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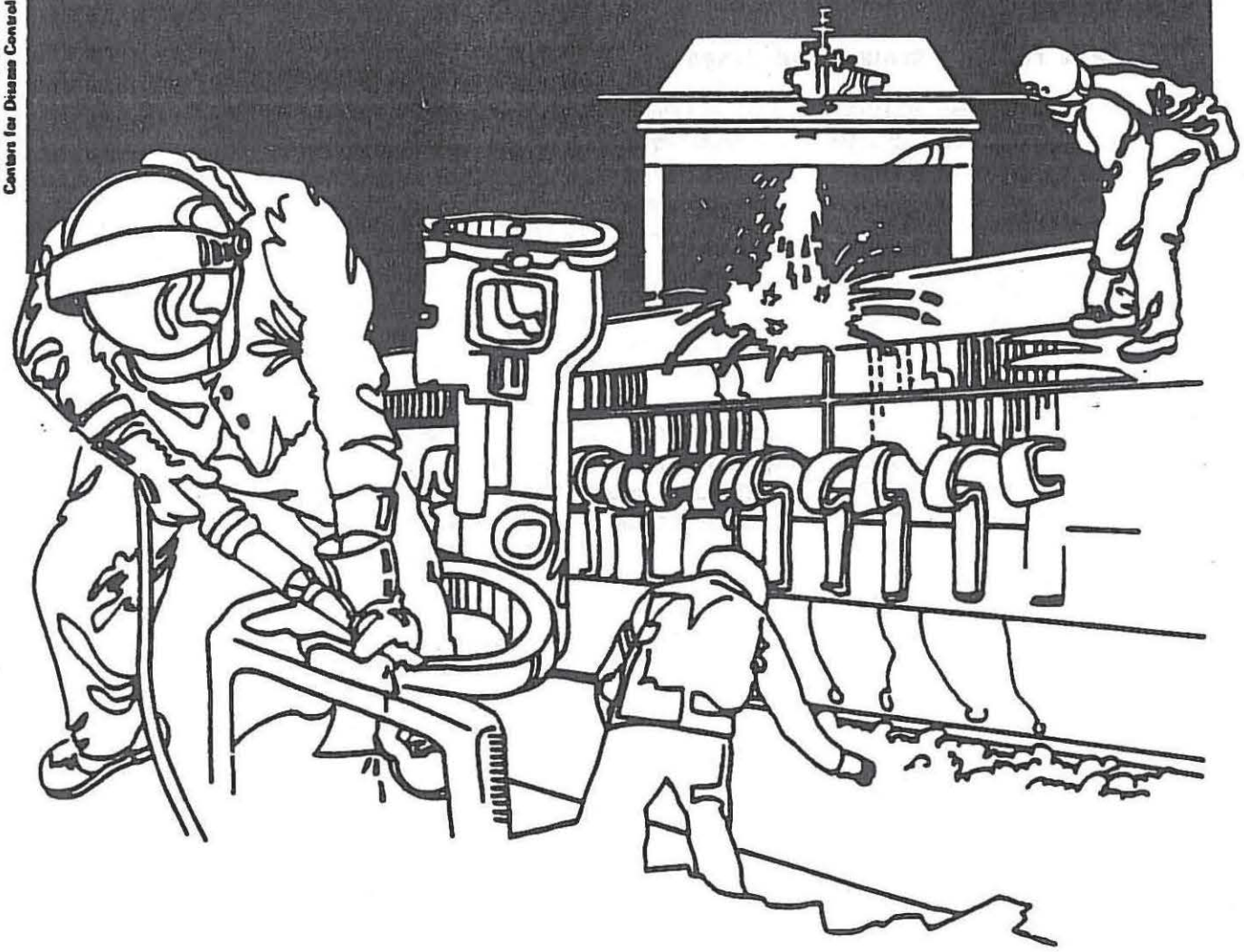

Health Hazard Evaluation Report

HETA 85-021-1654
PORTSMOUTH NAVAL SHIPYARD
PORTSMOUTH, NEW HAMPSHIRE

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

HETA 85-021-1654
Portsmouth Naval Shipyard
January 1986

NIOSH Investigator:
Kevin P. Mc Manus, I.H.

