPACING AND IN HIGHLY CONTAMINATED AREAS.
- FOR HOT PIPES.
- WHEN NOT DOING SMALL PIPING JOBS OR ON PROJECTS WHERE A BUSINESS MUST REMAIN OPEN. GLOVE BAGS SHOULD BE AVOIDED IF POSSIBLE DUE TO THE ADDED WORKING STRESS ON EMPLOYEES.
- FOR USE ON COMPLICATED PIPING SYSTEMS.
- NOT ON HOT PIPES OR FOR COMPLICATED PIPING SYSTEMS.
- FOR HOT PIPES OR AT THE U OF W FOR PIPE LENGTHS OVER 10 FEET.
- FOR HOT PIPE OR PIPE RUNS OF 30 LF OR MORE.
- NOT FOR HOT PIPES.

19. AS A FINAL QUESTION, HAVE YOU ENCOUNTERED ANY PARTICULARLY INTERESTING ABATEMENT PROJECTS THAT YOU COULD TELL ME ABOUT, ESPECIALLY ANY UNIQUE PROBLEMS AND HOW THEY WERE OVERCOME ?

* THE USE OF SCAFFOLDING WAS EMPLOYED FOR A JOB WHERE THE WORK AREA WAS ELEVATED IN ORDER TO GET WORKERS CLOSER TO THE TASK WHILE AVOIDING THE USE OF LADDERS. DISPOSAL CAN TAKE UP TO 20% OF THE MAN-HOURS ON A JOB, SAVE TIME HERE AND ITS MONEY IN THE BANK.

* ON A JOB FOR THE STATE OF WASHINGTON, WE EXPERIENCED A CONDITION WHEREBY DIRTY AIR WAS BEING DRAWN INTO A CLEAN SPACE BY A FLUE EFFECT THAT WAS PRE-EXISTING WITHIN THE BUILDING.

* WE HAVE BID ON A JOB AT THE U OF W FOR REMOVAL OF ASBESTOS SIDING LOCATED ON THE TOP OF THE STADIUM. OUR MAIN CONCERN HERE WILL BE WORKER SAFETY, SINCE A CONTAINMENT SYSTEM WILL NOT BE NECESSARY.

* ON A JOB WE HAD IN HAWAII, WE EXPERIENCED HIGH HUMIDITY WITHIN THE CONTAINMENT STRUCTURE. WE ENDED UP USING A HIGHER CAPACITY CHANGE AIR SYSTEM.

APPENDIX E
PARTICIPATING LABORATORIES

PARTICIPATING LABORATORIES

COMPANY NAME: AM TEST INC.
PHONE NUMBER: 885-1664
PERSON CONTACTED: JIM SMITH

COMPANY NAME: BIO MED RESEARCH
PHONE NUMBER: 882-0448
PERSON CONTACTED: CRAIG DELPHEY

COMPANY NAME: BLUE SKY TESTING LABORATORIES
PHONE NUMBER: 721-2583
PERSON CONTACTED: RICHARD KNIGHTS

COMPANY NAME: HAZ CON INC.
PHONE NUMBER: 763-7364
PERSON CONTACTED: MARIA MAJAR

COMPANY NAME: MED TOX ASSOCIATES INC.
PHONE NUMBER: 672-2428
PERSON CONTACTED: GENE GALLAGHER

COMPANY NAME: ASBESTO TEST
PHONE NUMBER: 297-4315
PERSON CONTACTED: ARLYNN PATTERSON

COMPANY NAME: BENNETT LABORATORIES INC
PHONE NUMBER: 272-4507
PERSON CONTACTED: GENE LOUGH

COMPANY NAME: MICRO LAB NORTHWEST
PHONE NUMBER: 885-9419
PERSON CONTACTED: RUSS CRUTCHER

COMPANY NAME: NORTHWEST ENVIRONMENTAL SERVICES INC
PHONE NUMBER: 622-8353
PERSON CONTACTED: MIA SAZON

APPENDIX F
PARTICIPATING ABATEMENT CONTRACTORS

PARTICIPATING ABATEMENT CONTRACTORS

COMPANY NAME: TLH ABATEMENT
PHONE NUMBER: 523-4441
PERSON CONTACTED: HERMAN HUSAN

COMPANY NAME: UNLIMITED SYSTEMS INCORPORATED
PHONE NUMBER: 362-4885
PERSON CONTACTED: ERNEST D. SCOTT

COMPANY NAME: ALPHA INSULATION INCORPORATED
PHONE NUMBER: 774-3906
PERSON CONTACTED: LARRY KAMAHELE

COMPANY NAME: ATLAS INSULATION INCORPORATED
PHONE NUMBER: 251-0081
PERSON CONTACTED: MIKE PIERCE

COMPANY NAME: HLD CONSTRUCTION
PHONE NUMBER: 472-4489
PERSON CONTACTED: JOHN DICKSON

COMPANY NAME: AA CONTRACTORS INCORPORATED
PHONE NUMBER: 767-4650
PERSON CONTACTED: MARK BLANKINSHIP

COMPANY NAME: CENTRAL INDUSTRIES
PHONE NUMBER: 932-8116
PERSON CONTACTED: RICHARD BASQUETTE

COMPANY NAME: J B MECHANICAL CONTRACTORS
PHONE NUMBER: 672-8075
PERSON CONTACTED: RICHARD LINES

COMPANY NAME: LONG SERVICES CORPORATION
PHONE NUMBER: 763-8433
PERSON CONTACTED: MIKE COLE

COMPANY NAME: PERFORMANCE ABATEMENT SERVICES INCORPORATED
PHONE NUMBER: 467-8733
PERSON CONTACTED: JEANIE BRETSCHNEIDER

COMPANY NAME: STEVE'S MAINTENANCE
PHONE NUMBER: 941-5113
PERSON CONTACTED: STEVEN BREWER

COMPANY NAME: KEMP ENTERPRISES INCORPORATED
PHONE NUMBER: 292-8308
PERSON CONTACTED: PAUL KEMP

COMPANY NAME: M J ASSOCIATES INCORPORATED
PHONE NUMBER: 752-9885
PERSON CONTACTED: MICHAEL HARA