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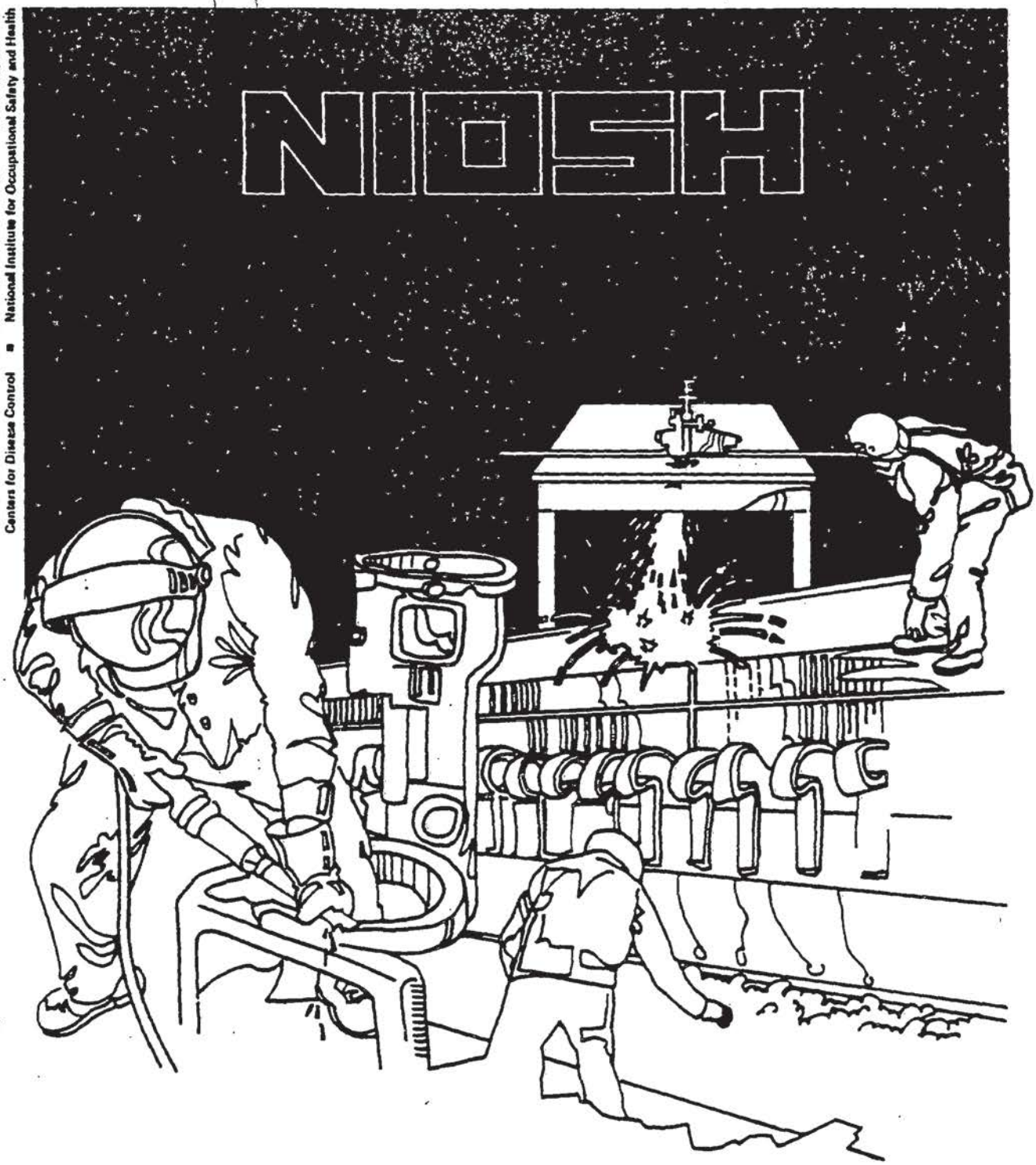

Health Hazard Evaluation Report

HETA 83-091-1637
RESIDENCES (TIMES BEACH
FLOOD DEBRIS CLEANUP)
TIMES BEACH, MISSOURI

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 83-091-1637
NOVEMBER 1985
RESIDENCES (TIMES BEACH FLOOD DEBRIS CLEANUP)
TIMES BEACH, MISSOURI

