U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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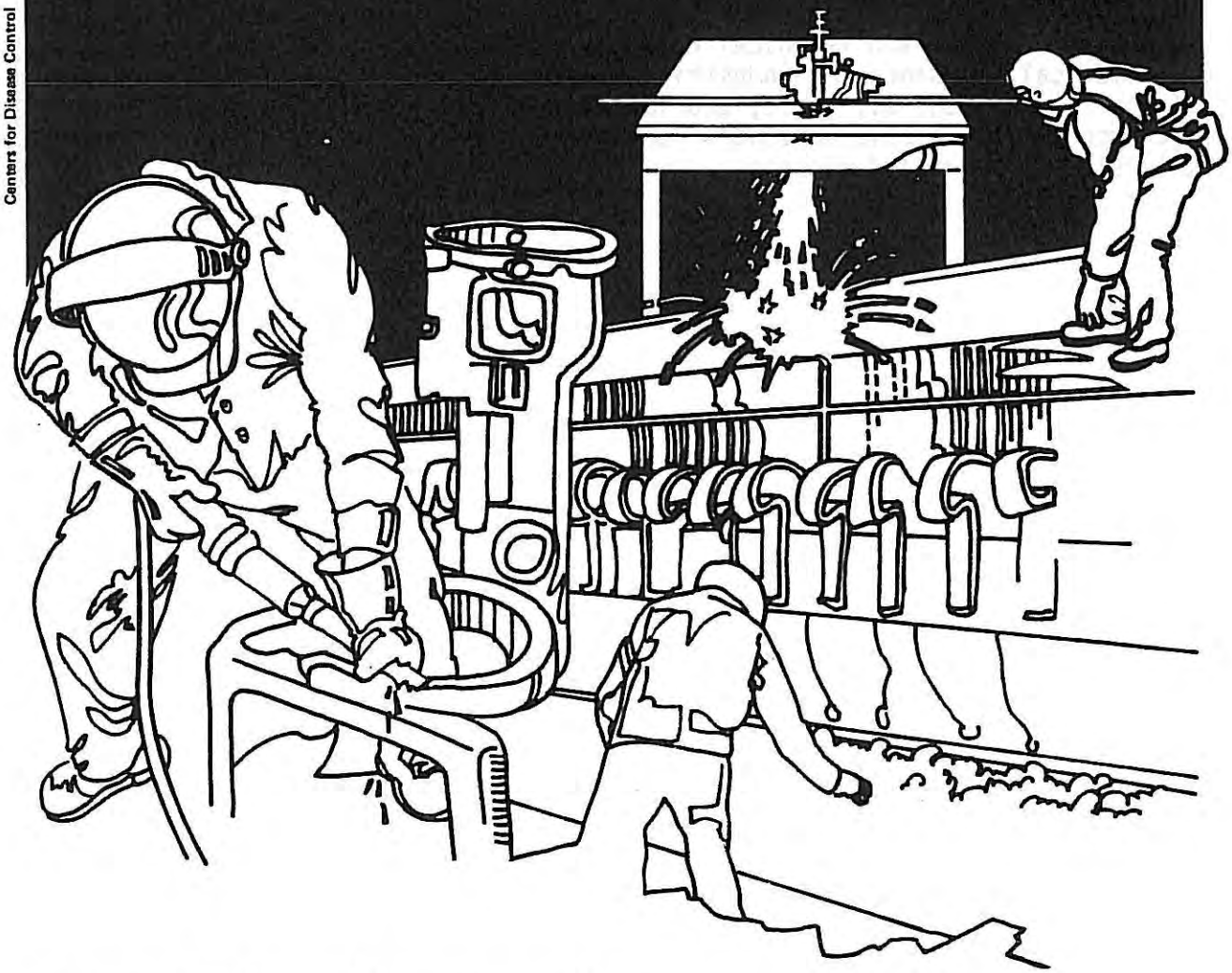
NIOSH



Health Hazard Evaluation Report

HETA 80-197-1215
PACIFIC, GAS AND
ELECTRIC-GEYERS FACILITY
SAN FRANCISCO, CALIFORNIA

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.

