

Health Hazard Evaluation Report

HETA 81-348-1225 PUBLIC UTILITIES COMMISSION 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.

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

HETA 81-348 -1225 Public Utilities Commission San Francisco, California November, 1982

NIOSH INVESTIGATOR Pierre L. Belanger, I.H.

I. SUMMARY

In July 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from the Manager of the Public Utilities Commission, San Francisco, California. The request was a result of several workers' (Municipal Metropolitan Subway/Street Service) complaints of periodic irritation from exposure to dust, particularly at the Embarcadero Center. A similar union request was filed with the California-Occupational Safety and Health Administration (CAL-OSHA); thus, it was decided to conduct a jointly designed study.

On August 12-14, 1982, an initial survey was conducted at the Embarcadero Center. Personal and area air samples were collected for dusts (total nuisance particulate, total silica (quartz), copper, iron oxide, vanadium, cadmium, lead and calcium), asbestos, ozone, nitrogen dioxide, nitrogen oxide, and carbon monoxide. Total dust air concentrations ranged from 0.10 to 0.56 milligrams of substance per cubic meter (mg/m^3) of air with only one sample having 16 percent quartz. Several high volume air samples were analyzed for several metals which included iron oxide (0.21 mg/m^3) , copper (0.21 mg/m^3) and lead (3.5 micrograms per cubic meter ug/m³), and no vanadium, cadmium or calcium was detected. Four asbestos air samples had concentrations ranging from 0.0047-0.02 fibers per cubic centimeter of air. Nitrogen dioxide (NO_2) concentrations ranged from 0.06-0.10 ppm (parts of a vapor or gas per million parts of air), and nitrogen oxide (NO) concentrations ranged from 0.05-0.50 ppm. The carbon monoxide concentrations ranged from 2-6 ppm and Ozone concentrations ranged from 0.028-0.030 ppm. All of these contaminants were below the NIOSH criteria and CAL-OSHA standards.

Temperature measurements (dry bulb- $76^{\circ}F$, wet bulb- $63^{\circ}F$) and the calculated relative humidity were within the comfort control range recommended by the American Society of Heating, Refrigerating and Air-Conditioning Engineers.

On September 30, 1981, and January 6, 1982, NIOSH conducted a follow-up survey to sample formaldehyde. Ten air samples were collected; however, no formaldehyde was detected.

Based on the data collected during this survey, it has been determined that workers were not overexposed to total nuisance dust, total quartz, copper, iron oxide, vanadium, cadmium, lead, calcium, asbestos, ozone, nitrogen dioxide, nitrogen oxide, carbon monoxide or formaldehyde. Furthermore, workers were not exposed to excessive temperatures or relative humidity. Recommendations are included in Section VIII to help reduce workers' complaints of dust irritation.

KEYWORDS: SIC 4111 (Local and suburban transit), Light rail vehicle operators, Subway operation, Pantograph

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II. INTRODUCTION

On June 5, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a health hazard evaluation request from the General Manager of the Public Utilities Commission (PUC) at San Francisco, California. The requestor was concerned about several light rail vehicle (LRV) operators' health complaints of dust irritation while working at the Embarcadero subway station. A similar request was filed by a union representative with the California-Occupational Safety and Health Administration (CAL-OSHA); consequently, it was decided to conduct a joint study.

On August 12-14, 1981, NIOSH and CAL-OSHA conducted an initial environmental survey of the Embarcadero Municipal Railway Center. Personal and area air samples were collected and analyzed for dusts (total nuisance, quartz, copper, iron oxide, vanadium, cadmium, lead, and calcium), asbestos, ozone, nitrogen dioxide, nitrogen oxide, and carbon monoxide.

The initial environmental air sampling results were discussed with management and union representatives on the last day of the survey. Those samples requiring laboratory analysis were discussed with company and union representatives at a meeting on September 30, 1981. The CAL-OSHA industrial hygenist subsequently sent a letter confirming the air sampling results and the investigators' recommendations.

