HETA 87-419-2010
FEBRUARY 1990
DRESSER INDUSTRIES
BEREA, KENTUCKY

NIOSH INVESTIGATORS:
Richard W. Hartle, C.I.H.
Scott Deitchman, M.D.

I. SUMMARY

On September 21, 1987, the National Institute for Occupational Safety and Health (NIOSH) received an emergency request from Dresser Industries for evaluation of an outbreak of illness among employees at Dresser's facility in Berea, Kentucky, which manufactures small pressure gauges. The request was initiated because of employee complaints of a sewer-like odor, and subjective complaints of numbness of the lips, tongue, and extremities; burning of the nose and throat; and dizziness. At the time of the request, nine employees had been sent to the local emergency room.

To identify air contaminants potentially responsible for the ill health effects, environmental monitoring was conducted in the general work area of the employees with health complaints, in work areas where no health complaints had been reported, and outside the facility. Results indicated a number of compounds common to this type of industrial environment, including various solvents, odorants, and lubricants. All compounds were in airborne concentrations of generally less than one part per million (ppm), much lower than the most restrictive occupational environmental evaluation criteria. Environmental monitoring conducted by the Kentucky Occupational Safety and Health Administration (KyOHSA) during the same time period did not detect the presence of airborne metals.

A NIOSH physician reviewed the medical records for all employees taken to the emergency room. Discussions were held with the examining physicians, and the only patient hospitalized in Berea was interviewed and examined. A questionnaire of employee symptoms and observations was administered to all employees present. Private interviews were held with all the employees affected on the first day of the incident, and additional discussions were held with area physicians. Employees described a wide variety of symptoms occurring during the period of the outbreak. Medical testing, however, did not reveal abnormalities which would be associated with these symptoms, with the exception of several patients whose arterial blood gas measurements suggested a mild respiratory alkalosis.

Although it is not possible for the NIOSH investigators to identify the initial stimulus for the outbreak (they were not present during the initial outbreak, and there was no recurrence during the investigation), it is possible that a single day of exposure to an unknown agent, possibly related to the connection of a new sewer system, contributed to symptoms perceived on that day. This event may have caused plant-wide anxiety and stress, generating a "collective stress syndrome" which propagated the development of subsequent worker symptoms.

KEYWORDS: SIC 3823 (Measuring and Controlling Instruments), collective stress syndrome

II. INTRODUCTION

On September 21, 1987, NIOSH received an emergency request for a Health Hazard Evaluation from Dresser Industries for evaluation of an ongoing outbreak of illness among employees at their facility in Berea, Kentucky. On the morning of Friday, September 18, 1987, eight employees complained of smelling a foul odor, which on later interview they described as "smelling like a sewer." They noted subjective complaints including: numbness and tingling of the lips, tongue, and extremities; burning of the nose and throat; light-headedness, weakness, and/or dizziness. After an attempt to relieve them with exposure to outside air, seven of the eight were sent to the emergency room of Berea Hospital. On Monday, September 21, the plant opened as usual. During the day, two more employees were taken to the hospital with similar complaints. That afternoon, Dresser management contacted NIOSH and submitted an emergency request for assistance. On Tuesday morning, September 22, five additional employees were affected and sent to the hospital, and Dresser management closed the plant. That afternoon a NIOSH investigative team arrived, and joined an investigative team from the Kentucky Labor Cabinet (KyOSH) already present.

III. BACKGROUND

At the Berea, Kentucky facility, Dresser manufactures various types of pressure gauges for use in a variety of applications (most notably fire extinguishers). The industrial processes include metal stamping, soldering and brazing, assembly, testing and calibration, and packaging. The facility is divided into three main areas, each comprising a "building" (although designated buildings 1-3, they are structurally attached). Each building is serviced by an individual ventilation system. The facility employs 379 workers of whom 85% are female; on the production line the percentage of women is higher, since most of the men are employed in a few areas involving heavy tooling and maintenance.

IV. EVALUATION DESIGN

A. Environmental

The environmental evaluation was initiated by touring the entire facility, with emphasis on the area where employees were most affected. At that time, informal interviews were conducted with management and employee representatives to determine 1) sources and types of potential environmental contaminants, and 2) recent changes in facility structure, work practices, or process chemicals.

