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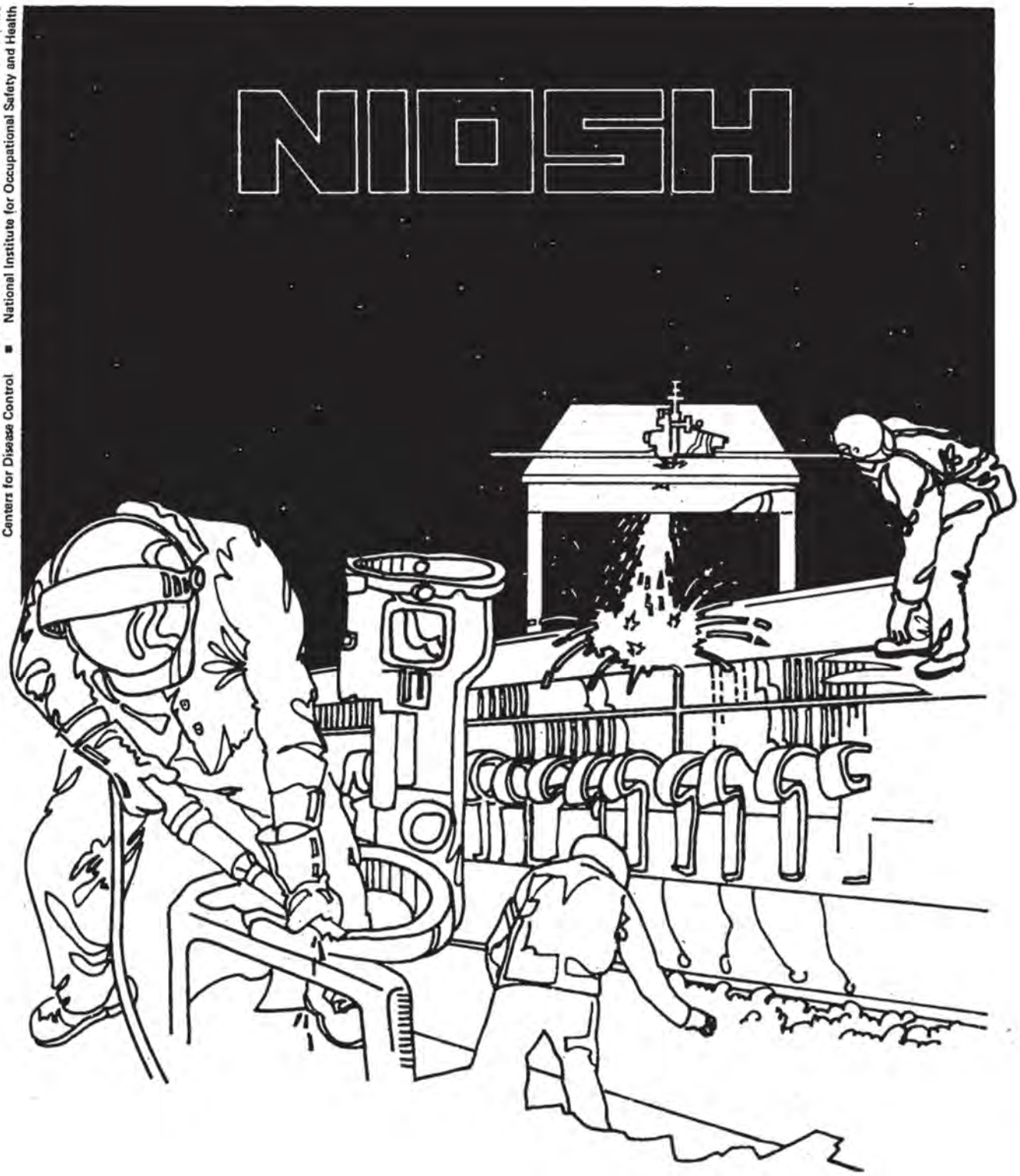

Health Hazard Evaluation Report

HETA 83-297-1846
TRUCK TERMINALS
ST. LOUIS, 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.

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TRUCK TERMINALS
ST. LOUIS, MISSOURI

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I. SUMMARY

On May 25, 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Brotherhood of Teamsters to conduct evaluations at three trucking terminals in St. Louis, Missouri, where there were concerns that current and former employees were exposed to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), which had been found in soil at the sites.

During December 1983 and March 1984, NIOSH conducted a medical survey among a group of self-selected current and former employees of the trucking companies. Medical questionnaires addressing a medical history, employment and TCDD exposure history, and current health status were administered to survey participants.

Reported numbness in hands and feet, pins and needles sensations in extremities, insomnia, and feeling blue or sad, were significantly associated with an individual's likelihood of being highly exposed to TCDD. (Similar associations for other symptom groups were not evident.) There were two participants who had rare diseases that have been associated with TCDD exposure. The first individual developed porphyria cutanea tarda in June 1982, and in February 1983 he developed a pelvic angiosarcoma believed to be of soft tissue origin. The second individual had a dermatofibrosarcoma, which developed in 1976.

On the basis of the data obtained during this investigation, no definite association between TCDD exposure and the reported symptoms and medical problems could be established. This was due largely to the biases inherent in self-reported data and participant self-selection.

Recommendations to eliminate and/or control possible TCDD exposures at the truck companies terminals were made at the time of the investigation and have been implemented.

Keywords: SIC 4231 (Terminal and Joint Terminal Maintenance Facilities for Motor Freight Transportation), 2,3,7,8-tetrachlorodibenzo-p-dioxin (CAS 1746-01-6), TCDD, dioxin, neurologic effects, sarcoma

II. INTRODUCTION

On May 25, 1983, the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Brotherhood of Teamsters to conduct an evaluation of current and former employee exposures to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), commonly known as dioxin, which had been found in soil at the sites at three truck terminals in St. Louis, Missouri. In 1983, the terminals belonged to Jones Truck Lines, P.J. Hamill Transfer Company, and Overnight Transportation Company (formerly the site of Pacific Intermountain Express and Best Way Motors).

Surface and subsurface soil samples and work area dust samples were collected by NIOSH investigators in July 1983. An epidemiologic survey was conducted to assess exposure and health status among current and past workers at the three sites in December 1983 and in March 1984. An interim report describing the study's findings was sent to the unions and companies in Novembver 1985.