HETA 80-197-1215
NOVEMBER 1982
PACIFIC, GAS AND
ELECTRIC-GEYERS FACILITY
SAN FRANCISCO, CALIFORNIA

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I. SUMMARY

On June 30, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) from the local union representing employees at PG&E Geysers facility near Healdburg, California. The requestor was concerned that employees may be exposed to ferrous sulfates, hydrogen sulfide, fibrous glass, several other metals. The incidence of heart attacks, high blood pressure, digestive problems, fatigue, sleepiness and chest colds were perceived by workers to be increased.

On August 7, 1980, NIOSH conducted an initial environmental and medical survey of three power plant facilities (units 3/4, 11 and 15) at the Geysers. On December 16-17, 1980, NIOSH conducted a follow-up environmental survey to evaluate employees exposure to vanadium pentoxide, inorganic mercury and arsenic, nuisance dust, sodium hyroxide and asbestos. Three air samples were collected for vanadium pentoxide but none was detected. Eleven personal air samples were collected for inorganic mercury and none was detected. Twenty-three air samples were collected for inorganic arsenic of which two samples detected arsenic at a concentration of 0.07 micrograms per cubic meter of air (mg/m^3) which is below the CAL-OSHA standard and NIOSH recommended ceiling limit of 2 mg/m^3. Eleven air samples collected for nuisance dust ranged in concentration from non-detectable to 1.26 milligrams per cubic meter of air (mg/m^3) which is below the CAL-OSHA standard (10 mg/m^3). One sodium hydroxide air sample was collected, but none was detected. Four asbestos air samples were collected, but none was detected. A bulk sample of a flocculant was collected and analyzed for acrylamide and none was detected. Two bulk samples of sand were analyzed for inorganic arsenic and none was detected. Eleven bulk samples of sediment or sludge were analyzed for metals. The major contaminants identified were iron, magnesium, sodium and aluminum. Two bulk samples of insulation were analyzed for asbestos, but none was identified.

Medical interviews revealed concerns regarding a suspected high incidence of heart attacks, hypertension, and stress. A case-finding questionnaire was sent to all Geysers employees in IBEW Local 1245, asking for information on heart attacks among workers under age 65. A total of five heart attacks over the length of employment were reported among a population of approximately 280 workers, which is not greater than the expected rate (at 1.46 per year). It was not possible to design an epidemiological evaluation of the potential hypertension or stress-related symptoms because of the lack of an adequate comparison group.

Based on the environmental air and bulk samples collected during the dates of this survey, overexposure to vanadium pentoxide, mercury, arsenic, nuisance dust, sodium hydroxide, asbestos and acrylamide did not exist. Workers did not appear to have a greater incidence of heart attacks than expected. Recommendations are included in section VIII to help reduce unnecessary worker exposures.

KEYWORDS: SIC 4961 (Steam Supply) Geothermal Power, Geysers.

II. INTRODUCTION

On June 30, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from an authorized representative of the International Brotherhood of Electrical Workers (IBEW), Local #1245, Walnut Creek, California. The requestor was concerned that employees (power plant operators, welders, electricians, machinists and mechanics) working at Pacific Gas and Electric (PG&E) Geysers facility near Healdsburg, California may be exposed to ferrous sulfates, hydrogen sulfide, fibrous glass, arsenic, lead and other metals. In addition, heart attacks, high blood pressure, digestive problems, fatigue, sleepiness and chest colds were perceived to have increased.

On August 7, 1980, NIOSH conducted an initial environmental and medical survey of the Geysers (units 3/4, 11 and 15) with union and management representatives. Based on discussions and observations a follow-up environmental survey was conducted on December 16 and 17, 1980, to evaluate potential exposure to the following chemicals: vanadium pentoxide, inorganic mercury, inorganic arsenic, nuisance dust, sodium hydroxide, asbestos and acrylamide. The air and bulk sample results were telephoned to the union and company industrial hygienists as soon as they became available.