The investigative methods previously undertaken by KyOSH were discussed to prevent duplication of efforts, and available results were reviewed. Environmental monitoring was initiated by NIOSH on the morning of September 22, 1987. To identify potential air contaminants and to determine if there was a difference between those present in the affected area and areas where no health effects were reported, monitoring was conducted in the general area of the health complaints, in work areas where no health complaints

had been reported, and outside the facility. The initial NIOSH environmental samples consisted of four charcoal tubes for gas chromatograph/mass spectrometer (GC/MS) analysis and three Carbotrap 300 tubes for thermal desorption GC/MS analysis. Because of the health complaints suffered during the sampling period and the subsequent plant shut-down, these samples were analyzed on a priority basis (i.e., samples were transported to the NIOSH analytical laboratory immediately following collection and analyzed within hours of collection).

A second set of air samples was obtained on the first day the plant re-opened (Thursday, September 24). These samples were submitted for non-priority GC/MS analysis. They were desorbed with one milliliter (ml) carbon disulfide upon arrival in the laboratory and screened by GC (FID) using a 30-meter SPB-1 fused capillary column (splitless mode). One sample was further analyzed by GC/MS to identify components. Standards were also prepared and analyzed to obtain limited quantitative data. The Carbotrap 300 tubes were thermally desorbed at 300°C in a thermal desorber unit that interfaces directly to a GC/MS system. These were trial samples, as the method or tubes had never been used and the unit was being tested in the NIOSH laboratory. For the second set of charcoal tube samples, collected during the day shift on the first day the plant returned to operation (Thursday, September 24), two qualitative charcoal samples plus one blank were desorbed with carbon disulfide, screened by GC, and analyzed by GC/MS. Major compounds identified on these tubes were then quantitated on the remaining samples. For GC-FID analyses, a 30-meter DB-Wax fused silica capillary column (splitless mode) was used.
The ventilation systems, both local exhaust and general, were evaluated for efficiency and potential for reintrainment of exhausted air. Smoke tube tests were conducted on the local exhaust at the automated brazing operation, sorting area (of brazed parts), cleaning operation (H_2SO_4 bath of brazed parts), and the induction heater; all were located in the area where the initial health effects were noted. A tour of the roof area was conducted to observe placement of air intake and local exhaust vents.

B. Medical

When the NIOSH investigative team arrived at Dresser Industries on Tuesday, the plant was closed, and none of the affected employees was available for examination. Medical information was collected from telephone and personal interviews with area physicians who had examined employees from the plant.

On Wednesday, NIOSH investigators reviewed the hospital records for all employees seen during the episode under investigation. Discussions were held with the examining physicians, and the only patient hospitalized in Berea was interviewed and examined. When workers at the plant were affected on Wednesday, a number of them were briefly seen before rescue vehicles arrived to transport them to the hospital. These new cases were reviewed with the area physicians who treated them.

On Thursday, meetings were held with the entire workforce at the plant, during which employee questions and answers were solicited. A questionnaire of employee symptoms and observations was administered to all employees present. Private interviews were held with all the employees affected on the first day of the incident. Additional discussions were held with area physicians.

C. Epidemiologic

A questionnaire **(Appendix 1)** was developed by NIOSH staff in Cincinnati conferring by telephone with the investigators in Berea on Wednesday, September 23. Elements of the questionnaire were selected on the basis of reports to area physicians, complaints expressed to the NIOSH investigators, and complaints expressed in other NIOSH investigations. Use of the questionnaire was intended to identify cases of illness other than those referred to area physicians, and to assess the nature and distribution of health and environmental complaints in the plant. The questionnaire was administered in the plant on Thursday, September 24, when the plant was shut down. The questionnaire was completed by workers seated at tables and work stations throughout the plant.

V. 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 recommended exposure limits (RELs), 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH RELs and ACGIH TLVs are lower than the corresponding OSHA standards. Both NIOSH RELs and ACGIH TLVs usually are based on more recent information than are the OSHA permissible exposure limits

(PELs). 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 RELs, by contrast, are based primarily 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 (STELs) or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

VI. RESULTS AND DISCUSSION

A. Chronology of Events

On the morning of Friday, September 18, 1987, eight employees complained of smelling a foul odor, which on later interview they described as "smelling like a sewer." They noted subjective complaints including: numbness and tingling of the lips, tongue, and extremities; burning of the nose and throat; light-headedness, weakness, and/or dizziness. After an attempt to relieve their symptoms with exposure to outside air, seven of the eight were sent to the emergency room of Berea Hospital. On Monday, September 21, the plant opened as usual. During the day, two more employees were taken to the hospital with similar complaints. That afternoon, Dresser management contacted NIOSH and submitted an emergency request for assistance.