III. BACKGROUND

During the early 1970's, it was common practice to spray truck terminal lots in St. Louis with waste oil to control dust. When it was later discovered that some of the waste oil was contaminated with dioxin, the terminals that were sprayed by the suspected waste hauler became a focus of concern and further investigation.

The U. S. Environmental Protection Agency sampled subsurface soils from several of the suspected dioxin-contaminated terminals in late 1982 and early 1983. Information gathered (Table I) led to the investigation of the three terminals covered in this report. Analysis of soil samples demonstrated levels of TCDD greater than one part per billion (ppb) at P. J. Hamill Transfer Company (900 Virginia Avenue), Jones Truck Line (then located at 5601 Hall Street), and Overnite Transportation Company (7455 Hall Street).

Based on workers' descriptions of the oil-soaked terminals during spraying, there was probably substantial dermal exposure to employees working in the terminal lots. Workers described an oily film covering the terminal lots after spraying. There were large puddles of oil, and workers doing maintenance under the trucks and hooking or unhooking trailers from cabs finished the day with arms and clothes soaked in the oil. The most heavily exposed workers would have been regular employees working as mechanics, refueling trucks, hooking and unhooking trailers to truck cabs, and loading and unloading trailers at the terminal docks. After the oil soaked into the ground and the TCDD became bound to dirt, it may have been available for inhalation exposure, at least until the lots were paved. Wind-blown surface dirt contaminated with TCDD in the early years after the spraying could have been inhaled by employees of the companies. Although TCDD-bound dirt

is bioavailable through ingestion,[1] this route of uptake probably accounted for little exposure in this adult population. There would have been relatively little exposure to soil after paving occurred, except at one terminal where the top 4 inches of soil were removed and the lot repaved with asphalt in 1978, and where a truck weighing scale pit was dug up in 1980.

Based on the hypothesized exposures, the NIOSH investigators have attempted to ascertain whether there was any risk of dioxin-related health effects among current and former employees at these sites. The health survey attempted to identify current and former workers with rare diseases linked epidemiologically to TCDD exposure and to identify patterns of illness that might require further investigation.

IV. METHODS AND MATERIALS

A. Environmental

In general, NIOSH collected four types of samples. They included:

1. Rafter settled dust samples - These samples were collected from the bottom flange of main support I-beams. These I-beams were approximately 8 by 16 inches and were 11 feet from the floor of the facility. These samples may be indicative of airborne dust accumulated since the facility was constructed.

2. Settled dust samples - These samples were collected from unobstructed surfaces within the structure. These samples may be indicative of more recent deposition of airborne dust.

3. Dirt samples - These samples were collected from a variety of floor surfaces within the structure. They may be indicative of potential contamination that is either tracked in or deposited by airborne dust from outside the structure.

4. Soil samples - These samples were collected from the surface of the ground at various locations outside the structure. The material collected has been exposed to the elements and may be indicative of an intermediate source of the dioxin-contaminated subsurface.

All the samples were collected in 20-ml glass vials, which were then capped and shipped directly to the laboratory. Many duplicate samples were collected and numbered, but not all submitted for analysis.

The samples were extracted and analyzed for TCDD by gas chromotography/mass spectroscopy (GC/MS) in accordance with EPA Method #613 (Revised July 1983). Variations of Method #613 were used, depending on the condition of individual samples.

B. Medical

A medical survey to assess exposure and health status among current and past workers at the contaminated St. Louis terminals was conducted in December 1983 and in March 1984. A medical questionnaire administered by NIOSH investigators was the principal survey instrument. A letter of invitation was sent to the last known address of workers known to have worked at any of the three sites between January 1971 and the end of 1983. Addresses of workers were obtained from union or available company records. Six hundred letters were mailed to employees of P.J. Hamill Transfer Company, Jones Truck Lines, and of Pacific Intermountain Express and Best Way Motor Company during the time that these companies were located at 7455 Hall Street. A second mailing was sent to those workers who did not participate in the initial survey. In addition, there was substantial news coverage of the survey. Anyone who had worked at or delivered regularly to any of the three terminals was allowed to participate.

Each of the participants was administered a questionnaire asking about medical history and work at the three truck terminals. Participants were divided into high- and low-exposure groups based on self-reported job title and time worked at the three terminals. (The questionnaire is included as Appendix I.) A worker was considered to be potentially more highly exposed, if he worked for three or more months between January 1971 and December 1974 as a dock worker, dock foreman, fueler, mechanic, or an employee who hooked and unhooked trucks in the terminal yard. All other workers were considered to have lower exposure. There were 75 workers in the high-exposure group and 253 in the low-exposure group.

All participants with skin problems or rashes at the time of the survey had an interview and a skin examination by a NIOSH physician. Cases of dermatologic problems suggestive of chloracne (and any skin condition not recognized by the NIOSH physician) were subsequently evaluated by a dermatologist.

V. EVALUATION CRITERIA

Exposure of workers to TCDD during the manufacture of chlorinated phenols, or as a result of explosions or accidents, has caused a variety of diseases. TCDD is known to cause chloracne.[2] It is a suspected cause of toxic hepatitis and porphyria cutanea tarda, and it has been implicated as a cause of peripheral neuropathy, neuro-psychiatric disease, increased susceptibility to infection, abnormal lipid metabolism, and damage to the endocrine, GI and cardiovascular systems in industrially exposed workers.[3-15]

Among people environmentally exposed to TCDD-contaminated soil, acute illness has occurred.[16] Small doses of TCDD are carcinogenic in rodents.[17-18] Phenoxy herbicides and chlorophenols, some of which may have contained TCDD, have been implicated as a cause of soft tissue sarcoma and malignant lymphoma in humans.[18-22] TCDD has also been shown to be teratogenic in rodents.[23]

No occupational exposure standard exists for TCDD. NIOSH 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".[24]

VI. RESULTS

A. Environmental

Jones Truck Lines had a dioxin concentration of approximately 18.7 ppb on the rafters inside the terminal. This level was also confirmed by sampling conducted independently by Jones Truck Lines. None of the other samples inside the three terminals had detectable dioxin. Two surface soil samples at Jones Truck Lines near one of the entrance gates had dioxin present. No other soil samples at the three sites had detectable dioxin.

B. Medical

Three hundred twenty-eight current and former terminal workers and truck drivers who delivered to the three sites participated in the survey in either December 1983 or March 1984. These 328 represent 55% of the 600 employees eligible for the study.