Interviews of workers were conducted by NIOSH medical staff revealing concerns regarding a suspected high incidence of heart attacks, hypertension, and stress. The workers stated that factors contributing to perceived stress were forced overtime, extended periods of being on call for additional shifts, and the approximately 45 minute drive in from the main roadway to the work site on a hazardous gravel road. In addition, many workers complained of persistent eye and skin irritation from the corrosive gases exhausted at the work site and of frequently wet work areas.

III. BACKGROUND

In November, 1977, NIOSH conducted a health hazard evaluation (HHE 77-121-490) survey of PG&E Company's geothermal power plant (units 5 and 6) near Healdsburg, California to determine whether hydrogen sulfide gas exposures caused workers' dermatitis and upper respiratory problems. It was determined that:

1) "Employees working in and around Unit #11 where the hydrogen sulfide (H_2S) abatement system is in operation, can develop dermatitis and/or pharyngitis unless proper work practices are followed".

2) "The toxic agents(s) which are responsible for the dermatitis and upper respiratory problems are probably contained in the H_2S abatement system sludge, but the specific substance(s) has not been identified".

3) "The H_2S gas exposure at the Geysers does not seem to present an occupational health problem to the workers".

The Geysers Power Plants use a process where geothermal energy is converted to electrical power. Natural gases and water vapor, evolving from the cooling of the earth's core, heat the near surface water which produces steam. The steam escapes to the atmosphere via hot springs or fumaroles. Union Oil Corporation conducts all drilling operations involving sinking of wells and capturing the steam which it sells to PG&E.

The steam is piped to one of the power plant units where it is used to turn the turbine blades. After the steam passes through the turbine, it flows to a condenser which converts it to hot water. The hot water is piped to a cooling tower after which the surplus cool water is reinjected into the steam-producing reservoir. Non-condensable gases are carried along with the hot water into the cooling tower. The only gas thought to present a potential air contaminant problem is hydrogen sulfide (H_2S). Several metals (inorganic mercury and arsenic) may be a potential health hazard as a result of the cooling tower drift and air pollution abatement equipment repair. As part of the H_2S air pollution abatement program, two processes were designed to remove H_2S from the air vented to the environment from the coolings towers. The older process uses an iron catalyst to oxidize H_2S to elemental sulfur and water. The sulfur is part of a precipitated sludge which has the following components: 63% sulfur, 19% iron and 17% oxygen and hydrogen with the remaining one percent of the sludge containing over 20 minerals and metals in trace quantities. The more recently designed process (STRETFORD PROCESS) produces elemental sulfur for processes condensing steam. This process scrubs non-condensible gases from the condenser ejector with an aqueous alkaline solution, which includes vanadium pentoxide, where hydrosulfide is formed and oxidized to form elemental sulfur. The process is 99% effective in removing H_2S from the condenser off-gases. There was also employee concern that sodium hydroxide exposures may occur during caustic tank servicing or repairs, asbestos exposures during turbine repairs, and acrylamide monomer (flocculant) exposure while working in the polymer room (unit 3/4). In the November, 1977 HHE (77-121-490) recommendations were made to help alleviate the eye and skin irritation found among workers at the Geysers Facility. Although the current request involved stress rather than irritation, many workers mentioned in interviews with NIOSH medical staff that they experienced continuing eye and skin irritation on a frequent basis.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

Several sampling techniques were used to evaluate the suspected contaminants which included: vanadium pentoxide, inorganic mercury, inorganic arsenic, nuisance dust, sodium hydroxide, asbestos and acrylamide. Personal and area air samples were collected at sites 3/4, 11 and 15. Airborne samples were collected using a sampling

train (calibrated vacuum pump and appropriate collection medium) through which a known volume of air is passed. In some instances, only bulk samples were collected and analyzed for the contaminants listed above. The following is a description of the sampling and analytical techniques used to characterize the airborne contaminant concentrations.

1) Vanadium Pentoxide and Nuisance Dust

Airborne samples were collected on a 37-millimeter (mm) cassette with filter (M-5) for a prescribed time at a flow rate of 1.5 liters per minute (lpm). Nuisance dust was determined gravimetrically, and vanadium pentoxide was analyzed by NIOSH Physical and Chemical Analytical Method (P&CAM) No. S-391. The analytical limit of detection for Vanadium was five micrograms per sample.