I. SUMMARY

On October 15, 1984 the National Institute for Occupational Safety and Health (NIOSH) received a request to conduct a Health Hazard Evaluation at the Portsmouth Naval Shipyard, Portsmouth, New Hampshire. The request was concerned with complaints of nose bleeds and upper respiratory tract irritation among employees in the insulation shop due to possible exposure to asbestos, fibrous glass and magnesium silicates.

NIOSH conducted environmental sampling and a questionnaire medical survey between April 8-11, 1985. Twenty-four air samples were collected throughout Building 2 (insulation shop) and analyzed for total fiber count. Four additional samples were analyzed by transmission electron microscopy (TEM) for fiber identification.

Nine air samples were collected to determine respirable dust (silica) exposure, primarily in the cement room. Bulk samples of each of the three types of cement were collected and analyzed using x-ray defraction for determination of quartz content.

The results of environmental sampling for asbestos fibers, silica, and respirable dust were all below recommended exposure limits and not significantly different from background readings which could be measured outdoors. The laboratory indicated that the TEM results were not significantly different from zero.

Seventy-three (out of a possible 100) completed medical questionnaires were received from insulators on all three shifts. The questionnaire was designed to be self-administered to determine the incidence of self reported symptoms, especially nose bleeds.

The symptom most frequently reported was sneezing, experienced by 59 employees (81%), followed by runny nose 53 (73%), frequent colds 52 (72%), and skin irritation 52 (72%). Forty-six employees (63%) reported having some occurrence of nose bleeds.

Based on the results of this investigation it has been determined that employee symptoms were probably caused by the irritating properties of magnesium silicate (dessicant), portland cement (alkaline) and fibrous glass (mechanical action), and poor work practices which result in direct contact and transfer of irritating dusts. Although airborne exposures are within the environmental criteria, and symptoms were not evidence of systemic injury, action should be taken to reduce the incidence of upper respiratory irritation which is a result of workplace exposure. Recommendations are found in the body of the report to help reduce the amount of irritation.

Keywords: Sic 3731, Irritation, Magnesium-Silicate, Portland Cement, Upper Respiratory, Nose-bleeds, Fibrous-glass.

Bulk samples of each of the three types of cement were collected and analyzed using x-ray defraction for determination of quartz content.

Seventy-three completed medical questionnaires were received from a total of 100 insulators on all three shifts, a 73% response rate. The questionnaire was designed to be self-administered to determine the incidence of self reported symptoms, especially nose bleeds. The questionnaire contains a certain bias, as specific symptoms were elicited. However, this investigation was not purporting to clinically measure the presence or severity of nose bleeds.

V. EVALUATION CRITERIA

Environmental Standards

The environmental criteria described below are intended to represent airborne concentrations of substances to which workers may be exposed for eight hours a day, 40 hours per week for a working lifetime without adverse health effects. Because of wide variation in individual susceptibility, a small percentage of workers may experience discomfort from some substances at concentrations at or below the recommended criteria.[2] A smaller percentage may be more seriously affected by aggravation of a pre-existing condition or by a hypersensitivity reaction. The time-weighted average (TWA) exposure refers to the average concentration during a normal 8-hour workday. The Short-Term Exposure Limit is the maximum allowable concentration, or ceiling, to which workers can be exposed during a period of up to 15 minutes, provided that no more than four excursions per day are permitted, with at least 60 minutes between exposure periods.