On September 30, 1981, and January 6, 1982, NIOSH conducted a follow-up environmental survey to sample for formaldehyde. The air samples collected on September 30, 1981, were discarded because of sampling, shipping and analytical difficulties discovered subsequent to the survey. Thus, a new sampling method was used on January 6, 1982. These results were telephoned to the representative in February 1982.

III. BACKGROUND

The San Francisco Municipal (MUNI) Railway system shares four stations and a subway tunnel with the Bay Area Rapid Transit (BART) system. BART operates its subway system at a level below the Muni system under the downtown portion of Market Street. Several LRV operators were concerned about dust irritation to employees and patrons at the Embarcadero Muni platform (end of line) and to LRV operators traveling in the underground portion of the tube (almost 5 miles long). Portions of the tube are constructed of relatively new cement. Some of the workers complained of black mucous at the end of the day when they blew their nose.

Approximately 200 workers are employed as LRV operators during one of several staggered shifts. The operators normally work an eight hour day, five day week. Operators at the time of the study sat at one end of the platform where they waited to be dispatched. Operators were dispatched from and

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returned to the Embarcadero Center several times a day. An enclosed room (Gilley room) was available to workers on lunch break; however, few workers were observed using it because it was too far from the dispatcher's desk.

A new enclosed facility (Gilley room and dispatch) was under construction during the time of our survey at the next station along the line.

Peak train traffic at the Embarcadero Center was 7:00 am to 9:00 am and 4:00 pm to 7:00 pm. Approximately 89 light rail vehicles are in operation during peak traffic periods, and 62 vehicles are in operation during normal traffic periods.

The ventilation for the station comes from the street entrances to the station and from a large plenum located below the middle of Market Street. The plenum is used by both BART and Muni to control smoke in the tunnel during emergencies.

Each of the LRV's have several sand boxes. The sand is used to assist the braking action when the vehicles travel along the surface streets during rainy periods. Some drivers occasionally use the sand-assist braking action when traveling in the tube. Some of the boxes were reportedly leaking sand.

A sweeping system was designed to be used inside the tube. A large vacuum system was mounted on a vehicle which travels along the rail. Two workers walk along the line in front of the sweeper vacuuming up dust, sand, paper, etc. The tube was reportedly not swept for two weeks prior to our survey because the sweeper was broken.

IV. EVALUATION DESIGN AND METHODS

Based on the workers' complaints and informal interviews with eight workers, it was decided to evaluate various dusts, fibers, and automotive exhaust exposures due to one or more of the following: sand, unfiltered air entering the plenum, pentagraph movement along the overhead power line, electric motors, frictional contact of the wheels along the tract, and residual cement dust from the tunnel.

Several sampling methods were employed to evaluate the potential airborne contaminants which included: total nuisance dust, total free silica (quartz), copper, iron oxide, vanadium, tadmium, lead, calcium, asbestos, ozone, nitrogen dioxide, nitrogen oxide, carbon monoxide and formaldehyde. Personal and area air samples were collected at various locations at the Embarcadero Center and during operation of the LRV's with direct reading instrumentation and air sampling trains. Calibrated direct reading instruments were operated for two and one-half full days to determine if airborne contaminant concentrations decreased significantly between peak periods, normal periods and shut down at night. An air sampling train, which consisted of a calibrated vacuum pump and appropriate sampling medium through which a known volume of

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air is passed, was used to sample during working hours. Also, a psychrometer was used to measure dry and wet bulb temperatures and calculate the relative humidity.

The following is a description of the sampling and analytical techniques used to characterize the airborne concentrations of the employees' work environment.

1. $0zone (0_3)$

Long term ozone air sampling was conducted using a direct reading instrument (Daisibi) with a strip chart recorder. The O_3 scale is 0-0.5 ppm (parts of a vapor or gas per million parts of contaminated air).

2. Nitrogen Dioxide (NO₂) and Nitrogen Oxide (NO)

A direct reading meter with a strip chart recorder, manufactured by Thermoelectron Environmental Instrument Division, was used to do long term sampling of NO_2 and NO. A filter (anhydrous calcium sulfate) was used to remove any interfering O_3 which may have been present.