On Tuesday morning, September 22, five additional employees were affected and sent to the hospital, and Dresser management closed the plant. On Tuesday afternoon the NIOSH investigative team arrived. An investigative team from KyOSH and a consulting industrial hygienist hired by the company were already present and had completed initial environmental sampling, which was negative. Plant management decided on that basis to reopen the plant the following day. The NIOSH industrial hygienist completed additional environmental studies, while the NIOSH medical officer contacted area physicians and the plant physician and discussed the cases they had seen.

On Wednesday, September 23, the industrial hygienists arrived before the start of first shift and set up their monitoring systems. First shift started at the usual time. Starting at about 11 a.m., workers complained of symptoms of illness similar to those reported earlier; reports of illness came from widely distributed areas of the plant, and workers left the building to escape a possible toxic exposure. Emergency service vehicles arrived, five employees were taken to the emergency room, and the plant was closed again. NIOSH and KyOSH industrial hygienists completed additional industrial hygiene monitoring during this time.

Although plant management kept the plant closed on Thursday, September 24, employees were instructed to arrive at the normal working time. Employees were asked to complete a NIOSH questionnaire asking about perceived environmental exposures and symptoms. Following completion of the questionnaire, meetings were held with employees, management, union representatives, and investigators from KyOSH and NIOSH. During these meetings, the results of the investigations were presented and employee questions were answered.

B. Environmental Results

Results of the sample set collected on Tuesday morning indicated the presence of a number of compounds common to this type of industrial environment, including 1,1,1-trichloroethane (most probably from a small degreasing operation), xylene, toluene, isopropanol, limonene, and various siloxane-type compounds (from adhesives and lubricants used near the gauge calibration area). All compounds were in airborne concentrations of generally less than one part per million (ppm); these levels were much lower than the most restrictive evaluation criteria. The repeat sampling conducted on Thursday, September 24, revealed essentially the same compounds in the same range of airborne concentrations. Environmental monitoring conducted by KyOSHA did not detect the presence of airborne metals.

An investigation of recent changes in the production process or an introduction of new process chemicals was undertaken by interviewing management and employee representatives. Two potential sources of airborne contaminants were discussed. The city of Berea had recently completed construction of a new sewage treatment plant, and on the previous Friday municipal workers had connected the plant's storm and sanitary lines to a new main on the property. It was possible that a backup of sewer gases had occurred on that day and triggered the initial episode. Several drains, located throughout the plant, provide direct access to the sewer line. To prevent any future potential for a similar situation, the plant and the fire department flushed the sewer lines inside and outside the plant. There was also concern that a new cooling oil used in one of the four compressors supplying compressed air to the plant might have contained contaminants or breakdown products that were spread through the plant. This compressor was therefore taken off-line and its oil changed back to the original. An investigation of the ventilation systems was also conducted.

Two thermonic Taylor-Winfield induction heaters are used for automated soldering/brazing of gauges, operating at 7.5 kilowatts, 450 kilohertz, and 460 volts. The systems are locally exhausted via strategically placed PVC pipe connected to the exhaust fan, which is exhausted to the roof. PVC pipe is used due to the radio frequency potential of the operation (i.e., to prevent the potential for directional wave guiding/grounding posed by metal ducting). KyOSH obtained general area environmental air samples in this area for lead, tin, zinc. Personal (breathing zone) samples were obtained for cadmium and chromium; all were negative.

C. Ventilation

The facility has seven tempered air handling units, located on the roof, six for production areas and one for the employee's cafeteria. Total ventilative capacity for the system is 111,500 cubic feet per minute (design). All units were operated at 20% outside air (minimum).

D. Medical Results

In addition to medical history and physical examinations, the affected employees received a variety of laboratory tests, including complete blood counts, serum electrolytes, arterial blood gases, carboxyhemoglobin levels, blood lead levels, and screens for various toxic agents. Neither the physicians' reports of signs and symptoms, the medical laboratory results, nor the private interviews were suggestive of a common hazardous exposure.

In interviews with the affected employees, workers described a wide range of symptoms. These included numbness and tingling of lips, tongue, and extremities, as well as light-headedness, dizziness, and feelings of overall weakness. The onset of these symptoms was often preceded by the worker smelling a foul odor or tasting a "metallic taste." The prior medical history related by these workers was generally non-contributory.

The case presentations of the affected workers were discussed with the physicians who attended them. Patients seen in acute presentation typically were noted to be anxious and tachypneic (breathing rapidly), but no other generalized abnormalities were noted.