The primary sources of environmental evaluation criteria considered for this study were: 1) NIOSH criteria documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) federal occupational health standards. The criteria judged most appropriate for this study are as follows:

Substance	NIOSH Recommended Criteria	ACGIH TLV	OSHA Standard
Crystalline Silica	50 ug/M^3	$\frac{10 \text{ mg/M}^3}{\%SiO_2+2}$	$\frac{10 \text{ mg/M}^3}{\%SiO_2+2}$
Fibrous Glass	3 fibers/cc or 5 mg/M^3	10 mg/M^3	15 mg/M^3
Asbestos	0.1 fibers/cc	0.2-2.0 f/cc	2.0 f/cc
Magnesium Silicate	N/A	10 mg/M^3	15 mg/M^3
Calcium Silicate	N/A	10 mg/M^3	15 mg/M^3
Portland Cement	N/A	10 mg/M^3	50 mppcf

II. INTRODUCTION

On October 15, 1984 the National Institute for Occupational Safety and Health (NIOSH) received a request from an authorized representative of the United Brotherhood of Carpenters and Joiners of America to conduct a Health Hazard Evaluation at the Portsmouth Naval Shipyard, Portsmouth, New Hampshire. The request was concerned with employee complaints of nose bleeds and upper respiratory tract irritation in the insulation shop due to possible exposure to asbestos, fibrous glass and magnesium silicates.

III. BACKGROUND

The insulation shop is located on the west side of dry-dock #1, inside the controlled industrial area of the shipyard. Approximately 100 employees work out of this shop. Only a few employees work in the shop full time. Asbestos is not currently used as an insulating material in the shop. However, the same shop previously was used for preparation and storage of asbestos insulation material. Attempts have been made to remove all asbestos material from the building and its surfaces. New walls, ceilings and floor coverings have been added to seal in any residual asbestos and prevent it from becoming airborne.

The insulation shop presently uses fibrous glass, magnesium silicate and portland cement to manufacture pipe insulation for Navy ships and submarines. Most employees of this shop also perform rip-outs and pipe covering on board these vessels. Air-supplied respirators are used during all rip-outs.

Employee exposures while ship-board was not a concern of the insulators at this time. Rather, their concern was due to numerous complaints of rhinitis, nose bleeds and upper respiratory irritation while working inside the insulation shop.

A NIOSH industrial hygienist conducted environmental sampling and a questionnaire medical survey between April 8-11, 1985. Aggregate questionnaire data was provided to both Union and Management officials on April 11. All environmental results, except TEM analysis, were telephoned to Shipyard officials On May 15, 1985.

IV. EVALUATION DESIGN AND METHODS

Twenty-four air samples were collected throughout Building 2 (insulation shop) and analyzed according to NIOSH Method 7400 for total fiber count.[1] Four additional samples were analyzed by transmission electron microscopy (TEM) for fiber identification.

Air samples were collected at a height approximating the breathing zone of employees. They were collected using Nucleopore 25mm mixed cellulose ester filters (open face) and MSA Model G battery-powered sampling pumps calibrated at 2.0 liters per minute (lpm).

Nine air samples were collected using tared PVC filters attached to a cyclone and analyzed gravimetrically to determine respirable dust (silica) exposure, primarily in the cement room.

Bulk samples of each of the three types of cement were collected and analyzed using x-ray defraction for determination of quartz content.

Seventy-three completed medical questionnaires were received from a total of 100 insulators on all three shifts, a 73% response rate. The questionnaire was designed to be self-administered to determine the incidence of self reported symptoms, especially nose bleeds. The questionnaire contains a certain bias, as specific symptoms were elicited. However, this investigation was not purporting to clinically measure the presence or severity of nose bleeds.