3. Carbon Monoxide (CO)

A direct reading instrument (Ecolyzer - 2000 series) with a strip chart recorder was used to monitor carbon monoxide. The scale range is 0-100 ppm

Total Dust Plus Metals (iron, copper, lead, vanadium and cadmium)

A high volume air sampler operating at 20 cubic feet per minute was used to collect several two-hour air samples. The filters were weighed and analyzed by atomic absorption spectrophotometry.

5. Asbestos

A sampling train operating at 1.5 liters per minute with an AA filter was used to sample for airborne asbestos. The sample was later analyzed in the laboratory by NIOSH Physical and Chemical Analytical Method (P&CAM) No. 239.

6. Formaldehyde

A sampling train with a coated Chromosorb 102 was used to collect an air sample of about 12 liters for four hours. Since this sampling method was discovered to have air sample stability problems, a new sampling medium (XAD-2 resin tube) was used, and the tube was analyzed by NIOSH method P&CAM No. 354.

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V. EVALUATION CRITERIA AND HEALTH EFFECTS

Occupational exposure criteria have been developed to evaluate workers' exposures 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 are 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).

Substance	Time Weighted Average (TWA) ^a	Ceiling Value
Nuisance Dust* Nuisance Dust (CAL-OSHA)	10 mg/m ^{3^b}	
Quartz (total silica) (ACGIH) Quartz (total silica) (CAL-OSHA)	0.3 mg/m ³ 30 mg/m ³ %SiO ₂ + 3	
Copper* (ACGIH) Copper (CAL-OSHA)	1 mg/m ³ 1 mg/m ³	2 mg/m ³ (15 min)
Iron Oxide* (ACGIH) Iron Oxide (CAL-CSHA)	5 mg/m ³ 1 mg/m ³	10 mg/m ³ (15 min)
Vanadium (NIOSH) Vanadium (CAL-OSHA)		0.05 mg/m ³ 0.5 mg/m ³
Calcium* (ACGIH) Calcium (CAL-OSHA)	2 mg/m ³ 2 mg/m ³	
Lead (NIOSH) Lead (CAL-OSHA)	0.05 mg/m ³ 0.05 mg/m3	
Ozone* (ACGIH) Ozone (CAL-OSHA)	0.1 ppm ^C 0.1 ppm	0.3 pm
Nitrogen Dioxide (NIOSH) Nitrogen Dioxide (CAL-OSHA)		1 ppm (15 min) 5 ppm

TABLE A

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TABLE A (Continued)

Substance	Time Weighted Average (TWA) ^a	Ceiling Value
Nitrogen Oxide (NIOSH) Nitrogen Oxide (CAL-OSHA)	25 ppm 25 ppm .	
Carbon Monoxide (NIOSH)	35 ppm	200 ppm
Carbon Monoxide (CAL-OSHA)	50 ppm	400 ppm
Formaldehyde (NIOSH) Formaldehyde (CAL-OSHA)	lowest feasible limit	2 ppm
Cadmium (NIOSH)	0.04 mg/m ³	0.2 mg/m ³ (15 min)
Cadmium (CAL-OSHA)	0.05 mg/m ³	0.6 mg/m ³
Asbestos (NIOSH)	0.1 fibers/cc	0.5 fibers/cc
Asbestos (CAL-OSHA)	2.0 fibers/cc	10 fibers/cc

- There are no NIOSH recommended criteria for evaluating this airborne chemical contaminant
- a) TWA-NIOSH exposure is based on a workday up to 10 hours long, whereas the CAL-OSHA and ACGIH standard is based on an 8-hour workday.
- b) mg/m³ milligrams of a substance per cubic meter of air
- c) ppm parts of a vapor or gas per million parts of contaminated air
- d) fibers/cc fibers per cubic centimeter of air