1. Questionnaire Results

Demographic information and other characteristics of workers by exposure category are presented in Table II. Since there were only 12 female participants, and all were in the low-exposure category, the subsequent statistical analyses were restricted to the responses of men. Demographic and other characteristics were otherwise not significantly different between exposure groups, with the exception of perceived exposure status. Each of the 316 male participants was asked whether he had experienced each of 45 symptoms or medical conditions since 1971 (pages 3-6 of questionnaire). If he had, he was asked if he had seen a doctor for that condition and when he had first seen the doctor. Prevalences for each exposure group were calculated for those symptoms or conditions about which the participant reported being concerned enough to see a doctor and for which the worker first saw a doctor after December 1970 (the date of first possible exposure) and before January 1983 (Table III).

In an attempt to minimize over-reporting of the many common and non-specific symptoms included in the questionnaire, only symptoms or conditions for which medical attention was reported to have been sought were counted. Symptoms for which a worker first saw a doctor after December 1982 were not counted, because the presence of dioxin at these sites was made public at this time. Information and other bias is likely to have been introduced into a person's decision to seek medical attention after this time, as there was extensive attention by the news media to the potential hazard associated with previous exposure to TCDD at these sites. Symptoms that might not ordinarily have been alarming might have been over-reported to physicians after the time of this news coverage.

Pins and needles sensation in hands or feet, and trouble falling asleep or staying asleep, were highly significantly associated with higher exposure ($p<0.01$). Weakness in arms or legs, dizziness, numbness in hands or feet, and feeling blue or sad were also associated with higher exposure ($p<0.05$). These are symptoms compatible with both central and peripheral nervous system pathology, but they are non-specific.

An attempt was made to control for the potentially confounding effects of age, race (white or non-white), diabetes, employment status (employed or not employed), drinking (less than or more than 7 drinks weekly), and two variables that categorized participants into high and unknown <u>perceived</u> exposure vs. low perceived exposure. For the symptoms weakness in arms or legs and dizziness, use of medications with potential central nervous system side effects was also considered to be a potential confounder. A stepwise logistic regression was performed in which the condition was modeled for exposure and the various possible confounding factors[25]. A parsimonious model was arrived at by excluding potential confounders which were not entered into the model on the first run. (Association with disease with $p>0.05$ excluded a confounder from inclusion in the final model). For 4 of 6 of the symptoms of interest, the association with exposure remained significant ($p<0.05$). Weakness in arms and legs ($p=0.13$) and dizziness ($p=0.07$) were not significantly associated with exposure after controlling for confounders. Table IV lists the symptoms and the confounders found to be significant by the logistic regression model. Diabetes and employment status (employed or not employed) were the most common significant confounders of the association between "actual" exposure and symptoms. (Actual exposure refers to job history, as described above).

Because the participating population was self-selected, and many symptoms were highly subjective, the NIOSH investigators were concerned about the presence of selection bias and response bias, that is, that people might be more likely to participate if they thought they had high exposure or had symptoms or illnesses, and that they may be more likely to recall symptoms or consider symptoms worthy of reporting if they thought that they were exposed to dioxin. The perceived exposure variable was included in an attempt to control for there biases. Actual exposure was highly associated with perceived exposure (Table II), and in the final logistic regression models, perceived exposure was not a significant confounder for any of the associations between symptoms and actual exposure. The association between actual exposure remained significant, even after adjusting (perhaps over-adjusting) for the effect of perceived exposure.

Thirty workers with skin lesions at the times of the survey were subsequently examined by a consulting dermatologist. Workers were referred either because they had acneiform lesions or because they had skin conditions not specifically recognized by the NIOSH staff physician. Of these thirty workers, two were thought to have lesions compatible with chloracne (including case #1 below). In neither case was the dermatologist able to confirm the diagnosis.

2. Evaluation of Individual Cases

There were two participants who had rare diseases that have been associated with to exposure to TCDD.

Case #1: A 59-year-old male developed symptomatic porphyria cutanea tarda in June 1982. Subsequent measurement of blood uroporphyrinogen decarboxylase revealed a normal level. In February 1983 a pelvic angiosarcoma, probably of soft tissue origin, was diagnosed. On examination he had comedones and comedonal cysts lateral to the eyes, over the malar crescents, the lateral aspect of the nose, and behind both ears. Although these skin lesions were compatible with chloracne, the diagnosis could not be confirmed, despite extensive evaluation by multiple dermatologists. A skin biopsy was reported by a consulting dermatopathologist not to be suggestive of chloracne. He recalled first noticing the acneiform lesions only after the diagnosis of the sarcoma and during his subsequent weight loss. He died in late 1984 as a result of his tumor.

The man had worked as a truck driver for over 21 years, and in the early 1970s worked for several years at one of the TCDD-contaminated trucking terminals. For several months during the early 1970s, he had worked unhooking trailers from trucks in the sprayed area of the terminal and thus had potentially higher

exposure to TCDD than in his usual work as a driver. He reported that his feet, legs, hands, and arms frequently became covered with oil from the terminal lot. He was in the high exposure group (as defined above by his self-reported exposure), and he reported a history of drinking one case of beer weekly for many years. This case has been previously reported[27].

Case #2: Another worker had a dermatofibrosarcoma of his right abdominal wall which developed in late 1976. (A dermatofibrosarcoma is a soft tissue sarcoma). The tumor was excised and has not recurred. He is currently in good health. This worker did not work at any of the three truck terminals, although he did deliver daily to one of the contaminated terminals during 1972 and 1973. He recalls that he slipped and fell in the oil on one occasion while the lot was being sprayed for dust control. He may also have had exposure to TCDD as a mechanic in a garage where he worked on trucks belonging to the waste hauling company responsible for spraying TCDD-contaminated oil in the three truck terminal lots and at other sites in Missouri. He worked in the garage from June 1974 through mid-1976. (Thus, there is a latency period [time from first exposure to onset of the tumor] of four years for his work at the truck terminals, or 2 1/2 years for his work as a mechanic.) Based only on his exposure at the truck terminals, this man would have been considered to be in the low-exposure category.

There were 6.2 parts per trillion (ppt) TCDD measured by Centers for Disease Control laboratories in a recent fat biopsy from this worker. Preliminary data suggest that this is not more TCDD than is found in individuals with no known occupational or environmental exposure to TCDD.

