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Asbestos Control in Steam-Electric Generating Plants

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A program to control industrial work exposures to airborne asbestos fibers is presented. The program is consistent with OSHA standards and with current good industrial hygiene practice. The program includes methods of problem evaluation, the establishment of effective corporate standards, and provisions for environmental and medical surveillance. Hazard control measures and techniques are discussed and their merits related.

Introduction

ASBESTOS HAS BEEN USED EXTENSIVELY for many years as a thermal insulator. When new asbestos insulation is applied or when old insulation is removed, considerable quantities of fiber may become airborne and, unless controlled, may lead to excessive inhalation exposures to the workers. Asbestos is known to cause a pulmonary fibrosis known as asbestosis and may cause carcinoma of the lung and mesothelium.¹ The Tennessee Valley Authority (TVA) has been engaged in efforts to prevent excessive workers exposure to airborne asbestos for about 30 years.

The Tennessee Valley Authority operates 12 coal-fired steam-electric generating plants in three states, Alabama, Kentucky and Tennessee. By 1978, three nuclear-powered steam-electric generating plants will be added, and several more are in the planning stages. These facilities require substantial amounts of thermal insulating materials both for initial construction and for replacement.

Each generating unit is scheduled to be out of service at approximately six-month intervals for maintenance of such systems as steam lines, boiler feed pumps, valves, and turbines. During these "outages" old insulation is routinely removed from the systems scheduled for maintenance, and new insulation is applied when the systems are rein-

stalled. Small insulating tasks may be completed as needed between outages.

The insulating materials originally installed in the coal-fired plants contained large amounts of asbestos, primarily amosite. Most of the insulation was preformed pipes and blocks of hydrous calcium silicate insulation reinforced with asbestos fibers. Other insulation included boards, blankets, felts, cloths, tapes, sleeves, and cements that contained various quantities of asbestos.

Evaluation of Exposure

At each steam-electric generating plant, TVA employs as many as six full-time insulators, including a foreman. These men are classified as asbestos workers. Usually, one or two full-time laborers are assigned to this group. During maintenance outages, temporary insulators are employed also.

Full-time insulators and laborers are monitored for exposure to asbestos twice yearly during unit outages.^{2,3} Part-time insulators are also monitored at these times; but because of the temporary nature of their employment, these insulators may not be individually monitored every six months.

In addition to individual exposure evaluations, area samples are taken to determine the airborne fiber concentrations in the general work environment. Sampling and analytical methods are those recommended by

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the National Institute for Occupational Safety and Health (NIOSH).¹ Typical data from a survey of a steam plant during a routine maintenance outage are given in Table I. It should be emphasized that during particle counting, no distinction is made between asbestos fibers and other fibers. During the indicated periods, the asbestos workers were engaged at: tearing out insulation; sawing,

installing, or building up insulation; mixing insulation cement; or cutting insulation with a shop band saw. The laborers were engaged primarily in cleaning up scrap insulation.

Control Methods

Hazard Control Standard

To begin a new effort to achieve better control of airborne asbestos fibers within TVA, a hazard control standard on asbestos was developed and is being instituted as part of the overall TVA hazard control plan. This standard is based primarily upon the asbestos dust standard promulgated by the Occupational Safety and Health Administration (OSHA) originally in 1972 and updated in 1974.⁴ The TVA requirements concerning permissible exposure limits, monitoring, medical surveillance, and control methods are identical to the OSHA standard. In addition, the TVA standard includes other requirements applicable to TVA's specific operations.

Exhaust Ventilation

Local exhaust ventilation⁵ is used to control airborne asbestos dust produced by cutting block and pipe insulation with a band saw in the steam plant insulation shops. Atmospheric sampling before and after such ventilation was installed has shown the efficiency of this type of control. Also, down-draft tables are used in some of the shops to control dusts from cutting with hand saws and from other shop work.

Wetting

Wetting has been shown to be an effective method of dust control, particularly in the cleanup of insulation scrap.⁶ Table II shows the effectiveness of wetting reflected in the exposures of two laborers sweeping with brooms to clean up insulation scrap. Wetting of insulation scrap before cleanup is being instituted throughout TVA steam plants.