Sixteen patients seen at the Berea Hospital underwent various laboratory tests as part of a diagnostic workup. These patients had normal complete blood counts, serum electrolytes, electrocardiograms, carboxyhemoglobin levels, blood lead levels, and toxicology screens. Eleven patients had arterial blood gas levels tested; three showed mild respiratory alkalosis, and the rest were normal. All patients recovered spontaneously. Patients seen in the emergency room typically were asymptomatic after 30 minutes in the emergency room, during which time the only therapy they received was oxygen by nasal cannula.

E. Epidemiologic Investigation

1. Questionnaire Response

The questionnaire was completed by all employees who came to work on Thursday, September 24, 1987. This totaled 347, or 91.6% of the total number of plant employees. The questionnaire asked about respondent personal demographics, as well as respondent observations and symptoms on Friday, September 18, and Wednesday, September 23, 1988. These two days were chosen to represent the first day of the outbreak (September 18) and a day when NIOSH observers were present

and industrial hygiene monitoring was being performed (September 23). The responses for each day were analyzed and examined separately.

The mean age of the respondents was 42.6 years, with a range from 25 to 66 years. The mean length of employment at Dresser Industries was 15.1 years, with a range of 1 month to 32 years. The gender distribution of the respondents was 68% female and 32% male. While 74% of the respondents had some education up to or including high school graduation, 26% had at least some college education (including college degrees or graduate studies).

2. Definition of Cases

a. Symptoms

The questionnaire asked respondents to indicate whether they had experienced any of seventeen symptoms. Table 1 shows the percent of cases reporting each symptom on the two days covered in the survey. The percentage of employees reporting each symptom on the two days was similar. On each day, respondents who said they had been ill that day (answered "yes" to question 10 or question 19 on the questionnaire) reported a wide range of diffuse symptoms; in fact, on the first day of illness 26% of the such respondents reported experiencing six or more symptoms. There was no observed association of certain symptoms into groups corresponding to a particular disease entity; this is compatible with the lack of consistent signs of illness noted upon examination by physicians. Therefore, for each day a case of illness was defined as self-reported illness (answering "yes" to question 10 or question 19); all other respondents were considered noncases. Using this definition, the overall attack rates were 31.5% for September 18 and 41.2% for September 23.

3. Association of Illness With Demographic Variables

Results from the questionnaire were analyzed to determine if a significant association existed between the demographic variables and being a case. The mean age of the case group was not significantly different from that of the noncase group on either day studied, as tested by Student's t test ($p=0.40$ on 9/18, $p=0.28$ on 9/23). Likewise the mean years of work experience at the Dresser plant did not significantly differ between the case and noncase groups ($p=0.12$ on 9/18, $p=0.21$ on 9/23). Gender was associated with being a case on both days studied; on 9/18, females had 3.8 times the rate of cases as males (95% confidence interval 2.2-6.9), while on 9/23, the rate of cases among females was 4.6 times that of males (95% confidence interval 2.7-7.7).

Fewer than half the respondents indicated they smoked cigarettes. Of 335 respondents who answered the question, 61% did not smoke, 6% smoked approximately 1/2 pack per day, 27% smoked about one pack per day, and 4% smoked 2 or more packs per day. Smoking cigarettes was not significantly associated with illness on September 18, but on September 23 the relative risk of illness among smokers compared to non-smokers was 1.9 (95% confidence interval 1.4-2.6).

The association of education and illness was studied by dividing respondents into two categories: those whose highest level of education was high school graduation, and those with at least some college or additional vocational training. When these groups were compared, the less educated group had a higher rate of illness on both days. On 9/18 the lower educational level had a relative risk of illness of 1.5 compared to the higher level (95% CI 0.96-2.3), while on 9/23 the relative risk was 1.4 (95% CI 1.0=2.1).

4. Odors

In interviews with area physicians and with the NIOSH medical officer, workers complained of smelling foul odors; employees reporting health symptoms often reported smelling a foul odor prior to the onset of symptoms. The NIOSH questionnaire addressed these complaints listing odors and asking workers to indicate which they had smelled on each day. The odors listed were selected either because of reports in interviews in this investigation (including chemicals and sewer gas) or based reports in other NIOSH investigations. Few respondents reported smelling any one odor; generally each odor was reported by fewer than 10% of the respondents. However, 30% of the respondents said they smelled at least one of the listed odors on 9/18, while 23% reported smelling at least one odor on September 23.

The association of illness with the perception of an odor was tested for each of the odors. Table 2 summarizes the results for the two days. Those respondents who reported smelling odors of chemicals, sewer gas, "sweet smell," or diesel fumes were at a higher risk of being a case than those who did not report such odors, with relative risks as high as 4.18 (for those who smelled an odor of chemicals on September 18). The elevated relative risk associated with all four of these odors was significant at the 95% level on both days.