VII. DISCUSSION

Analysis of environmental samples indicates that the potential for current exposure to TCDD at the three truck terminal sites is minimal. Samples of work areas and surface samples by NIOSH in 1983 showed no detectable TCDD in areas where workers currently are likely to be exposed. Less accessible terminal rafter dust samples were contaminated by TCDD at one site.

The implications of case #1 (with porphyria cutanea tarda and sarcoma) have been discussed previously.[26] The relationship between exposure and the subsequent development of disease is not entirely clear. The normal blood uroporphyrinogen decarboxylase suggests that the porphyria cutanea tarda is acquired rather than inherited.[27] However, both TCDD exposure and chronic alcohol ingestion have been reported to

result in porphyria cutanea tarda.[5,10,28] Although this person's tumor was clearly a sarcoma, it was not possible to determine whether it had arisen from bone or soft tissue. Two recent studies have shown an approximate sixfold increase in the risk of death from soft-tissue sarcoma among workers with histories of occupational exposures to TCDD-contaminated phenoxy acid herbicides or chlorophenols.[18,21] Other epidemiologic studies have been inconclusive because of small study populations and consequent low statistical power.[29,30] The presence of lesions which are compatible with chloracne support the possibility of a causal association with TCDD. However, this worker did not recall any remarkable acne during the period between 1971 and 1975 (when exposure is likely to have occurred).

The second case of sarcoma (this one definitely in soft tissue) occurred in a driver who subsequently worked as a mechanic, sometimes servicing the trucks of the waste hauler responsible for spraying the contaminated oil. The latency period (four years from the start of his job delivering to one of the truck terminals and two and one half years from the start of the job as a mechanic) was relatively short. Of the studies that have associated soft tissue sarcoma epidemiologically with exposure to phenoxy herbicides or chlorophenols, some of which may have contained TCDD, none provides data to assess latency adequately. Soft tissue sarcoma caused by radiation exposure occurs with a mean latency of 12 years.[31] Thorotrast-induced hepatic angiosarcoma is reported to occur with a latency between 16 and 40 years.[32] However, patients treated medically with immunosuppressive therapy have developed soft tissue sarcomas within two years of immunosuppression.[33,34] This worker probably had no more than minimal exposure to TCDD; his fat TCDD level was no higher than levels in persons without known exposure.[35] Although the half life of TCDD in humans has not been established, there is suggestive evidence that it may persist for prolonged periods in fat.[36]

As part of studies conducted by the Missouri Department of Health and the Centers for Disease Control, two other survey participants had adipose tissue (fat) analyzed for TCDD. Both had worked more than 15 years, ending in 1987, at the Overnight terminal site (then occupied by Pacific Intermountain Express) at jobs in the high-exposure category. Neither had military service in Vietnam or other known potential exposure to dioxin outside the truck terminal. Both reported neurologic symptoms in their questionnaires. Their fat TCDD levels (on a whole-weight basis) were 78 and 13.8 ppt, comparable to levels in persons without known dioxin exposure.[35] If they were exposed, then, their exposures would had to have been limited in order for their fat TCDD content to have returned to background levels in the 9-15 years between exposure and tissue collection.

Although TCDD exposure may have been modest, even in the "high-exposure" group, the results of the questionnaire survey suggest possible effects of TCDD exposure in this population. A variety of non-specific neurobehavioral symptoms (numbness in hands or feet, pins

and needles sensation in extremities, insomnia, and feeling blue or sad were significantly associated with higher likelihood of exposure to TCDD, even after controlling for multiple possible confounders. No other symptom groups or conditions were significantly more prevalent in the more exposed group than in the less exposed group.

These results are biologically plausible, based on reports from the medical and epidemiologic literature. Abnormalities of peripheral nerves manifested by both motor and sensory symptoms (including pins and needles sensation [parasthesias] and pain in the extremities) are a common finding among workers exposed industrially to TCDD.[3,4,7,10,14,37,38] There is also some evidence for peripheral neuropathy among people who have been exposed environmentally.[39] There are numerous reports from case series of heavily exposed workers of neurobehavioral effects, such as dizziness, weakness, fatigue, headaches, emotional lability, sleep disturbances, and loss of sex drive (among other symptoms of central nervous system effects).[4,11,13,37,39,40] One study demonstrated a higher score on the Minnesota Multiphasic Personality Inventory hypomania scale among more highly exposed workers.[7]

Definitive conclusions cannot be drawn from this survey because medical conditions and symptoms and exposures were self-reported by these self-selected participants. Both reporting bias and selection bias may have confounded the results, although attempts were made to control for each. Rates were calculated only for reported conditions serious enough to have prompted the participant to seek medical attention. An attempt was made to control for the selection and response biases by including the perceived exposure by the participants as an independent variable in the logistic regression procedure. In other populations exposed to TCDD, perceived exposure has been a significant confounder that more accurately predicted symptoms than "actual" exposure.[41] However, in this study it appears that actual exposure (as defined by time spent in certain job categories during the time of interest) predicted symptoms independently of, and better than, perceived exposure (as expressed by the participants). This holds true in spite of the fact that actual exposure and perceived exposure are highly correlated with each other and that treating perceived exposure as an independent variable risks over-controlling (inasmuch as participants' perception of their actual exposure is accurate).

Multiple comparisons were made, which could produce spurious associations. However, in this study all significant associations affected a single organ system (the nervous system), and in all of these, prevalences were greater among the more highly exposed group. Neither pattern would be expected if these were merely chance associations.

VIII. RECOMMENDATIONS

We recommended that the internal structure of Jones Truck Lines be thoroughly cleaned. This has been accomplished, and the site has been vacated by Jones Truck Lines.

Overnite Transportation Company has repaved its entire lot in accordance with our recommendations.

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Division of Surveillance, Hazard Evaluations, and Field Studies

XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications 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, Springfield, Virginia 22161. Information regarding its availability through NTIS can be obtained from NIOSH Publications Office at the Cincinnati address. Copies of this report have been sent to:

1. Jones Truck Lines
2. Overnight Transportation Co.
3. P.J. Hamill Transfer Co.
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6. International Brotherhood of Teamsters, Local 600
7. International Brotherhood of Teamsters, Local 618
8. International Brotherhood of Teamsters, Local 688
9. International Association of Machinists, Local 707
10. OSHA, Region VII

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.