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I. SUMMARY

As part of the Centers for Disease Control's assistance at the Times Beach, Missouri flood aftermath, the National Institute for Occupational Safety and Health was requested by the Missouri Department of Natural Resources (MDNR) to evaluate the cleanup contractor's health and safety program. The Environmental Protection Agency (EPA) had collected numerous sub-surface soil samples from the Times Beach roadways and were awaiting dioxin results when the Meramec River flooded Times Beach in December of 1982. Numerous homes were destroyed, and when the residents returned to claim salvagable possessions, they created tons of debris. Since it was impossible to know to what extent the flood debris was contaminated with dioxin, it was decided to clean up the debris as hazardous waste. This report discusses the equipment and personnel required to perform the cleanup, including the physical setup for decontamination procedures, as well as the effectiveness of their personal protective equipment program. Observations were made over a two-week period of the cleanup which hauled over 11,000 cubic yards of debris to a nearby landfill. Area and personal monitoring was performed for airborne dioxin and total dust. No airborne dioxin was detected. Total dust measurements ranged up to 6.98 mg/m^3 for one personal sample from a technician during one of the most dusty days during the cleanup. Recommendations for improving the decontamination procedures and personal protective equipment program are included.

Based on the information gathered during this study, it is concluded that workers were at no additional health risk from exposure to dioxin or total dust. A thorough discussion of the cleanup contractor's personal protective equipment program is included, along with an evaluation of the program's effectiveness.

KEYWORDS: SIC 4953 (Refuse Systems), Hazardous wastes, 2,3,7,8-tetrachlorodibenzo-p-dioxin, respirators, protective clothing, decontamination

II. INTRODUCTION

At the request of the Missouri Department of Natural Resources (MDNR), the National Institute for Occupational Safety and Health (NIOSH) monitored and evaluated the contractor's employee personal protective equipment (PPE) program during the cleanup of the Times Beach flood debris. This request came to NIOSH through the Centers for Disease Control's (CDC) Center for Environmental Health (CEH) who were working with the State of Missouri and other Federal agencies on the overall Times Beach problem.

III. BACKGROUND

Times Beach is located on the southwest border of St. Louis County approximately 25 miles from downtown St. Louis along I-44 and only 12 miles from the junction of I-270 and I-44. At the time of the flood, there were approximately 2,000 people living in Times Beach in 800 residences. There were also a dozen or so small businesses in the town that provided services to the local residents, as well as to travelers along I-44. Prior to the Meramec River flooding in early December 1982, the Environmental Protection Agency (EPA) had started collecting subsurface soil samples for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) from the streets of Times Beach. This sampling was initiated by EPA because it had been reported that oil containing residual wastes from a plant producing hexachlorophene from tetrachlorobenzene was sprayed on the streets for dust control during the summers of 1972 through 1976. The company that did this spraying had also sprayed other roads and horse stables in the area with oil that was contaminated with TCDD, and recent studies had shown that TCDD was still present in the sub-surface soils of those sites.

When the Meramec River flooded, almost the entire town was inundated with backwaters from the river. There was little erosion of the existing soils. The mobile homes in the northwest part of the town suffered the worst damage in that most were completely submerged in the floodwaters. The more permanent type of homes and their contents were damaged somewhat less, principally because they were located on higher ground. As is typical with most flooded towns, the residents returned after the waters receded to clean up and claim any salvageable possessions. During these activities, building materials, furniture, appliances, insulation and foodstuffs were moved out of the homes and placed along the streets for someone to pick up. At some point, it became known that there might be dioxin in the subsurface soils under the existing streets; and that the floodwaters could have spread the dioxin throughout the town and into the homes. EPA's systematic approach to the sampling and identification of dioxin in Eastern Missouri then received national media and political attention.