CHEMICAL TOXICOLOGY

- 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 mechanical injury. (1)
- 2. <u>Quartz (Crystalline Silica)</u>: The primary health effects associated with inhalation of free silica is a form pneumoconiosis (dusty lung) termed silicosis. Onset of this malady may vary from several years to twenty years or more after first exposure. The percent of free silica present in the environment generally determines the course of this disease. As the silicon dioxide is deposited into the lungs, the silica stimulates production of fibrotic nodules. The nodules in turn compress the alveoli (air sacs) thereby decreasing the lung function and producing restrictive type pulmonary disease. (2)

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Early silicosis termed "simple silicosis" is normally diagnosed by chest X-ray examination. Individuals with this disease are usually asymptomatic, and lung function impairment is not apparent. As the severity of silicosis increases, the symptoms become more prevalent, and these are marked by intolerance to exertion, episodes of coughing, and production of a thick sputum. Silicosis of this severity is diagnosed as "conglomerate silicosis" which is irreversible. Conglomerate silicosis incapacitates the affected worker regardless of termination of exposure. (2)

- <u>Copper</u>: Copper dust exposure may cause nose, throat, and eye irritation, a metallic taste in the mouth, and a direct, non-allergic irritation of the skin. (3)
- <u>Iron Oxide</u>: The inhalation of iron oxide dust may cause a benign pneumoconiosis (siderosis). These changes are not considered to be associated with any physical lung impairment. (1,2)
- <u>Vanadium</u>: Vanadium compounds, especially vanadium pentoxide, are respiratory, skin and eye irritants. The initial eye symptoms are profuse lacrimation and a burning sensation of the conjunctiva. Skin lesions are eczematous type and itch intensively. (2)
- <u>Calcium</u>: Calcium oxide is used as a binding agent in plastic, mortar and other building materials. It is irritating and may be caustic to the skin, conjunctiva, cornea and mucous membranes of the upper respiratory tract. (2)
- 7. Lead: Inhalation of lead dust and fumes is the major route of lead exposure in industry. A secondary source of exposure may be from lead dust contamination of food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. The absorbed lead can damage the kidneys, peripheral and central nervous systems, and the blood forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, digestive disturbances, high blood pressure, kidney damage, mental deficiency, or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women.
- 8. Ozone: This gas is an irritant to the eyes and mucous membranes. Symptoms of exposure to this gas include: dryness of upper respiratory passages, irritation to the mucous membranes of the nose and throat, choking, coughing, and severe fatigue, bronchial irritation, substernal soreness, and cough. Signs of subacute exposure include headache, malaise, shortness of breath, drowsiness, reduced ability to concentrate, and slowing of heart and respiration rate.⁽²⁾
- 9. Nitrogen Dioxide: Nitrogen dioxide causes irritation of the nose, throat, and lungs at low levels (5 ppm). It may cause cough and mucous secretion at these levels. At levels greater than 50 ppm, -NO₂ will cause serious swelling of the lungs and in some cases permanent lung damage. (3)

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10. <u>Carbon Monoxide</u>: The signs and symptoms of carbon monoxide poisoning may include headache, nausea, vomiting, dizziness, drowsiness, and collapse. In the blood stream, carbon monoxide rapidly binds to the oxygen-carrying capacity of the blood. The more COHb is formed, the more significant the symptoms. Heart disease may be made worse in workers who have coronary heart disease and who are exposed to carbon monoxide concentrations high enough to produce a COHb level greater than 5%. There is also important evidence that exposure to lower carbon monoxide concentrations, producing COHb levels below 5%, affects the nervous system and causes changes in visual alertness, response time, and fine judgement.⁽⁸⁾

The current CAL-OSHA standard for carbon monoxide is 50 ppm. Exposure at this level for 90 minutes may cause chest pain for persons with angina (chest pain related to heart disease); exposure for two hours may make leg cramps worse for persons who have leg cramping associated with vascular disease. The effects of carbon monoxide exposure, including the more common symptoms of headache, dizziness, and nausea, are made worse by heavy labor and a high temperature in the work area. (3)