TABLE I

APPROXIMATE DATES OF SPRAYING AND PAVING,
AND PEAK 1983 TCDD SOIL LEVELS -- TRUCK TERMINAL LOTS
ST. LOUIS, MISSOURI

	Date Sprayed With Contaminated Oil	Date Paved	Peak TCDD Subsurface Soil Levels
Site #1	1/1/71 - 12/31/73 (Exact date[s] unknown)	1974*/1978 (Exact date unknown)	93 ppb
Site #2	May 27, 1972	?1975* (Exact date unknown)	25 ppb
Site #3	1/1/71-12/31/73 (Exact date[s] unknown)	?1975 (Exact date unknown)	150 ppb

*Paved only with tar and pea gravel

TABLE II

DEMOGRAPHIC INFORMATION AND CHARACTERISTICS
OF PARTICIPANTS -- BY EXPOSURE
TRUCK TERMINAL MEDICAL SURVEY
ST. LOUIS, MISSOURI
HETA 83-297
DECEMBER 1983 and MARCH 1984

DEMOGRAPHIC CHARACTERISTICS	LOW EXPOSURE	HIGH EXPOSURE
Sex:		
Women[1]	12	0
Men	241	75
Mean Age (years)	49.8	52.1
Race		
White (not Hispanic)	221 (91.7%)	71 (94.7%)
Black	17 (7.1%)	4 (5.3%)
Hispanic	2 (1.2%)	0

OTHER CHARACTERISTICS	NUMBER LOW-EXPOSED (%)	NUMBER HIGH-EXPOSED (%)
Use of Medications	84 (34.9%)	35 (46.7%)
Drinking		
(7 or more drinks weekly)	70 (29.8%)	28 (38.4%)
Prior Job Exposures to Chemicals	169 (73.2%)	46 (66.7%)
Current Smokers	103 (55.4%)	41 (68.3%)
Vietnam Veterans	5 (2.2%)	1 (1.5%)
History of Living at		
Dioxin-contaminated Site	7 (3.1%)	3 (4.2%)
Perceived Exposure[2]		
High ("Very Heavy" or "Heavy")	56 (23.2%)	36 (48.0%)
"Unknown" or "no opinion"	106 (44.0%)	26 (34.7%)
Low ("Moderate", "Light" or "None")	79 (32.8)	13 (17.3%)
Employed	149 (61.8)	41 (54.7%)
Not employed (unemployed, retired, or disabled)	91 (38.2)	34 (45.3%)

1. Because there were so few of them, women were excluded from all subsequent analyses.

2. $X^2 = 461.7$, d.f. = 2, $p < 1 \times 10^{-8}$

TABLE III

INCIDENCE OF SYMPTOMS AND DISEASE
FOR WHICH MEDICAL ATTENTION WAS FIRST SOUGHT
BETWEEN JANUARY 1971 and DECEMBER 1982
TRUCK TERMINALS, ST. LOUIS, MISSOURI
HETA 83-297

DISEASE OR CONDITION	NUMBER LOW EXPOSURE (%)	NUMBER HIGH EXPOSURE (%)
Hepatitis	2 (0.8%)	2 (2.7%)
Cirrhosis	5 (2.1)	0 (0)
Yellow Jaundice	2 (0.8)	2 (2.7)
Other Liver Disease	2 (0.8)	0 (0)
Nephritis	18 (7.8)	9 (12.0)
Bloody Urine	13 (5.5)	9 (12.2)
Protein in Urine	5 (2.1)	3 (4.2)
Other Kidney Disease	6 (2.5)	0 (0)
Cystitis or Bladder Infection	8 (3.5)	4 (5.6)
Neurologic Disease	5 (2.1)	2 (2.8)
Heart Disease	25 (10.6)	8 (11.0)
Psoriasis	9 (3.9)	4 (5.5)
Dermatitis	28 (12.0)	10 (14.1)
Acne	8 (3.4)	2 (2.7)
Eczema	2 (0.8)	0 (0)
Eye Infections or Red Eye	15 (6.4)	3 (4.1)
Seizures, Fits or Epilepsy	3 (1.2)	0 (0)
Mental Illness	3 (1.2)	0 (0)
Depression	13 (5.5)	4 (5.5)
Diabetes	13 (5.5)	3 (4.2)
High Blood Pressure	51 (22.4)	15 (22.4)

TABLE III (CONTINUED)

INCIDENCE OF SYMPTOMS AND DISEASE
FOR WHICH MEDICAL ATTENTION WAS FIRST SOUGHT
BETWEEN JANUARY 1971 and DECEMBER 1982
TRUCK TERMINALS, ST. LOUIS, MISSOURI
HETA 83-297

DISEASE OR CONDITION	NUMBER LOW EXPOSURE (%)	NUMBER HIGH EXPOSURE (%)
Chronic itching or burning skin irritation	46 (19.9%)	11 (15.9%)
Other serious skin problems	25 (10.6)	3 (4.2)
Chronic itching or burning eyes	13 (5.6)	6 (8.3)
Weakness in arms or legs[1]	23 (10.2)	14 (19.4)
Tremors	10 (4.2)	6 (8.2)
Dizziness[1]	18 (7.8)	13 (18.1)
Numbness in hands or feet[1]	27 (11.8)	15 (21.7)
Pins & needles sensation in hands or feet[2]	21 (9.1)	15 (21.4)
Severe headaches	16 (6.9)	7 (10.1)
Joint or bone pain	40 (18.6)	12 (18.2)
Muscle aches or pains	24 (10.3)	13 (18.6)
Trouble falling or staying asleep[2]	10 (4.2)	9 (12.9)
Excessive nervousness or irritability	23 (9.8)	7 (10.2)
Trouble remembering things	7 (2.9)	2 (2.8)
Loss or lack of appetite	10 (4.2)	1 (1.4)
Feeling blue or sad[1]	5 (2.1)	5 (6.9)
Feeling worried or anxious	8 (3.4)	5 (6.9)
Loss of 10 lbs. or more in one month while NOT on a diet	8 (3.4)	5 (7.1)
Other	17 (9.1)	9 (15.5)
Impotence	25 (11.1)	11 (15.7)
Loss of sex drive	21 (9.5)	12 (16.9)
Inability to have children (infertility)[3]	12 (5.2)	2 (2.8)
Adverse Reproductive Outcome (Miscarriage, birth defect, stillbirth)[3]	21 (11.5)	4 (7.0)
Cancer[4]	24 (10.1)	4 (5.3)

1. Difference in prevalence: $p < 0.05$ (Fisher's exact test).

2. Difference in prevalence: $p < 0.01$ (Fisher's exact test).

3. Question as worded did not ask whether a doctor had been seen for this condition.

4. Question asked whether the participant had ever been diagnosed as having cancer. (Diseases diagnosed before 1971 and after 1982 were not excluded from the calculations.)