2) Inorganic Mercury

Air was drawn through a 150 milligram impregnated charcoal tube. The vacuum pump operated at a flow rate of 100 cubic centimeters per minute. The samples were analyzed by NIOSH method P&CAM No. S-199. The limit of detection was 0.5 micrograms per tube.

3) Inorganic Arsenic

Air samples were collected on a 37-mm cassette and filter (either M-5 or AA) at a flow rate of 1.5 lpm. The samples were analyzed by NIOSH method P&CAM S-309. The limit of detection was 0.02 micrograms per sample.

Two bulk samples of sand were collected in scintillation vials. The samples were analyzed by graphite furnace atomic absorption spectroscopy. The limit of detection was 0.2 micrograms per sample based on a 20 milligram sample weight.

4) Sodium Hydroxide

One air sample was collected, using a 37-mm cassette with a AA filter, at a flowrate of 1.5 lpm. The sample was analyzed using NIOSH method P&CAM No. 173. The limit of detection was two micrograms per filter.

5) Asbestos

Asbestos air samples were collected using a 37-mm cassette with a AA filter at a flowrate of 1.5 lpm. The samples were analyzed by NIOSH method P&CAM no. 239 utilizing Phase Contrast Microscopy. The limit of detection was determined to be 0.03 fibers/field or 4500 fibers/filter. Bulk samples of suspect material were analyzed by the same method.

6) Acrylamide

One bulk sample was submitted to the laboratory for analysis of acrylamide. The sample was analyzed with the OSHA method No. 21 with modifications due to the collection matrix being water. The modifications were in the selection of columns and the temperature program of the gas chromatograph. The detection limit for acrylamide in the water matrix was 17 micrograms per sample.

7) Bulk Samples for Metals

Eleven bulk samples were collected in scintillation vials and submitted to the laboratory for qualitative analysis of trace metals by inductively coupled plasma-atomic emission spectroscopy. Approximately 29 metals were included in the analysis.

B. MEDICAL

A brief questionnaire was mailed to approximately 300 permanent workers employed at the Geysers Facility, inquiring whether they knew of any Geysers workers who had suffered heart attacks in the past several years. This case-finding effort was intended to determine whether in fact there was an increased incidence of heart attacks at the Geysers Facility which should be further investigated. The number of reported attacks was compared with the total number of permanent workers to give an incidence rate, which was then compared to the national rate for white males in this age range because the workforce is predominantly caucasian.

All workers who were interviewed regarding the potentially stress-related problems at the Geysers Facility were also asked about dermatitis and eye irritation. Most reported that this was a frequent and persistent problem.

Although it was felt by NIOSH investigators that many of the workers interviewed were in fact experiencing job-related stress, the fact that there was no permanent workers doing similar tasks at the Geysers Facility who were not subject to forced overtime, periods of being on call for extra shifts, and the drive into the work site described above, it was not possible to design a study which could have assessed the work-relatedness of the workers' symptoms.

V. EVALUATION CRITERIA AND HEALTH EFFECTS

A. Environmental

Occupational exposure criteria have been developed to evaluate worker's exposure to chemical substances. The criteria are based on the best available information from industrial experience, from experimental human and animal studies, and, when possible from a combination of the three. These values below represent concentrations to which it is believed that nearly all workers may be exposed for an 8-10 hour day, 40-hour work week throughout a lifetime without experiencing adverse health effects.

Three sources of criteria generally used to evaluate the workroom concentrations of air contaminants: (1) NIOSH criteria for recommended standards; (2) recommended Threshold Limit Values (TLV's) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), 1981; and (3) California-Occupational Safety and Health Administration (CAL-OSHA) standards (1981),