Wetting is also an effective method of suppressing dust when wall boards that contain

TABLE I
Asbestos Sampling Data

Classification	Monitoring Date ^a	TWAC ^b Fibers/cm ³	PSC ^c Fibers/cm ³
Asbestos worker	4/24	3.1	8.2
	4/25	1.0	3.6
	5/23	4.7	18.1
	5/29	0.7	0.9
	5/30	0.3	0.5
Asbestos worker	5/31	0.6	1.1
	4/24	3.3	7.2
	4/25	1.1	2.7
	4/30	3.5	17.0
	5/23	2.2	13.8
Asbestos worker	5/24	0.0	0.0
	5/25	<0.1	0.3
	5/29	1.1	4.1
	4/24	5.9	14.8
	4/25	1.5	2.4
Asbestos worker	5/29	0.6	3.0
	5/30	0.6	1.5
	5/31	<0.1	0.2
	4/24	1.6	24.6
	4/25	0.2	1.5
Laborer	5/23	<0.1	1.1
	5/25	<0.1	0.3
	4/24	1.7	17.6
	4/25	0.4	2.9
	4/30	3.6	21.5
Laborer	5/25	0.0	0.0
	5/31	<0.1	0.4
	4/24	3.7	6.4
	4/25	1.6	2.4
	5/24	0.0	0.0
	5/25	0.0	0.0

^aAll in 1973.

^bTWAC: Eight-hour time-weighted average airborne concentration. Present threshold limit value is 5 fibers greater than 5 micrometers each in length per cubic centimeter of air (5 fibers > 5 $\mu\text{m}/\text{cm}^3$).

^cPSC: Peak single-sample concentration. Present ceiling limit value is 10 fibers greater than 5 micrometers each in length per cubic centimeter of air (10 fibers > 5 $\mu\text{m}/\text{cm}^3$).

TABLE II
Wet Method Effectiveness of Controlling
Airborne Asbestos Fibers

Task	No. of Samples	Fibers ($> 5 \mu\text{m}/\text{cm}^3$)
Removing dry scrap insulation	13	0.3-13.8
Removing wet scrap insulation	6	0.0-0.3

asbestos are cut with high-speed radial saws. This method has reduced airborne asbestos fibers by 85%.

Control of Waste

Another method of controlling asbestos fibers during cleanup of scrap is to use plastic sheeting to catch the scrap. This is especially effective where insulation work is performed over open-grating floors. Scrap material falling through grating floors may spread fiber contamination over several levels of a plant, thus potentially exposing employees in other areas.

Respiratory Protection

At the present time, the type of respiratory protection used most often by TVA insulators is an air purifying respirator with a replaceable filter, which is approved by the Bureau of Mines and NIOSH for use as protection against the dusts that produce pneumoconiosis.⁷ TVA has not approved the single-use type of air purifying respirator for protection against airborne asbestos fibers, primarily because of concern for the effectiveness of the face seal. In order to comply with the "TVA Hazard Control Standard on Asbestos," powered air-purifying respirators or supplied-air respirators must be worn when the ceiling or the time-weighted average concentrations are reasonably expected to exceed 10 times but not more than 100 times the prescribed limits. Our monitoring program has not yet indicated a need for this type of respiratory protection. However, the standard requires the use of supplied-air respirators and special clothing during removal of insulation that contains asbestos, regard-

less of the concentrations of airborne asbestos that may be present during this process. TVA expects that, for many years to come, insulation that contains asbestos will be removed in TVA steam plants. Therefore, TVA is implementing more stringent requirements concerning protective clothing and respiratory protection during removal of this insulation.

Medical Control

The TVA Division of Medical Services examines workers before employment and periodically thereafter. Asbestos workers are given an annual respiratory health evaluation that includes respiratory history, physical examination, chest X-ray, and pulmonary function testing.

Training

Training is a factor too often overlooked in industrial hygiene control efforts. Informed and trained workers are much less prone to overexposure than those who are left ignorant of the nature and control of the hazards they face. TVA is organizing a training program for insulators and insulator laborers to explain the nature of the potential asbestos hazard. Protective systems and devices and the reasons for their use will be described. Good work practices will be encouraged, and the reasoning behind them will be explained to the workers. Instructors will demonstrate respirators, and the workers will be drilled in their proper use and care. Hazard control requirements for respirator use will be explained, and respirator limitations will be delineated.