The longer the debris lay the more serious the problem became because some of the debris contained putrescible matter which could provide harborage for rodents and communicable disease organisms. The State of Missouri and the EPA were then faced with a very difficult decision. If the flood debris was contaminated with TCDD, there was not an approved waste site in the State of Missouri that could accept the flood debris while, on the other hand, the debris was fast becoming an immediate health problem to the few remaining residents. A decision was made to remove the debris to a local hazardous waste landfill, and a hazardous materials handling contractor was hired to carry out the effort under the direct supervision of the MDNR. A staging area was set up by the contractor within the city limits of Times Beach, and initial site work began on January 8, 1983. Some debris was loaded directly into trucks, while additional debris was moved to a central location on the site for ease of loading. By January 10, 1983, all available trucks were loaded with debris but remained in Times Beach because of a court order banning the use of the intended landfill. The stalemate was finally broken, and the first trucks rolled to the landfill on January 12, 1983.

IV. FLOOD DEBRIS HANDLING PROCESS

The residual flood debris left by the residents was piled in the ditches, front yards, and just about anywhere on the residents' property. Small four-wheel drive, open cab uniloaders (Bobcats) were used by operators to move the debris to the streets in front of the residences. These uniloaders were then used to push the debris into the buckets of larger closed cab front-end loaders. The large loaders shuttled back and forth until the 40 cubic yard dump trucks were loaded. The loaded trucks were then covered and proceeded to the exterior washing area before going to the landfill. Once at the landfill, the trailers were uncovered and the debris dumped in a prepared cell. As the cell was filled, it was covered with borrow dirt then compacted and gravelled and another layer built up. A total of 278 truckloads were hauled to this landfill, amounting to over 11,000 cubic yards of flood debris. The project was completed on February 2, 1983.

V. EQUIPMENT AND PERSONNEL

The resources required to carry out this cleanup included land, equipment and people. Two areas were used by the contractor to carry out the cleanup project. Both areas were within the city limits of Times Beach; therefore, both were adjacent to streets that contain the contaminated subsurface soils. The main staging area was located on the south side of the town between I-44 and one of the city streets. This location was selected because it was accessible by hard-surfaced road, was located in areas that showed

lower levels of dioxin contamination in the subsurface soils, and was secured by an in-place chain link fence. The staging area was set up as shown in Figure 1. This area served as the nerve center for the entire operation. Personal protective equipment (PPE) was donned and doffed in this area. Loading equipment was stored and repaired in this area. Trucks were parked in this area prior to being loaded and sometimes after loading. The area also served as parking for the people who visited the site. The other area used by the contractor was east of the staging area and was used only to wash down trucks before they entered I-44 to travel to the landfill.

In addition to the usual hand tools required to carry out these types of activities, a variety of power equipment was used. The equipment was parked in the staging area and was returned there during lunch break and when the workday was over. This equipment included up to four small front-end loaders called uniloaders or by the brand name of Bobcats. These units were open cabbed and generally operated by the same people. Two larger front-end rubber tired loaders were used during the cleanup process. They also were parked in the staging area and returned during the lunch break and at the end of the work shift. Likewise, the tandem-trailer 40 cubic yard dump trucks were dispatched out of the staging area. Pickups were also used to transport people and small tools throughout the site, using the staging area as a base.

Personnel at the site were divided into the following categories:

1. Overall Project Management - Provided direction to staff, obtained resources, dispatched trucks, did not enter work zones

2. Site Supervisors - Directed day-to-day work activities at the work zones

3. Technicians - Assisted in work zones loading front-end loaders, directing filling of trucks, covering trucks, cleaning out trucks at landfill site

4. Open Cab Operators - Operated uniloaders throughout work zones

5. Closed Cab Operators - Operated large front-end loaders throughout work zones

6. Truck Drivers - Operated dump trucks in work zones and on highway to landfill site.

Additional personnel was brought on site at times to repair equipment or just to tour operations. For the most part, these individuals were confined to the staging area.