5. Location

As seen on the map (Figure 1), the Dresser plant is divided into three adjoining production buildings and an adjacent office area. Attack rates were analyzed by building; each of the three production building and the office were

considered as a separate unit. The attack rates in the four units are shown in Table 3; on both days the highestattack rate occurred in Building 2, where the initial onset of illness had occurred. The attack rates among the four buildings differed significantly by chi-squared test (p=0.000 on both days). No building was free of cases, and when cases were examined by location in chronologic order of occurrence, no pattern was seen to suggest that cases started in one area and spread from there. The spread of cases did not correspond to the plant ventilation system, as each building was served by its own air handling units.

6. Risk of Being a Case Both Days

Having been ill on 9/18 was significantly associated with being ill on September 23 (Mantel-Haenzel chi-square= 56.97, p=0.000000).

F. Discussion

The outbreak of illness at Dresser was characterized by several factors. First, there were no substances used in the workplace that could plausibly be associated with the symptoms reported by affected employees. Second, after comprehensive industrial hygiene monitoring, no detectable environmental agents which could cause these symptoms were found. Finally, the cases seen by area physicians lacked consistent signs or laboratory findings (as would be expected with a common exposure to a toxic agent), and rapid spontaneous recovery occurred in all cases. Although epidemiologic analysis of the questionnaire data revealed several significant associations between illness and demographic characteristics, perception of odors, and location, these findings could not be related to any demonstrable environmental or medical findings.

We therefore postulate that the ongoing nature of the outbreak at Dresser Industries represents an outbreak of collective stress syndrome. Outbreaks of this nature have been reported in other plants, including plants investigated by NIOSH.[1,2,3] Collective stress syndrome (also known as collective anxiety reaction, mass psychogenic illness, and other synonyms), refers to the occurrence, in a related group of people over a short period of time, of physical conditions either initiated or exacerbated by conflict between an individual's perceived stresses and coping capabilities.

This outbreak fits previous descriptions of collective anxiety reactions in several ways. Typically these outbreaks have occurred in workplaces where work is predominantly repetitive, assembly-line work, and the workplace is includes a high proportion of women and of employees with education at or below the level of high school graduate.[2] It must be emphasized that data do not exist to show that any of these factors cause these outbreaks; the characteristics mentioned have only been

observed in previous outbreaks. In addition, the investigations of these outbreaks often yield negative results for both the environmental and medical studies. All these characteristics applied to the outbreak at Dresser Industries.

In some investigations, it has been shown or postulated that the outbreak began when a physical exposure caused illness among workers.[4] After that exposure ceased, symptoms of illness persisted among workers; it has been suggested that the exposure served as an "initiator" of increased anxiety and stress, and triggered an outbreak of collective stress syndrome. If the outbreak at Dresser Industries was similarly initiated, it occurred before NIOSH or KyOSH investigators were present to detect and measure it. It is possible that when the plant was connected to a new sewer line on September 18, there may have been an inadvertent blowback of sewer gases into the plant. Such an exposure could have caused transient irritation or discomfort in exposed workers, yet could have dissipated by the time investigators began air sampling on September 22.

It has been postulated that in an outbreak where stress is a primary cause, the sight of one worker becoming ill would raise enough anxiety in a co-worker to cause stress-related illness.[5] As part of the NIOSH investigation we therefore tested whether such an effect of line-of-sight transmission occurred. As noted earlier, location and order of occurrence of cases were plotted on a map of the plant, but no evidence was seen of such a progression of cases. In addition, the questionnaire asked if the respondent had witnessed someone else becoming ill. We then tested for an association of illness with having witnessed another case. Workers who reported witnessing another worker become ill were at increased relative risk of illness themselves on both days; on September 18 that risk was not statistically significant (RR=1.53, 95% confidence interval 0.90-2.59), but on September 23 the relative risk of 2.16 was significant (95% confidence interval 1.72-2.72). The questionnaire design did not permit the analysis to determine whether the respondent became ill before or after witnessing another case.

It has also been observed that outbreaks of collective stress syndrome have occurred in workplaces involving repetitious work. An attempt was made to determine if an association existed between illness and repetitive work in this outbreak. Job titles reported by respondents were subjectively categorized by the investigators as "repetitious" or "not repetitious;" for example, work on an assembly line was classified as repetitious, while more varied work such as maintenance was classified as not repetitious. Production jobs which could not be classified, and all office jobs, were excluded from the analysis. For September 18, although a relative risk of 3.15 was associated with repetitive work, it was not statistically significant (95% confidence interval 0.86-11.47). The relative risk of illness associated with repetitious work was greater on September 23 (RR=9.10, 95% confidence interval 1.37-60.71).