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Magnesium Silicate	N/A	10 mg/M^3	15 mg/M^3
Calcium Silicate	N/A	10 mg/M^3	15 mg/M^3
Portland Cement	N/A	10 mg/M^3	50 mppcf

NOTE: ppm = parts per million parts of air
mg/M^3 = milligrams per cubic meter of air
ug/M^3 = micrograms per cubic meter of air
mppcf = millions of particles per cubic foot

Health Effects

Crystalline Silica

The crystalline forms of silica can cause severe tissue damage when inhaled. Silicosis is a form of pulmonary fibrosis caused by the deposition of fine particles of crystalline silica in the lungs. Symptoms usually develop insidiously, with cough, shortness of breath, chest pain, weakness, wheezing, and nonspecific chest illnesses. Silicosis usually occurs after years of exposure, but may appear in a shorter time if exposure concentrations are very high. This latter form is referred to as rapidly-developing silicosis, and its etiology and pathology are not as well understood. Silicosis is usually diagnosed through chest x-rays, occupational exposure histories, and pulmonary function tests. The manner in which silica affects pulmonary tissue is not fully understood, and theories have been proposed based on the physical shape of the crystals, their solubility, toxicity to macrophages in the lungs, or their crystalline structure. There is evidence that cristobalite and tridymite, which have a different crystalline form from that of quartz, have a greater capacity to produce silicosis.[3]

Dusts

The potential dust exposures related to work in the insulation shop include cement, calcium silicate, magnesium silicate and fibrous glass. All of these dusts possess irritant properties: cement due to its' alkalinity, calcium and magnesium silicate due to their absorbent (hygroscopic) quality and fibrous glass due to mechanical action.

The irritant properties of all these dusts can cause irritation of the sensory receptors of the bronchial mucous membrane, leading to a reflex contraction of the smooth muscle (bronchial obstruction). These dusts may be generally classified as nuissance dusts, but exposure to them may exacerbate pre-existing chest conditions like asthma, bronchiectasis, and bronchitis.[4]

Asbestos

Increased health risk resulting from occupational exposure to asbestos has been well documented in the scientific literature. Initially, asbestos was associated with a chronic and debilitating lung disease called asbestosis, which normally occurred following long-term exposures to high levels of asbestos fibers. More recently, asbestos has also been linked to several types of cancer, including mesothelioma (a rare cancer of the chest and abdominal lining) and cancers of the lung, esophagus, stomach and colon. These cancers usually appear many years after the initial

contact with asbestos, and sometimes result from short-term and/or low level exposures. This indicates that there may not be a "safe" level of exposure to asbestos for the elimination of all cancer risk. Additionally, cigarette smoking in combination with asbestos exposure greatly increases the risk of developing lung cancer.[5]

The Occupational Safety and Health Administration (OSHA) standard for asbestos, limits exposure to 2 fibers/cc (greater than 5 microns in length) averaged over an 8-hour workday with a ceiling concentration of 10 fibers/cc not to be exceeded over a fifteen-minute period. There is also a provision for medical monitoring of workers routinely exposed to levels in excess of 0.1 fibers/cc. This exposure standard was devised to minimize the risk of developing asbestosis. OSHA is presently going through the rule-making process to lower this standard. The American Conference of Governmental Industrial Hygienists (ACGIH), an independent scientific body, also recommends chrysotile asbestos exposures be limited to between 0.2 and 2 fibers/cc, depending on the type of asbestos present, over an 8-hour workday (with a notation that asbestos is a human carcinogen).

NIOSH currently recommends that occupational exposure to asbestos be kept to the lowest feasible level that can reliably be determined. This recommendation is based on the proven human carcinogenicity of asbestos and on the absence of a known threshold exposure level below which there is no risk of cancer. For most industrial settings, the lowest feasible limit for reliable detection of asbestos corresponds to a level of 0.1 fibers/cc.

Fibrous Glass

Different dimensions of fibrous glass will produce different biologic effects. Large diameter (greater than 3.5 microns) fibers have been found to cause skin, eye, and upper respiratory tract irritation; a relatively low frequency of fibrotic changes; and a very slight indication of an excess mortality due to nonmalignant respiratory disease. Smaller diameter (less than 3.5 microns) fibrous glass has not been conclusively related to health effects in humans but glass fibers of this dimension have only been produced since the 1960's. Smaller diameter fibers have the ability to penetrate to the alveoli and this potential is cause for concern. On the basis of available information, NIOSH does not consider fibrous glass to be a substance that produces cancer as a result of occupational exposure. Fibrous glass does not appear to possess the same potential as asbestos for causing health hazard.[6]

VI. RESULTS

Environmental

The results of silica analysis of the three bulk samples indicated that HI-Temp contained 9.4% quartz; Portland Cement, less than 0.75% quartz; and Super, 3.2% quartz.