VI. HEALTH AND SAFETY PROGRAM

A written copy of a Health and Safety Plan was never obtained. Information concerning the Health and Safety Program was obtained through interviews or observations. Most of the technicians, operators and field supervisors have received some formal training in the proper use of personal protective equipment. Some of this training focused on fit testing and the proper use and maintenance of respiratory protection devices. At this project, each person was responsible for cleaning and maintaining his own respirator. Two technicians were responsible for the day-to-day operations of the overall personal protection program. This included helping in the donning and doffing of personal protective equipment, preparation of decontamination solutions, ordering supplies, cleaning up area and overall supervision. Workers preparing to go on site to the work zones came to the staging area along roads that were within the Times Beach city limits. They disembarked from their vehicles and went into an 8 X 40-foot box trailer that served as a change area. Conceptually, this trailer was in a non-contaminated zone; although, at times, this fact was highly questionable. All workers donned the following equipment:

1. Neoprene rubber boots
2. Tyvek suit with hood
3. Three layers of gloves
    a. Surgeon's glove
    b. Cotton
    c. Neoprene
4. Suit was taped at boots and gloves
5. Eye protection goggles
6. Hard hat
7. Half mask respirator with pesticide cartridges.

Technicians were then transported to the work zones in the back of pickups while operators drove their equipment. Truck drivers were issued the same equipment, but its proper use was never monitored except to remind them that they were to wear the equipment while in

the work zones. Workers were instructed to leave all equipment in place until the crews returned to the staging area for lunch break. Most times, this meant keeping the equipment on for periods up to four hours. Returning to the staging area, the workers proceeded to the decontamination area where the PPE technicians helped in the spray washing of boots and the decontamination of boots and gloves before removal. These activities were carried out on top of 4 X 4 pallets that kept the workers off the ground and were easily washed down. Tape and suits were then removed and respirators cleaned (usually just dipped) before proceeding to the box trailer to get into street clothes. Equipment was brought back into the staging area from the work zones during the lunch break. After eating, the PPE was again donned, including new protective suits. The shift was completed and the decontamination cycle repeated.

VII. ENVIRONMENTAL METHODS

One of the more important inputs in prescribing an effective personal protective equipment program is to identify and quantify the environmental contaminants in the workers' breathing zone. Although the PPE program was set up without knowledge of workers' exposure at this project, it was felt that sampling would be appropriate so that more definitive recommendations could be made at future similar sites. Sampling for airborne TCDD in a physical state similar to how it exists in Times Beach has not been successful to date. Therefore, the sampling program was designed to not only sample the airborne dust for TCDD, but to sample the total dust the workers were exposed to and model their potential dioxin exposure.

With these thoughts in mind, the following samples were collected:

1. Hi-Vol samples in staging area for TCDD
2. Personal samples for TCDD
3. Bulk samples for TCDD
4. Area samples for total dust
5. Personal samples for total dust.

Air samples were collected during a two-week time period in January 1983. The weather conditions during the two-week sampling period were quite varied. Although there was no precipitation during the study, there had been rain and snow the previous week; therefore, the ground, as well as the flood debris, was wet. By the start of the second week of sampling, things were drying out to the point that the contractor was watering the streets to control dust. The

sky was clear for most days, with noontime temperatures in the low 20's. A low of 5°F was recorded one morning, and by noon the temperature rose to 19°F, with winds of 25 mph gusting to 40 mph. Dust was definitely blowing this day.

Five Hi-Vol air samples were taken for TCDD using 8 X 10-inch glass fiber filters. They were only collected in the staging area because of the availability of electricity. Twenty personal air samples were collected for TCDD from the workers in all job categories in 37mm cassettes on teflon filters, using battery-operated air sampling pumps, at a rate of four liters per minute (lpm). Some bulk dust and soil samples were collected.

Personal total dust air samples were collected from workers in five of the six job categories during the two-week period. Area total dust air samples were also collected from various locations in the staging area.

VIII. EVALUATION CRITERIA

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week, for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes and, thus, potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 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) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. The OSHA standards also may be required to take

into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based solely on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

No occupational exposure standard exists for 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). NIOSH[1] has recommended that TCDD be regarded as a potential occupational carcinogen, "that occupational exposure to TCDD be controlled to the fullest extent feasible, and that decontamination measures be used for TCDD-contaminated work environments".

The only other worker exposure at this site was to total dust. The ACGIH[2] recommends 10 mg/m^3 as a guideline criteria for exposure to total dust, while the OSHA[3] personal exposure limit (PEL) is 15 mg/m^3.