VII. CONCLUSIONS

It is not possible for us to make a definitive conclusion about the initial stimulus for the outbreak on September 18. We were not present to conduct environmental investigations on that day, and any airborne contaminant dissipated before we arrived on September 22. We were not able to detect a recurrence of such an exposure during our investigation. We postulate that a single day of exposure, possibly related to the connection of the plant to a new sewer system, may have contributed to symptoms perceived on the first day of illness. This event caused plant-wide anxiety and stress, generating a collective stress syndrome which propagated the development of worker symptoms leading to plant shutdown.

The conclusion that the illness of September 21-23 may have been due to collective stress syndrome does not mean that it is not "real." The term refers to illness in which the primary cause is psychological stress, arising from the occupational and or general social environment, rather than physical stress from environmental chemical, physical, or infectious agents. The occurrence of illness from collective stress syndrome does not imply a psychiatric disorder. It can represent normal psychological and physical reactions to a stressful environment.

VIII. RECOMMENDATIONS

At a closing conference held on Friday, September 25, the NIOSH/KyOSH investigation was summarized and recommendations were made. These recommendations are repeated here.

1. Management and union representatives were praised for the degree to which they cooperated with each other and with the investigative team. It was nonetheless recommended that representatives from both management and the union take all possible steps in the future to ensure that workers feel informed about issues in the plant, and believe that, either as individuals or through their union representatives, they have input into management decisions which affecting them.

2. It is recommended that smoking on the job be discouraged.

IX. REFERENCES

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X. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared by:

Richard W. Hartle, C.I.H.
Industrial Hygienist
Industrial Hygiene Section

Scott Deitchman, M.D.
Medical Officer
Medical Section

Originating Office:

Hazard Evaluations and Technical Assistance Branch
Division of Surveillance, Hazard Evaluations, and Field Studies

XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are temporarily available upon request from NIOSH, Hazard Evaluations and Technical Assistance Branch, 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. Dresser Industries
2. Kentucky OSHA
3. NIOSH, Atlanta Region
4. OSHA, Region IV

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 1
Symptoms Reported by Case Respondents for Each Day
Dresser Industries
HETA 87-419
June 1987

Symptom	Percentage of Cases Reporting	
	Sept. 18	Sept. 23
Headache	66	73
Sleepiness	42	34
Lightheadedness	40	55
Sore throat	40	46
Weakness	34	37
Shortness of breath	30	27
Numbness	28	35
Dizziness	25	34
Nausea	23	24
Fast heart beat	19	21
Sense of floating	16	23
Disorientation	15	17
Chest pain	15	24
Stomach pain	14	15
Blurred vision	13	15
Vomiting	3	4
"Passed out"	0	1

Table 2

Relative Risk (with 95% confidence interval) of Illness
Associated With Perception of Environmental Odors

Dresser Industries
HETA 87-419
June 1987

Odor	9/18/87		9/23/87	
	RR	95% CI	RR	95% CI
Chemicals	4.2	2.5-7.0	1.9	1.5-2.5
Sewer gas	2.3	1.8-3.2	2.0	1.5-2.6
Natural gas	1.2	0.7-2.0	1.9	1.4-2.7
"Sweet smell"	1.7	1.1-2.6	1.8	1.4-2.4
Diesel fumes	2.3	1.4-3.8	2.0	1.8-2.4
Licorice	1.4	0.6-3.3	1.6	0.9-2.9

Table 3

Rates of Illness in Different Buildings (percentage of workers in that building each day who reported being ill)

Dresser Industries
HETA 87-419
June 1987

Building	Sept. 18	Sept. 23
Building 1	20.9	30.6
Building 2	57.7	69.7
Building 3	24.6	36.4
Office	8.7	48.3

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Centers for Disease Control
National Institute for
Occupational Safety & Health
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati OH 45226-1998

September 24, 1987
HETA 87-419
Notice to Dresser Industries Employees

The National Institute for Occupational Safety and Health (NIOSH), an agency of the U.S. Public Health Service, is conducting an investigation of the outbreak of illness among employees at the Dresser Industries plant in Berea, Kentucky. As part of this investigation, we are asking employees to complete a questionnaire. This questionnaire asks about your job, medical history, and any symptoms you may have had during the outbreak. We would like you to complete the questionnaire whether or not you have been sick.