- 11. <u>Asbestos</u>: 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 include a high incidence of cancer, especially lung cancer and mesothelioma (a cancer of the thin membranes which line the chest and abdomen). (2)
- 12. <u>Cadmium</u>: Cadmium is a respiratory tract irritant which is poorly absorbed by the skin and intestinal tract, but it is well absorbed by inhalation. Once absorbed, cadmium has a very long half life and is retained by the kidney and liver.
- 13. Formaldehyde: Formaldehyde is best known for its use by embalmers and morticians to preserve dead bodies and tissues. It has a sharp odor which can be smelled at very low levels (less than 1 ppm). At concentrations ranging from 0.1 to 5 ppm, formaldehyde makes the eyes burn, tearing may occur and general irritation of the upper respiratory passages. Low levels of 0.3-2.7 ppm have also been found to disturb sleep and to be irritating to a smaller number of people. (3) Higher exposures (10-20 ppm) may produce coughing, tightening in the chest and palpitation of the heart.

Formaldehyde has induced a rare form of nasal cancer in two test animals as reported by the Chemical Industry Institute of Toxicology. Formaldehyde has also been shown to be a mutagen in several test systems.

Based on these finds, NIOSH recommends that formaldehyde be handled in the work place as a potential occupational carcinogen and that work practices be employed to control occupational exposures to the lowest feasible limit.

VI. RESULTS, DISCUSSION AND OBSERVATIONS

After a rather comprehensive study of the Embarcadero Center and one LRV operator, it has been determined that employees were not overexposed to nuisance dust, total quartz, asbestos, copper, iron oxide, vanadium, cadmium, lead, calcium, ozone, nitrogen dioxide, nitrogen oxide, carbon monoxide or formaldehyde on the dates of the study.

The environmental air sampling results (listed below) reported by the CAL-OSHA investigator in a letter to the Public Utilities Commission safety officer were expressed as "dose" exposures. (The measured exposure value divided by the 8-hour permissible exposure limit.)

Total dust ().04	Cadmium Not detectable
Quartz (free silica) ().10	Lead 0.07
Asbestos C	0.005	Calcium Very low
Copper	0.03	Ozone 0.2 - 0.3
Iron Oxide (0.04	Nitrogen Dioxide 0.02
Vanadium Not detec	table	Carbon Monoxide 0.1

All of these "doses" are far below the CAL-OSHA exposure limits; however, in order to determine whether the NIOSH criteria or ACGIH-TLV is exceeded, these results have been expressed as time-weighted averages. The eight total dust air concentrations (Table 1) ranged from $0.10 - 0.56 \text{ mg/m}^3$ which is below the ACGIH recommended criteria. Several high volume air samples were analyzed for several contaminants. Iron oxide dust was measured to be 0.21 mg/m^3 which is below the ACGIH-TLV. Airborne copper and lead concentrations were measured to be 0.21 mg/m^3 and 3.5 ug/m^3 respectively which is below the NIOSH criteria. No vanadium or cadmium were detected, and calcium was below a quantifiable concentration.

Six total dust air samples were analyzed for quartz (Table I). Only one sample (0.56 mg/m³) detected quartz (16 percent): however, the calculated concentration of that sample, 1.58 mg/m^3 , was well below the calculated CAL-OSHA standard.

Four asbestos air samples (Table II) were collected from the platform and the LRV operator. The airborne concentrations which ranged from 0.0047 - 0.02 fibers per cubic centimeter of air were below the NIOSH recommended criteria.

The direct reading air measurements of nitrogen dioxide ranged from 0.06 to 0.10 ppm. The air measurements of nitrogen oxide concentrations ranged from 0.05 to 0.50 ppm. Neither of these chemicals exceeded the NIOSH recommended criteria or CAL-OSHA standard.

The direct reading airborne carbon monoxide concentrations ranged from 2 - 6 ppm which is well below the NIOSH recommended criteria and CAL-OSHA standard.

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The airborne ozone concentrations ranged from 0.028-0.030 which is well below the CAL-OSHA standard.