TABLE A

Substance	Time Weighted Average (TWA)[a]	Ceiling Value
Vandium Pentoxide (NIOSH)		0.05 mg/m^3 [(b)] (15 min)
Vandium Pentoxide (CAL-OSHA)		0.5 mg/m^3
Inorganic Mercury (NIOSH)	0.05 mg/m^3	
Inorganic Mercury (CAL-OSHA)	0.05 mg/m^3	0.1 mg/m^3
Inorganic Arsenic (NIOSH)		0.002 mg/m^3 (15 min)
Inorganic Arsenic (CAL-OSHA)	0.1 mg/m^3	
Nuisance Dust (NIOSH)		
Nuisance Dust (CAL-OSHA)	15.0 mg/m^3	
Sodium Hydroxide (NIOSH)		2.0 mg/m^3 (15 min)
Sodium Hydroxide (CAL-OSHA)		2.0 mg/m^3
Asbestos (NIOSH)	0.1 fibers/cc [(c)]	0.5 fibers/cc (15 min)
Asbestos (CAL-OSHA)	2 fibers/cc	10 fibers/cc
Acrylamide (NIOSH)	0.3 mg/m^3	
Acrylamide (CAL-OSHA)	0.3 mg/m^3	

(a) TWA - NIOSH exposure is based on a workday up to 10 hours long, whereas the CAL-OSHA Standard is based on an 8-hour workday.

(b) mg/m^3 - milligrams of a substance per cubic meter of air.

(c) fibers/cc - fibers per cubic centimeter of air.

B. Medical

The annual incidence for heart attacks among white males in the United States is 489 per 100,000 [10]. For the permanent worker population of approximately 300 at the Geysers Facility, the corresponding expected incidence of heart attack would be 1.46 per year. Although there is no doubt about the associate between an increased incidence of heart attack and pre-existing hypertension, the casual link between stress and hypertension is still debated. There was no opportunity in this population to study this potential link.

C. Toxicology

1. Vanadium: Vanadium compounds, especially vanadium pentoxide, are respiratory skin and eye irritants. The initial eye symptoms are profuse lacrimation and a burning sensation of conjuctiva. Skin lesions are eczematous type and itch intensively. [3,11]

2. Inorganic Mercury: Mercury is a primary skin and mucous membrane irritant. It may occasionally be a skin sensitizer. Acute poisoning due to inhalation of vapor may cause interstitial pneumonitis, bronchitis and bronchiolitis.[4,11]

3. Inorganic Arsenic: Arsenic compounds are skin mucous membranes and eye irritants. Occupational exposure to arsenic compounds results in hyperpegmentation of the skin and hyperkeratoses of the hands and feet. Arsenic compounds may produce dermatoses and epidermal carcinoma as well as other types of cancer. [2,5,11]

4. Total nuisance dust: These dusts have little adverse health effects on the lungs and do not produce significant organic disease or toxic effect when exposures are kept under reasonable control. Excessive exposure may reduce visibility and may result in deposits in the eyes, ears, and nasal passages or cause injury to the skin or mucous membrane by chemical or mechnical action. [1]

5. Sodium hydroxide: This compound is very alkaline and corrosive to the body tissue. Dermatitis may result from repeated exposure to dilute solutions of liquid, mists or dusts. [6.11]

6. Asbestos: Overexposure to asbestos fibers can cause asbestosis as well as other lung ailments. Asbestosis is a chronic lung ailment which can result in shortness of breath due to fibrotic changes and scarring of lung tissue. Usually there is a period of 10 to 35 years before this chronic lung ailment will become manifest. Other effects from inhalation of asbestos fibers are the asbestos-related neoplasms.

7. Acrylamide: Occupational exposure via inhalation and skin absorption may produce peripheral neuropathy. Signs and symptoms include numbness of the limbs, muscular weakness, increased sweating of the hands, fatigue and lethargy. [2,8]

VI. RESULTS AND DISCUSSION

A. Environmental

Employee airborne overexposure to vanadium pentoxide dust, inorganic mercury, inorganic arsenic, nuisance dust, sodium hydroxide and asbestos did not occur on the dates of this survey.

Three area air samples were collected for vanadium pentoxide dust at unit 15 and vanadium pentoxide was detected.

Eleven personal and area air samples were collected for inorganic mercury at all three power plant locations (3/4, 11 and 15) during sludge pump repair (3/4) near the water clarifier (3/4) at the air pollution equipment abatement area (11), within the cooling tower drift (11) and near the Stretford circulating pump (15). No mercury was detected.