IX. RESULTS

The TCDD air sampling results are shown in Table 1. The Hi-Vol results suffered all kinds of analytical sensitivity problems, even though they were analyzed by high resolution gas chromotography mass spectroscopy. The filters were pre-extracted, but still they all showed TCDD in the blanks. Therefore, we concluded that the results were not meaningful. The personal samples were prioritized and four were analyzed initially. They all showed less than the limit of detection per sample in approximately two cubic meters of air. The bulk samples proved almost impossible to deal with. The various matrices, as well as the amount of material collected, resulted in limits of detection that provided no useful information. The possible exception was one bulk dry dust sample collected from the rear bumper of one of the supervisor's pickup trucks showed 15 nanograms of TCDD per gram of dust.

The total dust air sample results are shown in Table 2. The results for the technicians are truly personal samples in that the samples were collected from the worker's breathing zone during his work cycle. These results were the highest of any recorded and ranged from 0.28 to 6.98 mg/m^3. This range can be attributed both to different tasks being performed and to changes in the

weather. During the first week of sampling, the roads and debris were wet; but by the end of the second week, things were beginning to dry. For the other job categories, samplers were attached to the workers for the first day. This proved not to be feasible because of the workers sitting down to drive; and, therefore, for the rest of the sampling the samplers were machine mounted. The filters were still located as close as possible to the workers' breathing zone. The open cab results ranged up to 1.30 mg/m^3, again the highest level occurred during the dry period. The results for the closed cab operators showed the second highest total dust level at 3.76 mg/m^3. There are two possible reasons for this unexpected result. The first would be that the cab doors were kept open during the work cycle and the second could be that residual dust within the cab was continually aerosolized by the heater. The results for the remaining job categories were all less than 0.37 mg/m^3 and were influenced by many factors, including the smoking of truck drivers while they were out of the working zones.

Additional total dust sample results are shown in Table 3. These include site area samples from the main entrance gate to the staging area and at another location on the perimeter of the staging area, 3,000 feet east of the main gate. The results from these two sampling sites are indicative of the relative level of activity. The two samples from the superintendent's office are interesting in that the levels exceeded a significant number of the samples collected in the working zones. It is suspected that most of this dust was from cigarette smoke.

Using these limited results to try and estimate a worst case worker exposure scenario requires the following assumptions:

1. No protective equipment was used.
2. All dust is respirable and retained.
3. Total dust exposure 7.0 mg/m^3
4. Fifteen Nanograms/gm TCDD in total dust
5. Worker breathes approximately 10 m^3 per shift.

If all of these conditions were met, the daily body burden of TCDD would be approximately one nanogram. It is highly unlikely that all of these conditions ever existed at this project. Therefore, it can be concluded that the workers at this site were not subjected to an increased health risk because they were not exposed to significant amounts of TCDD.

X. DISCUSSIONS AND RECOMMENDATIONS

The decision to clean up the Times Beach flood debris in EPA designated Level "C" protection, as described in Section VI, was made before the extent of TCDD contamination was known. At the time, this appeared to be a prudent decision, and the cleanup contractor proceeded on that assumption. The recommendations developed in this section were developed from the perspective that the greatest level of worker protection should be provided. Although they may appear to be fairly critical of the cleanup operations from a worker protection point of view, they are presented as goals that operations of this type should be striving to attain.

The siting of the staging area within the contaminated area of Times Beach left a lot to be desired. All individuals reporting to the staging area for work drove through the contaminated area on hard-paved roads. Ideally, the staging area should have been located in a clean zone so that clean workers and vehicles were separated from the contaminated zone by the staging area.

This concept of separation was not adhered to once individuals were inside the staging area. No physical barriers of non-contaminated vs. contaminated zones were provided. The doffing and donning of PPE took place in the same area, basically shoulder to shoulder. Donning of PPE should have taken place inside a clearly marked zone of no contamination, with the workers then proceeding to the contaminated work zones. The decontamination area needed to be set out in more of a linear fashion so that as workers were decontaminated they progressed to a cleaner and cleaner state. As conditions existed, there was free access to all locations within the staging area. Heavy equipment that was used in the work zones outside the staging area was constantly brought back to the staging area for storage and repairs. Under ideal circumstances, it should have been decontaminated each time it returned to the staging area.