TABLE IV

ASSOCIATION OF NEUROBEHAVIORAL SYMPTOMS WITH EXPOSURE
RESULTS OF LOGISTIC REGRESSION TO CONTROL
FOR POTENTIAL CONFOUNDERS--TRUCK TERMINAL MEDICAL SURVEY
ST. LOUIS, MISSOURI
DECEMBER 1983 and MARCH 1984
HETA 83-297

SYMPTOM	ASSOCIATION WITH EXPOSURE (p)	CONFOUNDERS
Weakness in arms or legs	0.130	Diabetes, medication use*
Dizziness	0.070	Use of medication*, employment status
Numbness in hands or feet	0.033	Diabetes, employment status
Pins & needles sensation in hands or feet	0.006	Diabetes, employment status
Trouble falling or staying asleep	0.041	Employment status
Feeling blue or sad	0.029	Diabetes

* Only medication groups which might have a central nervous system effect were included.

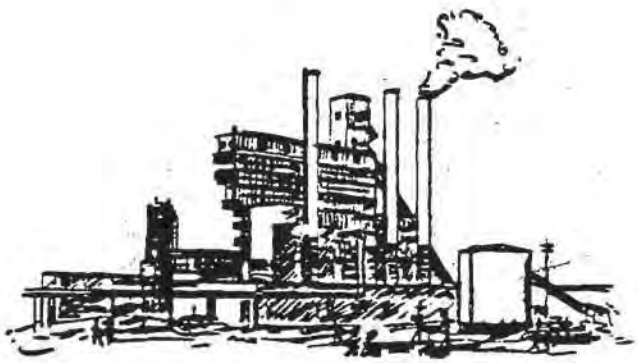
NIOSH

TRUCK TERMINAL MEDICAL SURVEY
ST. LOUIS, MISSOURI

HETA 83-297

DECEMBER 1983

QUESTIONNAIRE



U. S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service, Centers for Disease Control
National Institute for Occupational Safety and Health

CDC/NIOSH (C) TF 83-297
12/83 (Exp. 12/84)

(PLEASE PRINT)

HETA 83-297 TRUCK TERMINAL MEDICAL SURVEY

Interviewer: _____

Today's Date: _____

Identification #: ☐☐☐☐ *(1-4)*

A. DEMOGRAPHIC

(1) Participant's Name: _____
First MI Last

(2) Participant's Address: _____
Street (Apt #)

_____
City State Zip

(3) Telephone: ( ) _____

(4) Social Security Number ☐☐☐-☐☐-☐☐☐☐ *(5-13)*

(5) Date of Birth: Mo.☐☐ Day☐☐ Year 19☐☐ *(14-19)*

(6) ☐ Sex 1 = Male 2 = Female *(20)*

(7) ☐ Race
1 = White (Not Hispanic)
2 = Black (Not Hispanic)
3 = Hispanic *(21)*
4 = American Indian or Alaskan Native
5 = Asian or Pacific Islander

(8) Please identify two individuals (relatives or friends) who will always know where to contact you:

NAME _____ NAME _____

Relationship _____ Relationship _____

Address _____ Address _____

_____ _____

Phone ( ) _____ Phone ( ) _____

(9) Would you please briefly explain why you are participating in this survey?

_____

_____

(1 = valid; 2 = not valid; 8 = unknown) ☐ (22)

B. MEDICAL HISTORY

I am now going to ask you some questions about your health.

(10) How would you describe your health?

(1 = Excellent; 2 = Good; 3 = Fair*; 4 = Poor*) ☐ (23)

*Explain _____

(11) When you have a medical problem, where do you seek treatment? ☐ (24)

1 = Private or family doctor
2 = Emergency room
3 = Group health plan (HMO)
4 = Clinic
5 = Doesn't seek treatment
8 = Unknown

(12) When did you last have a physical exam? 19 ☐☐ (25-

CARD /0/1/ (79-

(13) Since 1971, have you had any of the following medical problems?

(IF YES): Did you see a doctor? What year did you first see the doctor?

(1 = yes; 2 = no; 8 = unknown)

CONDITION	—(IF YES)→	SEEN BY DOCTOR	YEAR	*PAST 4 MOS
Hepatitis	☐ (5)	☐ (6)	19☐☐ (7-8)	☐ (9)
Cirrhosis	☐ (10)	☐ (11)	19☐☐ (12-13)	☐ (14)
Yellow jaundice	☐ (15)	☐ (16)	19☐☐ (17-18)	☐ (19)
Other liver disease (Spec)	☐ (20)	☐ (21)	19☐☐ (22-23)	☐ (24)
Nephritis (kidney infection or inflammation)	☐ (25)	☐ (26)	19☐☐ (27-28)	☐ (29)
Bloody urine	☐ (30)	☐ (31)	19☐☐ (32-33)	☐ (34)
Protein in urine	☐ (35)	☐ (36)	19☐☐ (37-38)	☐ (39)
Other kidney disease (Spec)	☐ (40)	☐ (41)	19☐☐ (42-43)	☐ (44)
Cystitis or bladder infection	☐ (45)	☐ (46)	19☐☐ (47-48)	☐ (49)
Neurologic disease	☐ (50)	☐ (51)	19☐☐ (52-53)	☐ (54)
Heart disease	☐ (55)	☐ (56)	19☐☐ (57-58)	☐ (59)
Psoriasis	☐ (60)	☐ (61)	19☐☐ (62-63)	☐ (64)

CARD / 0 / 2 / (79-80)

Since 1971, have you had any of these medical problems?

CONDITION	—(IF YES)→	SEEN BY DOCTOR	YEAR	*PAST 4 MOS
Dermatitis	☐ (5)	☐ (6)	19☐☐ (7-8)	☐ (9)
Acne (pimples, blackheads as an adult)	☐ (10)	☐ (11)	19☐☐ (12-13)	☐ (14)
Eczema	☐ (15)	☐ (16)	19☐☐ (17-18)	☐ (19)
Eye infections or red eye	☐ (20)	☐ (21)	19☐☐ (22-23)	☐ (24)
Seizures, fits, epilepsy	☐ (25)	☐ (26)	19☐☐ (27-28)	☐ (29)
Mental illness	☐ (30)	☐ (31)	19☐☐ (32-33)	☐ (34)
Depression	☐ (35)	☐ (36)	19☐☐ (37-38)	☐ (39)
High blood pressure	☐ (40)	☐ (41)	19☐☐ (42-43)	☐ (44)
Diabetes	☐ (45)	☐ (46)	19☐☐ (47-48)	☐ (49)

(14) *During just the past 4 months, have you been troubled by any of these medical problems? (Interviewer Note: Please read each condition in #13 which was seen by a doctor. Code answers in "Past 4 Months" column).