Twenty three personal and area air samples were collected for inorganic arsenic at all three power plant locations. Air samples were collected during sludge pump repairs (3/4), during turbine repair (3/4), at the Air pollution equipment abatement area (11), downwind of the cooling tower drift (11,15) at sludge handling and end of clarifier (11) near the Stretford circulating pump (15) and near the hydrogen peroxide tank south of the cooling tower (15). Only two personal air samples (table I) detected arsenic at a concentration of 0.07 micrograms per cubic meter of air (ug/m^3) based on a time weighted average. This is below the CAL-OSHA Standard of 0.01 milligrams per cubic meter of air. If this quantity of arsenic had been collected during a 15 minute period, the sample concentration would still have been below the NIOSH recommended ceiling limit of 2 ug/m^3.

Eleven personal and area air samples were simultaneously collected for total nuisance dust while collecting inorganic arsenic air samples. Nuisance dust concentrations ranged from non-detectable to 1.26 mg/m^3. None exceeded the CAL-OSHA standard of 10 mg/m^3. One personal air sample was collected for sodium hydroxide at unit 3/4 during a caustic tank repair, and none was detected.

Four personal and area air samples were collected for asbestos during turbine repair (3/4) and down wind of the cooling tower(11). No asbestos exposures were measured.

One bulk liquid sample of flocculant (polyacrylamide in water) was collected from the polymer room of unit 3/4 to determine if the acrylamide monomer was present. None was detected in the sample.

Two bulk sand samples were collected inside and outside the sand blasting shed of unit 3/4 for inorganic arsenic, and none was detected.

Three bulk samples were collected and analyzed for asbestos. Two of the samples were steam pipe insulation collected from unit 11 and 15, and one sample was a decomposing piece of material from cooling tower number 11. None of the insulation material contained asbestos; however, the cooling tower was found to have 40-50% chrysotile asbestos.

Eleven bulk samples were collected from units 3/4 and 11 for metal analysis. The bulk samples consisted of sludge collected from the iron mix tanks (3/4, 11), the centrifuge deck (11), turbine room (11), sediment from the cooling tower (3/4, 11) and pump residue (3/4). Twenty nine metals were identified and quantified as a percentage by weight. The major contaminants identified, i.e. greater than 1 percent by weight, were iron, magnesium, sodium and aluminum.

Several workers at unit 3/4 were observed on top of the cooling tower without the proper protective clothing or hydrogen sulfide monitors. The eye wash next to the caustic tank at unit 15 was not working. The water to the eye wash was shut off due to repairs on the water line and no one at unit 15 had been informed until one of the NIOSH survey team tried the fountain and it failed to operate.

The clean and dirty respirators at unit 3/4 were stored in the same cabinet and not identified as to whether they were clean or dirty.

Warning signs were placed at the stairway entrance to cooling tower number 15 and other towers 3/4, and 11 warning workers of the potential exposure to arsenic. Workers had not been given any training sessions regarding arsenic exposure or previous notifications that the signs were going to be displayed.

B. Medical

A total of five heart attacks were reported for the period of the respondents' employment. This incidence is not greater than that expected for the population at risk, or 1.46 per year. Because a larger study of the relationship between hypertension and stress was not feasible, for lack of adequate comparison groups, these outcomes were not examined.

VII. CONCLUSIONS

Based on the environmental results, NIOSH concluded that workers were not overexposed to vanadium pentoxide dust, inorganic mercury, and arsenic, nuisance dust, sodium hydroxide and asbestos. Workers did not appear to have a greater incidence of heart attacks than expected for the population at risk.

VIII. RECOMMENDATIONS

1. Portable eye washes should be provided at stationary eye wash fountains when the fountains are shut down for repairs.

2. Workers should receive periodic training to reinforce the need for wearing personal protective equipment and monitoring equipment when on the cooling tower.

3. Workers should be notified and trained about potentially hazardous areas prior to the installation of warning signs to prevent either apathy or excessive alarm.