The wastewater from the decontamination of trucks that were going off site was allowed to accumulate on the surface and seep into the ground. Wastewater from the PPE decontamination area was also dumped on the surface within the staging area. Granted the fact that the site was already contaminated with TCDD, this approach provided an excellent opportunity for contaminating clean zones.

The personal protective equipment program also had some deficiencies. Several of the larger workers were continually tearing out the crotch of their tyvek suits, which required down-time for replacement or patching with duct tape. Although all of the suits purchased by the contractor were extra large, some additional effort should have gone into locating proper fitting clothes for the larger workers. Three layers of gloves was

probably not necessary. The remaining protective clothing and wearing of such was adequate. However, the respiratory protection provided was inadequate by any standards. Although some workers indicated they had been fit tested, they were all supplied the same size respirator. This leads one to believe that most of the respirators did not fit properly.

No fit testing was observed taking place on site. Quantitative fit testing should have been performed off-site to establish respiratory size and then spot checked at the site. The appropriate canisters were used and were usually changed each day. Close inspection of some of the respirators indicated some were not properly maintained. Numerous flapper valves were cracked or wrinkled and some not even in place. Closer supervision or more intensive working training on respirator maintenance would have been desirable.

The work cycle required of these individuals was difficult. A four-hour period with no access to restrooms is too much to expect, especially under the cold working conditions at this site. Since this project took place in the winter, the workers had no problems with heat stress. A similar operation during July or August would need to incorporate provisions to monitor environmental and physiological parameters to prevent worker heat stress problems.

XI. CONCLUSIONS

The contractor's health and safety program during the flood debris cleanup at Times Beach had a number of major deficiencies. In retrospect, EPA tests showed that the flood debris at Times Beach was not significantly contaminated with TCDD, although the debris was removed from contaminated areas. Therefore, the deficiencies in the contractor's program did not result in any increased health risk to their employees. On the other hand, if the debris had been contaminated, the contractor's program would not have adequately protected his employees.

XII. AUTHORSHIP AND ACKNOWLEDGEMENTS

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XIII. 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), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from the NIOSH Publications Office at the above address.

Copies of the report have been sent to:

1. Missouri Department of Natural Resources
2. Missouri Division of Health
3. Environmental Specialists, Incorporated
4. EPA, Region VII
5. NIOSH, Region VII
6. OSHA, Region VII

XIV. REFERENCES

1. National Institute for Occupational Safety and Health (1984), 2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD, "dioxin"). Current Intelligence Bulletin 40. U.S. Government Printing Office: 1984 - 759-103/1038, DHHS (NIOSH) Publication No. 84-104.