Nine respirable dust air samples indicated exposures ranging from 8.7 ug/M^3 to 30 ug/M^3. Based on the results of the bulk samples, the maximum silica exposure would range from 0.82 ug.M^3 to 2.82 ug/M^3. These results indicate very little respirable dust, and are summarized as follows:

Sample No.	Location	Volume	Result (ug/M^3)	Criteria	
				Silica	Dust
4913911	Lunch room	1229 L	29	50	5000
41013915	Workbench	750 L	30	50	5000
41013916	Mud room	755 L	17	50	5000
41013953	Lunch room	751 L	20	50	5000
41113957	Lunchroom	765 L	27	50	5000
41113962	Mud room	753 L	8.7	50	5000
4913963	Workbench	1258 L	28	50	5000
4913964	Mud room	1299 L	11.5	50	5000
41113266	Workbench	751 L	27	50	5000

Eighteen samples were analyzed by phase contrast microscopy for total fibers. The calculated result is the total number of fibers (all types) greater than 5 microns in length per cubic centimeter or air. Results are summarized below.

Sample no.	Location	Volume	Result (Fibers/cc)
410117	Band Saw	886 Liters	0.002
410119	Lunchroom	850	*0.0017
410125	Foreman's office	844	*0.0018
410138	Fab Workbench	874	*0.0017
411137	Storage rm	852	0.0018
411140	Attic	882	*0.0017
411141	Lunchroom	900	*0.0017
411143	Fab Workbench	890	*0.0017
411145	Band Saw	888	*0.0017
4911	Personal	410	*0.0036
4912	Personal	352	0.005
4915	Fab Workbench	833	0.0018
49127	Pad room	884	0.0017
49224	Band Saw	632	*0.0023
49229	Pad room	634	*0.0023
49232	Fab Workbench	630	*0.0023
49236	Lunchroom	562	*0.0027
411148	Pad room	894	*0.0017

* = Less than the limit of detection calculated for that sample. Results that are reported above the limit of detection have not been field blank corrected, and as such the reported numbers are probably higher than actual exposure. Results less than 0.01 f/cc are generally not considered significant for the phase contrast method.

The four samples selected for transmission electron microscopy were collected in the storage room, lunchroom, pad room, and at the band saw operation. In all cases, the laboratory reported that the asbestos fiber concentration was not significantly different from zero. In only one case (band saw) was an asbestos fiber found that could be observed by phase contrast microscopy. The TEM analyses revealed the following characteristics.

Sample No. 4913 (Lunchroom) contained one amosite fiber, 1.88 microns in length and 0.56 microns in diameter, within the area of the sample analyzed. This amounts to 2,936 fibers per filter, or 0.003 fibers per cubic centimeter (f/cc). The laboratory reported a total of 46,972 structures on the filter composed of many large particles and combustion aerosol.

Sample No. 4914 (Band Saw) contained one tremolite fiber, 10.31 microns in length and 0.31 microns in diameter, within the area of the filter analyzed. This was the only fiber that could have been observed by phase contrast microscopy. This calculates to 3,014 fibers per filter, or 0.003 f/cc. The laboratory reported a total of 198,953 total structures on the filter composed of acicular particles with pointed ends.

Sample No. 410128 (Pad Room) contained one chrysotile fiber, 1.19 microns in length and 0.06 microns in diameter, within the area of the filter analyzed. This calculates to 2,851 fibers per filter, or 0.003 f/cc. The laboratory reported a total of 79,832 total structures on the filter composed of acicular particles with pointed ends and a few large particles.