Your participation in this survey is entirely voluntary. In accordance with the Privacy Act of 1974 (Public Law 83-579), all medical and other personal information that you provide will be considered confidential. No information that could identify you will be released to the company, the company doctor, or anyone else without your written authorization. You may omit your name from the questionnaire if you wish.

The NIOSH medical investigators will answer any questions you may have regarding this survey. If you have any questions after the survey, you may contact Dr. Scott Deitchman, Hazard Evaluations and Technical Branch, NIOSH, 4676 Columbia Parkway, Cincinnati, Ohio 45226, Telephone 513-841-4386.

DRESSER INDUSTRIES
QUESTIONNAIRE

Berea Kentucky
HETA 87-419

Name_____ ID#__ __ __ __ (1-4)

1. How old are you? _____ (5-6)

2. What is your sex? Male____1 Female____2 (7)

3. How many years of school did you complete? (please circle) (8)
   1. less than 12
   2. high school graduate
   3. some vocational or college training
   4. college graduate or beyond

4. How long have you worked at this plant? __ __years __ __months (9-10)

5. Have you ever been told by a physician that you had any of the following?

a)	Heart disease	Yes_____1.	No_____2	(11)
b)	High blood pressure	Yes_____1.	No_____2	(12)
c)	Lung disease	Yes_____1.	No_____2	(13)
c)	Asthma	Yes_____1.	No_____2	(14)
d)	Kidney disease	Yes_____1.	No_____2	(15)
e)	Anemia	Yes_____1.	No_____2	(16)
f)	Diabetes	Yes_____1.	No_____2	(17)
g)	Impaired sense of touch	Yes_____1.	No_____2	(18)
h)	Sinus problems	Yes_____1.	No_____2	(19)
i)	Loss of muscle strength	Yes_____1.	No_____2	(20)
j)	Psychiatric or emotional problem.	Yes_____1.	No_____2	(21)
k)	Other medical problem	Yes_____1.	No_____2	(22)
	If yes please specify_____			(23-24)

_____

_____

6. Do you take any medications? Yes ____1. No____2. (25)

If yes, please list _____ (26-28)

_____

_____

7. Do you have any allergies? Yes ____1 No____2 (29)

If yes, what are you allergic to? (30-32)

_____

_____

_____

8. How many cigarettes do you smoke a day? (33)

1. none
2. 1/2 a pack or less
3. about 1 pack
4. 2 or more packs

9. Did you work on Friday, September 18? yes____1 no___2 (34)
(if yes, answer the following questions; if no go to question 19)

On Friday September 18, did you notice any of the following unusual conditions inside the plant?

CONDITIONS

Chemical exposures	Yes ____1 No___2	(35)
Odors of:		
sewer gas	Yes ____1 No___2	(36)
licorice odor	Yes ____1 No___2	(37)
natural gas odor	Yes ____1 No___2	(38)
sweet smell	Yes ____1 No___2	(39)
diesel fumes	Yes ____1 No___2	(40)

If yes to any of the above, when did you first notice the smell?
(Example 1:30 PM)__ __:__ __ AM/PM (41-45)
At what time were the odors the worst? __ __:__ __ AM/PM (46-50)

10. Did you feel sick at work on Friday September 18th?
Yes ____1 No___2 Don't remember____3 (51)

(IF YOU ANSWERED 'Yes', did you have any of the following symptoms?)

lightheadedness	Yes ____1 No___2	(52)
headache	Yes ____1 No___2	(53)
sleepiness	Yes ____1 No___2	(54)
numbness or tingling	Yes ____1 No___2	(55)
dizziness	Yes ____1 No___2	(56)
weakness	Yes ____1 No___2	(57)
nausea	Yes ____1 No___2	(58)

blurred vision	Yes ____1 No___2	(59)
racing heart beat	Yes ____1 No___2	(60)
stomach pain	Yes ____1 No___2	(61)
chest pain	Yes ____1 No___2	(62)
shortness of breath	Yes ____1 No___2	(63)
sore throat	Yes ____1 No___2	(64)
passed out	Yes ____1 No___2	(65)
vomiting	Yes ____1 No___2	(66)
felt like I was floating	Yes ____1 No___2	(67)
disorientation	Yes ____1 No___2	(68)

11. What time was it when you first began to feel ill?
(If you were not sick leave blank.)
__ __:__ __ AM/PM (69-73)

CARD __0__ __1__ (79-80)