4. The respirator storage area at unit 3/4 should have properly marked areas for clean and dirty respirators.

IX. REFERENCES

1. Okawa, Melvin T., Milby, Thomas M.D., Whorton, Donald M.D., Health Hazard Evaluation Determination Report 77-121-490, Pacific, Gas and Electric Company Geysers Power Plant, U.S. Dept. of HEW, NIOSH, 1977.

2. Proctor, N.D., and Hughes, J.P., Chemical Hazards of the Work place, Philadelphia, Lippincott, 1978.

3. Criteria for a Recommended Standard: Occupational Exposure to Vanadium, DHEW (NIOSH) Publication No. 77-222, Cincinnati, U.S. Department of Health, Education and Welfare, NIOSH, 1977

4. Criteria for a Recommended Standard: Occupational Exposure to Inorganic Mercury, DHEW (NIOSH) Publication No. 73-11024, Cincinnati,U.S. Department of Health, Education and Welfare NIOSH, 1973.

5. Criteria for a Recommended Standard: Occupation Exposure to Sodium Hydroxide, DHEW (NIOSH) Publication No. 76-105, Cincinnati, U.S. Department of Health, Education and Welfare, NIOSH, 1976.

6. Criteria for a Revised Recommended Asbestos Standard, DHEW (NIOSH) Publication No. 77-169, Cincinnati, U.S. Department of Health, Education, and Welfare, NIOSH, 1977.

7. Criteria for a Recommended Standard: Occupational Expsoure to Acrylamide, DHEW (NIOSH) Publication No. 77-112, Cincinnati, U.S. Department of Health, Education and Welfare, NIOSH, 1977.

8. Kestin, Joseph et. al, Sourcebook on the Production of Electricity from Geothermal Energy, U.S. Department of Energy.

9. Monthly Statistics Report, Final Mortality, 1978. Vol. 29 No. 6, National Center for Health Statistics Health Survey Number US DHHS/NCHS.

10. Occupational Diseases - A Guide to their Recognition, U.S. Dept. HEW, NIOSH Pub. No. 77-181, Rev. Ed. June 1977.

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XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publication Office, at the Cincinnati address.

1. International Brotherhood of Electrical Workers, Local 1245.
2. The Geysers Power Plant, Pacific, Gas and Electric Company.
3. NIOSH, Region IX.
4. CAL-OSHA.
5. Federal OSHA

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

TABLE I

SUMMARY of Air Samples
Collected for Inorganic Arsenic and
Total Nuisance Dust
Pacific, Gas and Electric (PG&E) Geysers
Healdsburg, California
December 16-17, 1980

DATE	Type SAMPLE	LOCATION	VOLUME(liters)	Sample PERIOD	INORGANIC ARSENIC ug/m^3(a)	TOTAL DUST Mg/m^3(b)
12-16	P(c)	Unit 3-4, Sludge pump repair	420	0920-1400	0.07	0.55
12-16	P	Unit 3-4, Sludge pump repair	405	0928-1400	0.07	0.79
12-16	P	Unit 3-4, Turbine repair	540	0841-1441	N.D.(d)	0.15
12-16	P	Unit II, Chemical room-during pump repair	165	0922-1112	N.D.	0.12
12-16	P	Unit II, Chemical room-during pump repair	165	0922-1112	N.D.	0.06
12-16	A(e)	Unit II, Sledge handling and end of caustics	578	0829-1456	N.D.	N.D.
12-16	A	Unit II, Iron Mixing Room	540	0858-1458	N.D.	0.02
12-16	A	Unit 15, Near Caustic Tank	450	1030-1530	N.D.	N.D.
12-17	P	Unit II, Abatement Area	83	1102-1157	N.D.	0.12
12-17	P	Unit II, Iron Mixing Room	165	0902-1148	N.D.	0.18
12-17	P	Unit II, Abatement Area	158	1008-1156	N.D.	1.26

a) ug/m^3 - micrograms of contaminant per cubic meter of air.
b) mg/m^3 - milligrams of contaminant per cubic meter of air.
c) P - Personal air sample
d) N.D. - None detected
e) A - Area air sample

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