Sample No. 410134 (Storage Room) contained two chrysotile fibers and one amosite fiber, ranging from 1.38 to 2.50 microns in length and 0.06 microns in diameter, within the area of the filter analyzed. This calculates to 8,870 fibers per filter, or 0.010 f/cc. The laboratory reported a total of 47,308 total structures on the filter composed of acicular particles, spheres, and combustion aerosol.

Medical

Sixty-seven males and six females responded to the health effects questionnaire, a 73% response rate. The average age of respondents was 35, and the average length of employment 6.6 years. Thirty-two of the seventy-three (44%) were smokers.

The symptom most frequently reported was sneezing, experienced by 59 employees (81%), followed by runny nose 53 (73%), frequent colds 52 (72%), and skin irritation 52 (72%). Forty-six employees (63%) reported having some occurrence of nose bleeds.

Those who indicated a positive response to nose bleeds were asked to identify the frequency and severity of the problem. The average frequency of nose bleeds was approximately twice per week, while the severity of the problem was most commonly, spotting when blowing ones nose.

Only one employee responded that the nose bleeds do not stop on their own. Eleven employees reported that nose bleeds were more severe than spotting, but stop on their own. However, their occurrence was less frequent than the average.

The presence of symptoms was not shift dependent. Employees on all three shifts reported symptoms with equal frequency.

Only 19 employees indicated that they have reported the nose bleeds to the shipyard medical department (40% of those reporting the symptom).

VII. DISCUSSION

The results of the phase contrast microscopy, which looks at all fibers of all types greater than 5 microns in length, indicated very low airborne fiber contamination within the building. The results are not significantly different from background readings which could be measured outdoors.

The TEM results, which counts all asbestos fibers, even the ones too small to be seen by phase contrast microscopy and thus not included in the OSHA standard, indicated that asbestos levels are at or below background levels. The laboratory indicated that the results were not significantly different from zero.

The amount of respirable dust measured in the shop was extremely low. Even if one were to assume that all of the respirable dust was free crystalline silica, the highest concentration measured was 30 micrograms per cubic meter, which is below the NIOSH criteria of 50 ug/M^3.

The results of the questionnaire survey indicated that a significant number of employees are experiencing symptoms related to work in this building. However, employee exposures to chemicals within the building are within all environmental criteria. The results suggest that the employee symptoms are not a result of systemic action, rather, they are likely the result of the irritating properties of the dusts. Observation of the work practices indicated that the most likely exposure mechanism is direct physical contact. The dusts enter the upper respiratory region because employees with dust on their hands, rub their nose and deposit the irritating dust .

VIII. CONCLUSIONS

Based on the results of this investigation it has been determined that employee symptoms were probably caused by the irritating properties of magnesium silicate (dessicant), portland cement (alkaline) and fibrous glass (mechanical action), and poor work practices which resulted in direct contact and transfer of the irritating dusts. Although airborne exposures are within the environmental criteria, and symptoms were not evidence of systemic injury, action should be taken to reduce the incidence of upper respiratory irritation which is a result of workplace exposure.

IX. RECOMMENDATION

Employees should pay rigorous attention to personal hygiene to prevent the transmission of the dust from their hands to their nose and eyes. Barrier creams or moisturizers may also alleviate much of the irritation caused by these materials.

X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:	Kevin P. McManus, I.H. Regional Industrial Hygienist NIOSH - Region 1 1401 JFK Federal Building Boston, Massachusetts
Originating Office	Hazard Evaluation and Technical Assistance Branch Division of Surveillance, Hazard Evaluations and Field Studies Cincinnati, Ohio

XI. REFERENCES

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XII. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia, 22161. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Portsmouth Naval Shipyard, Portsmouth, N.H.
2. Metal Trades Council, Portsmouth, N.H.
3. United Brotherhood of Carpenters and Joiners of America
   Washington, D.C.
4. U.S. Department of Labor - OSHA, Region 1, Boston, Ma.

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

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