CARD 0 3 (79-80)

Since 1971, have you been troubled by any of the following symptoms or conditions?

(IF YES): Did you see a doctor? What year did you first see the doctor?

(1 = yes; 2 = no; 8 = unknown)

CONDITION	—(IF YES)→	SEEN BY DOCTOR	YEAR	*PAST 4 MOS
Chronic itching and/or burning skin irritations	☐ (5)	☐ (6)	19☐☐ (7-8)	☐ (9)
Other serious skin problems	☐ (10)	☐ (11)	19☐☐ (12-13)	☐ (14)
Chronic itching and/or burning eyes	☐ (15)	☐ (16)	19☐☐ (17-18)	☐ (19)
Weakness in arms or legs	☐ (20)	☐ (21)	19☐☐ (22-23)	☐ (24)
Tremors	☐ (25)	☐ (26)	19☐☐ (27-28)	☐ (29)
Dizziness	☐ (30)	☐ (31)	19☐☐ (32-33)	☐ (34)
Numbness in hands or feet	☐ (35)	☐ (36)	19☐☐ (37-38)	☐ (39)
Pins-and-needles sensation in hands or feet	☐ (40)	☐ (41)	19☐☐ (42-43)	☐ (44)
Severe headaches	☐ (45)	☐ (46)	19☐☐ (47-48)	☐ (49)
Joint or bone pain	☐ (50)	☐ (51)	19☐☐ (52-53)	☐ (54)

CARD 0 4 (79-80)

Since 1971, have you been troubled by any of these symptoms or conditions?

CONDITION	—(IF YES)→	SEEN BY DOCTOR	YEAR	**PAST 4 MONTHS
Muscle aches or pain	☐ (5)	☐ (6)	19☐☐ (7-8)	☐ (9)
Trouble falling asleep or staying asleep	☐ (10)	☐ (11)	19☐☐ (12-13)	☐ (14)
Excessive feelings of nervousness or irritability	☐ (15)	☐ (16)	19☐☐ (17-18)	☐ (19)
Trouble remembering things	☐ (20)	☐ (21)	19☐☐ (22-23)	☐ (24)
Loss or lack of appetite	☐ (25)	☐ (26)	19☐☐ (27-28)	☐ (29)
Feeling blue or sad	☐ (30)	☐ (31)	19☐☐ (32-33)	☐ (34)
Feeling worried or anxious	☐ (35)	☐ (36)	19☐☐ (37-38)	☐ (39)
Loss of 10 pds. or more in 1 month (while not on a diet)	☐ (40)	☐ (41)	19☐☐ (42-43)	☐ (44)
Other _____	☐ (45)	☐ (46)	19☐☐ (47-48)	☐ (49)

(16) **During just the past 4 months, have you been troubled by any of these symptoms or conditions 3 or more days out of a typical week? (Interviewer Note: Please read each condition in #15 which was seen by a doctor. Code answers in "Past 4 Months" column).

(17) Have you ever been diagnosed as having cancer?

(1 = yes; 2 = no, 8 = unknown) ☐ (50)

If yes, describe the type of cancer and date diagnosed _____

Now I am going to ask you some questions about your reproductive health.

MALE RESPONDENTS

(18) Since 1971, have you seen a doctor for any of the following problems?

(1 = yes; 2 = no; 8 = unknown)

PROBLEM		YEAR
Impotence (inability to have or maintain an erection)	☐ (51)	19☐☐ (52-53)
Loss of sex drive	☐ (54)	19☐☐ (55-56)

(19) Has your wife or partner ever tried for a full year with you to get pregnant and been unable? ☐ (57) 19☐☐ (58-59)

FEMALE RESPONDENTS

(20) Since 1971, have you seen a doctor for any of the following problems?

(1 = yes; 2 = no; 8 = unknown)

PROBLEM		YEAR	
Irregular periods	☐ (60)	19☐☐	(61-62)
Chronic excessive menstrual flow	☐ (63)	19☐☐	(64-65)
Abnormal pap smear	☐ (66)	19☐☐	(67-68)
Loss of sex drive	☐ (69)	19☐☐	(70-71)

(21) Have you ever tried for a full year to get pregnant and been unable? ☐ (72) 19☐☐ (73-74)

(22) How old were you when you had your first period? ☐☐ (75-76)

(23) Are you still having periods?

(1 = yes; 2 = no; 8 = unknown) ☐ (77)

If no, when did you stop having periods? _____

CARD / 0/ 5/ (79-80)

ALL RESPONDENTS

(24) Have you or your spouse or partner ever had a:

(1 = yes; 2 = no; 8 = unknown)

OUTCOME		MONTH/DAY/YEAR	
Miscarriage	☐ (5)	☐☐ - ☐☐ - ☐☐	(6-11)
Baby born with birth defect	☐ (12)	☐☐ - ☐☐ - ☐☐	(13-18)
Stillbirth (born dead after 28 weeks of gestation)	☐ (19)	☐☐ - ☐☐ - ☐☐	(20-25)

(25) Do you NOW take any of the following medicines?

(1 = yes; 2 = no; 8 = unknown)

		Name of Drug	Length of time taken
☐ Blood pressure medicines	(26)		
☐ Other heart medicines	(27)		
☐ Anti-Histamines	(28)		
☐ Sleeping pills	(29)		
☐ Birth Control pills	(30)		
☐ Muscle relaxants	(31)		
☐ Sedatives or tranquilizers	(32)		
☐ Medications to help you stay awake	(33)		
☐ Other (specify) _____	(34)		

(26) Please specify your approximate weight for the following time periods.