Substitution

One of the most effective control measures is substitution of a less hazardous material. Manufacturers have, over the past several years, developed a complete line of thermal insulation materials that do not contain asbestos. For all practical purposes, the thermal insulating properties of these materials are as good as those of materials that con-

Company

Amtex Corp.
Amspec
Atlas Textile
Calsilite
Carborundum
Celotex
Certain-teed Pl
Eagle-Picher
Forty-Eight In
Johns-Manvill
Kenne Corp.
Owens-Corin
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TABLE III
Manufacturers of Asbestos-free Thermal Insulation

Company	Pipe Covering	Blocks	Boards	Blankets	Felts	Cements	Tapes &	
							Sleeves	Cloth
Amtext Corp.				X				X
Amspec	X	X						
Atlas Textile							X	X
Calsilite	X	X						
Carborundum				X	X			
Celotex	X	X	X	X	X	X	X	X
Certain-teed Products	X		X	X				
Eagle-Picher	X	X	X	X	X	X		
Forty-Eight Insulators	X	X	X	X	X	X	X	
Johns-Manville	X	X	X	X	X	X		
Kenne Corp.	X	X	X	X	X	X		
Owens-Corning	X	X	X	X				
Pabco	X	X						
Pittsburgh-Corning	X	X		X				
Rock Wool Mfg.			X	X		X	X	
U.S. Gypsum	X	X	X	X	X	X		

tain asbestos. Table III shows the available types of thermal insulation that do not contain asbestos and the companies that supply such insulation.

TVA is working to replace insulation that contains asbestos with compositions that do not contain asbestos. Responsible persons in the TVA Office of Engineering Design and Construction, the Division of Purchasing, and each individual steam-electric generating plant have been informed of the availability of insulating materials that do not contain asbestos and have been advised that such materials should be used whenever possible. Pure asbestos is no longer specified in the design and construction of new plants. Superintendents of operating plants are phasing out pure asbestos insulation in maintenance insulation. The most common substitutes for asbestos are fibrous glass, rock wool, mineral wool, and ceramic fibers.^{2,3} These appear to be less hazardous than asbestos, although confirmation may come only with detailed toxicological investigations and industrial experience. Fiber glass is a borosilicate glass, mineral and rock wool are basically calcium silicates, and ceramic fibers are aluminum silicate. The nonfibrous constituents of thermal insulation are usual-

ly considered to be "inert" or nuisance particulates even when they are airborne and respirable. These materials primarily are composed of various types of silicates, usually calcium silicate or magnesium silicate.

The substitution of materials that do not contain asbestos for those that do does not necessarily eliminate all health hazards. In some formulations that do not contain asbestos the physiological effect of exposure is apparently not well defined. Some formulations may, for example, prove to be less toxic but may be more dusty in use; in these cases, the hazard potential of the substitute may equal or even exceed that of the asbestos formulation. The crystalline form of some mineral fibers has not yet been well defined, and the absence of hazardous quantities of trace constituents has not yet been confirmed.

Nor does the substitution of less hazardous materials for those that contain asbestos eliminate the need for dust suppression. In many instances concentrations of nuisance materials may exceed the Threshold Limit Value of 10 mg/m³ and therefore must be controlled by dust suppression.

Further research is needed to find substitutes for asbestos that are both acceptable

in terms of hazard control and that meet the important considerations in selecting insulating materials, such as cost, engineering performance in reducing heat loss (or gain), ease of application, durability and ease of maintenance.

Summary

The Tennessee Valley Authority has implemented an asbestos control program in its steam-electric generating plants that will eventually result in minimal exposure to airborne asbestos fibers. The program is based primarily upon the substitution of thermal insulation materials that do not contain asbestos fibers for those that do. Insulating materials that contain no asbestos are available commercially and appear to be acceptable substitutes. However, research is needed to assure that these materials meet both engineering and hazard control requirements. Other control methods such as local exhaust ventilation, wetting, respiratory protection, and training are also used and will continue to be required in the future to control nuisance dusts even when apparently less hazardous materials are substituted for those that

contain asbestos.

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NIH Biohazards Safety Guide

The Division of Research Services of the National Institutes of Health has prepared a manual of safety procedures and guidelines to protect employees working with biological agents, tissue cultures and animals. The *NIH Biohazards Safety Guide* contains information on the development of safety programs, the identification and classification of hazardous microorganisms, procedures for the control of biohazards and the monitoring of laboratories.

Single copies can be obtained without charge from the Chief, Environmental Services Branch, DRS, Building 13, Room 3K04, National Institutes of Health, Bethesda, Maryland 20014. Multiple copies can be purchased from the Superintendent of Documents, GPO, Washington, D.C., for \$3.85 each. The GPO Stock Number is 1740-00383.

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Introduction

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