12. If you were ill on that day did you...?

Go to the hospital	Yes ____1 No___2	(5)
See a physician (not at the hospital)	Yes ____1 No___2	(6)

(If yes give name and phone number of the physician if known)

_____ (7)

Go to the first aid station	Yes ____1 No___2	(8)
Stayed at work	Yes ____1 No___2	(9)

13. Before you first experienced symptoms, did you witness other workers becoming ill?

Yes ____1 No___2 (10)

14. What did you think was the direct cause of illness on September 18? (11)

Chemicals ventilation	_____1
Psychological factors	_____2
Ventilation	_____3
Other	_____4
Don't know	_____5

15. In what area were you working that day? (12-13)

FX FAB____1
FX ASY____2
UT ASY LINE 1___3
UT ASY LINE 2___4
UT ASY LINE 3___5
UT ASY LINE 4___6
UT ASY LINE 5___7
UT ASY LINE 7___8
I-123 ___9
D-085 ___10

16. On a scale of 1 to 10, how safe do you think it was to return to work in the plant after the illness on Friday September 18.

1 2 3 4 5 6 7 8 9 10 (14-15)
Safe Hazardous

17. On Wednesday September 16th, or Thursday September 17th, were you sick at work?
Yes____1 No____2 (16)

18. On Wednesday September 23, did you notice any of the following unusual conditions
inside the plant?

CONDITIONS

Chemical exposures	Yes ____1 No___2	(17)
Odors of:		
sewer gas	Yes ____1 No___2	(18)
licorice odor	Yes ____1 No___2	(19)
natural gas odor	Yes ____1 No___2	(20)
sweet smell	Yes ____1 No___2	(21)
diesel fumes	Yes ____1 No___2	(22)

If yes to any of the above, when did you first notice the smell?
(Example 1:30 PM)__ __:__ __ AM/PM (23-27)
At what time were the odors the worst? __ __:__ __ AM/PM (28-32)

19. Did you feel sick at work on Wednesday September 23rd?
Yes ____1 No___2 Don't remember____3 (33)

(IF YOU ANSWERED 'Yes', did you have any of the following symptoms?)

lightheadedness	Yes ____1 No___2	(34)
headache	Yes ____1 No___2	(35)
sleepiness	Yes ____1 No___2	(36)
numbness or tingling	Yes ____1 No___2	(37)
dizziness	Yes ____1 No___2	(38)
weakness	Yes ____1 No___2	(39)
nausea	Yes ____1 No___2	(40)
blurred vision	Yes ____1 No___2	(41)
racing heart beat	Yes ____1 No___2	(42)
stomach pain	Yes ____1 No___2	(43)
chest pain	Yes ____1 No___2	(44)
shortness of breath	Yes ____1 No___2	(45)
sore throat	Yes ____1 No___2	(46)
passed out	Yes ____1 No___2	(47)
vomiting	Yes ____1 No___2	(48)
felt like I was floating	Yes ____1 No___2	(49)
disorientation	Yes ____1 No___2	(50)

20. What time was it when you first began to feel ill?
(If you were not sick leave blank.)
__ __:__ __ AM/PM (51-55)

21. If you were ill on that day did you...?

Go to the hospital	Yes ____1 No___2	(56)
See a physician (not at the hospital)	Yes ____1 No___2	(57)
(If yes give name and phone number of the physician if known)		
_____		(58-77)
_____		
Go to the first aid station	Yes ____1 No___2	(71)
Stayed at work	Yes ____1 No___2	(72)

22. Before you first experienced symptoms, did you witness other workers becoming ill?

Yes ____1 No___2 (73)

23. What did you think was the direct cause of illness on September 23? (74)

Chemicals ventilation	_____1
Psychological factors	_____2
Ventilation	_____3
Other	_____4
Don't know	_____5

24. In what area were you working that day? (75-76)

FX FAB____1
FX ASY____2
UT ASY LINE 1___3
UT ASY LINE 2___4
UT ASY LINE 3___5
UT ASY LINE 4___6
UT ASY LINE 5___7
UT ASY LINE 7___8
I-123 ___9
D-085 ___10

25. On a scale of 1 to 10, how safe do you think it was to return to work in the plant after the illness on Wednesday September 23rd.

1 2 3 4 5 6 7 8 9 10 (76-77)
Safe Hazardous

25. On Monday September 21th, or Tuesday September 22nd, were you sick at work? (78)
Yes____1 No____2

CARD 0 2 (79-80)

17. What shift do you work? (41)
First_____1
Second_____2

Card 0 3 (78-79)