Ten formaldehyde air samples were collected from the Muni Center; however, no formaldehyde was detected.

A psychometer was used to measure the temperatures and calculate the relative humidity. The measured dry bulb temperature (76° Fahrenheit) and wel bulb temperatures (63° Fahrenheit) and calculated relative humidity (49 percent) was within the comfort control range recommended by the American Society of Heating. Refrigerating and Air-Conditioning Engineer (ASHRAE). The ASHRAE Society recommends a comfort control range of 72-79°F and a relative humidity of 20-60 percent.

The track at the Embarcadero Center was observed by the investigators and the P.U.C. Safety Officer to need sweeping. Sand and paper were observed along the track and a fine black carbon dust was observed along the walls. The safety officer made several inquiries and determined that the sweeper was not broken, but it simply needed new filters. The safety officer made arrangements to obtain vacuum filters in order that track sweeping could be resumed at night when the station was closed.

The investigators rode with one of the LRV operators to conduct air sampling. It was observed that the LRV air intakes delivered unfiltered air directly onto the operator as the vehicle traveled inside the tube.

VII. CONCLUSIONS

Based on the environmental data collected at the Embarcadero Center and on the light rail vehicles, no overexposures to total dust, total quartz, asbestos, copper, iron oxide, vanadium, cadmium, lead, calcium, ozone nitrogen dioxide, nitric oxide, carbon monoxide and formaldehyde were measured. Also, no excessive temperatures were measured at the platform of the Embarcadero Center. Workers who complained to management about irritation may be experiencing intermittent irritant effects, or synergistic effects due to the chemicals evaluated, or allergies or sensitivity or a combination of all the above. Recommendations have been included below to help reduce workers' complaints.

VIII. RECOMMENDATIONS

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- The large plenum, located at the middle of Market Street, is designed for smoke control during emergencies should have a filter system installed to prevent dust from being blown into the tube.
- Consideration should be given to washing down the walls of the tube to remove residual cement dust.
- The tube should be vacuumed periodically to pick up the brake sand, dust from the pentagraph, and the old cement dust from the walls of the tube.

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- 4. The LRV air intake located above the operators' head should have a filter installed to remove dust when traveling inside the tube.
- 5. The operators new dispatch center at Montgomery Station should have a positive pressure 100 percent filtered air supply. The doors should remain closed at all times, and workers should be encouraged to stay inside instead of sitting on the platform.
- Installation of an activated charcoal filtering system at the operators' new Gilley room may help reduce ozone and nitrogen dioxide concentrations.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this Determination 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); 5285 Port Royal Road, Springfield, Virginia 22151. 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. Public Utilities Commission, San Francisco, California.
- 2. Transport Workers Association (AFL-CIO) Local 250A.
- 3. CAL-OSHA

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- 4. U.S. Dept. of Labor Region IX.
- 5. NIOSH Region IX.

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

TABLE I

Total Nuisance Dust Concentration San Francisco Municipal Metro System August 13, 1981

1

LOCATION	TYPE SAMPLE	TIME-WEIGHTED AVERAGE CONCENTRATION (mg/m ³)	PERCENT QUARTZ
Information Booth Operator	(P)	0.19	N.D.
High Volume Air Sample	(A)	0.43	3
Dispatcher	(P)	0.28	N.D.
Recorder	(P)	0.38	N.D.
Next to Coffee Table	(A)	0,28	N.D.
Next to fire extinguisher	(A)	0.28	N.D.
At switching Next to Gillery	Room (A)	0.56	16.0
Muni Operator	(P)	0.10	

TABLE II

Asbestos Air Samples Collected at the Embarcadero Center and the LRV San Francisco Municipal Metro System August 13, 1981

LOCATION	TYPE SAMPLE	Time-Weighted Average CONCENTRATIONS (fibers/cc)
Information Booth Operator	A	0.002
By Coffee Table	А	0.0047
Muni Operator	Ρ	0.0056
Muni Operator	A	0.02

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