	Weight (pounds)	Indicate change (#lbs) since 10 yrs ago	+ or -
a. What was your weight 10 years ago?			
b. How much did you weigh 5 years ago?		☐☐☐ (35-37)	☐ (38)
c. How much did you weigh 1 year ago?		☐☐☐ (39-41)	☐ (42)
d. How much do you weigh today?		☐☐☐ (43-45)	☐ (46)

[Interviewer note: If weight loss greater than 15 # is reported, then ask respondent:]

e. To what do you attribute your weight loss? (1 = yes; 2 = no; 8 = unknown)

☐ Diet (wt. loss program or other changes) (47)

☐ Exercise program (48)

☐ Other (specify) _____ (49)

C. HABITS

(1 = yes; 2 = no; 8 = unknown)

(27) Have you ever smoked cigarettes? ☐ (50)

("No" means less than 100 cigarettes in your entire life)

If Yes:

☐ Do you smoke cigarettes now? (51)

☐☐ How old were you when you started smoking? (52-53)

☐☐ At what age did you quit? (Code "99" if NA) (54-55)

☐☐ Total number of years you smoked? (56-57)

☐ Average number of packs per day smoked? (58)

(28) ☐☐ If a drink is 1 can or bottle of beer, 1 glass of wine or 1 cocktail or shot of liquor, then how many drinks do you have in a week, on the average? (Code "00" if less than 1/week or zero). (59-60

Now I am going to ask you some questions about your employment history.

(29) ☐ What is your current employment status? (61)

1 = Employed 3 = Retired
2 = Unemployed 4 = Disabled

D. EXPOSURES

(30) ☐ What is the name of the company you work (or worked) for? (62)

1 = Hamill 4 = Overnite
2 = PIE 5 = Best Way
3 = Jones 6 = Other (specify) _____

CARD /0/6/ (79-80

(31) Please indicate all of the jobs you have held during your employment at (Hamill, PIE, Best Way, Jones, Overnite,) and the dates you worked at those jobs (1 = yes; 2 = no; 8 = unknown)

JOB		COMPANY CODE (See Q30)		DATES JOBS WORKED (mo/yr)	
☐ Dockworker	(5)	☐	(6)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(7-14)
☐ Drayage driver	(15)	☐	(16)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(17-24)
☐ City driver	(25)	☐	(26)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(27-34)
☐ Road driver	(35)	☐	(36)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(37-44)
☐ Janitor	(45)	☐	(46)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(47-54)
☐ Fueler	(55)	☐	(56)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(57-64)
☐ Tireman	(65)	☐	(66)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(67-74)

CARD / 0 / 2 / (79-80)

☐ Foreman	(5)	☐	(6)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(7-14)
☐ Mechanic	(15)	☐	(16)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(17-24)
☐ Spotter	(25)	☐	(26)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(27-34)
☐ Office Worker	(35)	☐	(36)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(37-44)
☐ Other: specify	(45)	☐	(46)	☐☐ - ☐☐ TO ☐☐ - ☐☐	(47-54)

(32) ☐ Have you worked as an interline, drayage or city driver, or road driver from another company delivering to or picking up from Hamill, PIE, Jones, Best Way or Overnite? (55)

(1 = yes; 2 = no; 8 = unknown)

↓

[If no, go to question #37]

[If yes]

(33) ☐ Did you deliver to or pick up from Hamill, Jones, or PIE for years 1971-74? (56)

CARD / 0 / 8 / (79-80)

(1 = yes; 2 = no; 8 = unknown)

↓

[If no, go to question 36]

(If yes to question #33):

(34) For each of those companies, what was the average number of times, during a typical week, that you visited each terminal for the years 1971-1974?

# of visits/each week

Hamill ☐☐ (5-6) PIE ☐☐ (7-8) Jones ☐☐ (9-10)

(If yes to question #33):

(35) When you would visit these terminals back in 1971-74, what was the usual amount of time you would remain at each of these terminals during a typical visit?

Average time/visit (minutes)

Hamill ☐☐☐ (11-13) PIE ☐☐☐ (14-16) Jones ☐☐☐ (17-19)

(If no to question #33):

(36) During what years did you deliver to or pick up from Jones, PIE, Hamill, Overnite, or Best Way?

Jones 19☐☐ TO 19☐☐ (20-23)

PIE 19☐☐ TO 19☐☐ (28-31)

Hamill 19☐☐ TO 19☐☐ (36-39)

Overnite 19☐☐ TO 19☐☐ (24-27)

Best Way 19☐☐ TO 19☐☐ (32-35)

(37) Please list all jobs you have held for more than 3 months, working back from your current job.

	Company	Job or Type of Work	Dates Employed (approx)
1.			
2.			
3.			
4.			

(38) ☐ Were any of those jobs in the manufacture, use, transport or disposal of chemicals (such as pesticides, fertilizers or petroleum products) or the manufacture and use of electrical equipment (such as transformers and capacitors)? (1 = yes; 2 = no; 8 = unknown) (40)

↓

[If yes, indicate which job(s) using line code(s) from Question 37 _____]

E. DIOXIN RELATED CONDITIONS

(39) Did you serve in the U.S. Armed Forces in Vietnam?

☐ (1 = yes; 2 = no) (41)

What dates did you serve in Vietnam? (mo/day/yr)

☐☐ - ☐☐ - ☐☐ TO ☐☐ - ☐☐ - ☐☐ (42-53)

Were you involved in defoliant (herbicide spraying) operations or did you operate in defoliated areas in Viet Nam?

☐ (1 = yes; 2 = no; 8 = unknown) (54)

(40) In the last 15 years have you lived in any area known to have dioxin contaminations?

☐ (1 = yes; 2 = no; 8 = unknown) (55)

(Identify area) _____

(41) Do you have any skin problems that are present right now?

☐ (1 = yes; 2 = no; 8 = unknown) (56)

[If yes, refer to NIOSH physician now]

(42) Have you been told by a physician that you have now or have ever had:

_____ Chloracne _____ (Date of DX)

_____ Porphyria Cutanea Tarda _____ (Date of DX)

(Interviewer note: If yes to any of the above, obtain):

A. Physician's name _____

Address _____

City/State/Zip _____

Phone _____

B. Signed release for medical records.

(43) How much exposure to dioxin do you think you have had? ☐ (57)

1 = Very heavy
2 = Heavy
3 = Moderate
4 = Light
5 = None
6 = No opinion
8 = Unknown

(44) How much of a hazard do you think this exposure is to your health? ☐ (58)

1 = Serious
2 = Moderate
3 = Minimal
4 = None
5 = No opinion
8 = Unknown

CARD / 0/ 9/ (79-80)

THANK YOU FOR YOUR PARTICIPATION IN THIS SURVEY.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
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