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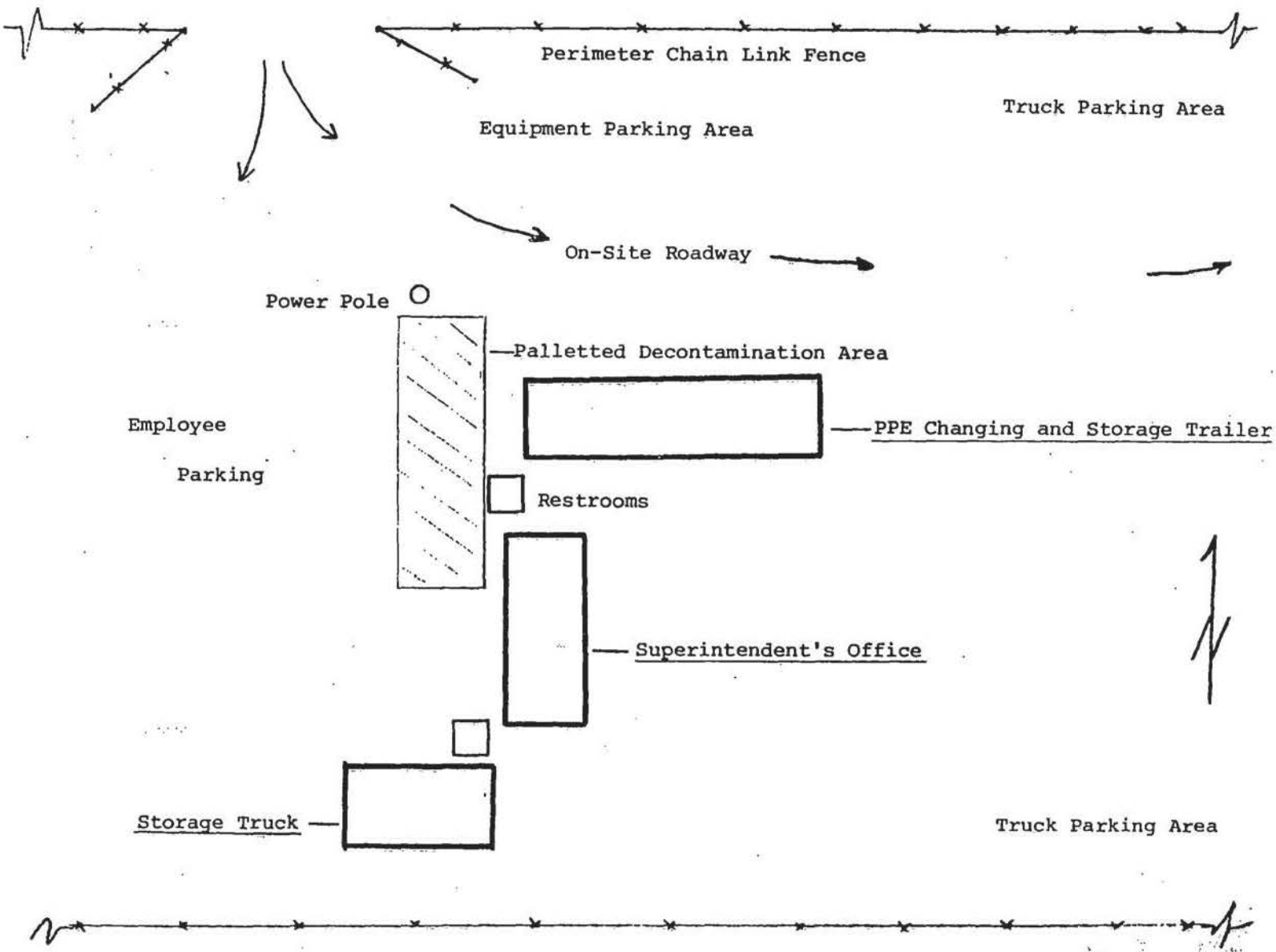

Figure 1 LAYOUT OF STAGING AREA - TIMES BEACH FLOOD DEBRIS CLEANUP

TABLE 1

TIMES BEACH FLOOD DEBRIS CLEANUP

DIOXIN RESULTS

Hi-Vol Samples-------	5 samples taken on 5 days using 8X10 GF Filters
	10-30 nanograms reported per 900 M^3 sample
	Field blanks were also in this range
Personal Samples-----	20 samples taken at 4 lpm on 37mm teflon
	4 prioritized samples analyzed
	Less than 1 nanogram per sample reported
	in 2 M^3 of air
Bulk Samples---------	Several samples of various materials taken
	Only 1 bulk dust sample anaylzed
	15 nanograms per gram reported

TABLE 2

TIMES BEACH FLOOD DEBRIS CLEANUP

TOTAL DUST SAMPLES

mg/M^3

Date	Tech-nicians	Open Cab	Closed Cab	Truck Drivers	Super-visors
1/12	0.69	0.32	--	0.22	--
1/13	1.41	0.37	0.26	--	--
1/14	0.28	0.05	0.13	0.22	--
1/18	--	0.93	--	0.31	0.17
1/19	3.21	0.38	0.68	0.20	0.30
1/20	6.98	1.30	3.76	0.18	0.37

TABLE 3

TIMES BEACH FLOOD DEBRIS CLEANUP

TOTAL DUST SAMPLES

mg/M^3

Misc. Results:

Main Gate Area Sample - Ranged from	0.19 to 1.00
Area Sample Unused Yard Entrance	0.02 & 0.01
Project Superintendent's Office	0.55 & 1.20
Truck Washer Personal Sample	0.12

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