HETA 86-380-1957
APRIL 1989
YORK INTERNATIONAL CORPORATION
MADISONVILLE, KENTUCKY

NIOSH INVESTIGATORS:
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## I. SUMMARY

On May 28, 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from employees at the Central Environmental Systems plant of the York International Corporation in Madisonville, Kentucky. The requestors reported that workers in the coil department at this plant were experiencing health problems due to overexposure to trichloroethylene (TCE). This coil department was being phased out to be replaced by more modern equipment in a different area of the plant.

On June 10-11, 1986, environmental and medical evaluations were conducted at the plant. Full-shift personal exposures to airborne TCE and phosgene (a decomposition product of TCE in the presence of UV Light) were measured. TCE concentrations in the breathing-zones of workers in the coil department ranged from 31 to 38 parts per million (ppm), and averaged 34 ppm, during the first day's survey. Full-shift TCE exposures ranged from 20 to 46 ppm the second day, and averaged 35 ppm. The workers who were monitored included brazers, pushers, and coil handlers. One short-term potential exposure to greater than 100 ppm TCE was measured. The worker was wearing a self-contained breathing apparatus during this time period. The diffusion monitors for phosgene indicated that the workers in the brazing lines were exposed to phosgene at concentrations of 0.01 ppm and less. All of the full-shift exposures to trichloroethylene, except for one, exceeded the 25 ppm NIOSH recommended exposure limit (REL). None exceeded the OSHA permissible exposure limit (PEL) of 100 ppm. No measured exposures to phosgene exceeded the NIOSH REL of 0.1 ppm.

The medical evaluation consisted of personal interviews with workers on both workshifts during the evaluation, a review of the company's OSHA 200 log (record of occupational illnesses and injuries), and an appraisal of the overall health and safety program in effect at the facility. Personal interviews were held with 28 workers. Within the previous month 20 (71%) reported that they had experienced headache, 20 (71%) dizziness, 18 (64%) nausea, 16 (57%) sleepiness, and 15 (54%) eye, nose, or throat irritation. During the evaluation, two employees were escorted out of the workplace by the NIOSH medical officer. They were suffering from severe, acute symptoms suspected to be due to TCE overexposure.

Based on the findings of this evaluation, the NIOSH investigators concluded that a health hazard to workers existed in the coil department of York Industries' Central Environmental Systems plant in Madisonville, Kentucky, due to overexposure to trichloroethylene. Recommendations (previously made) aimed at reducing the exposures and improving the overall safety and health program are made in Section VIII of this report.

KEYWORDS: SIC 3585 (Air Conditioning and Warm Air Heating Equipment and Commercial and Industrial Refrigeration Equipment), trichloroethylene, TCE, phosgene, degreasing equipment, brazing.

## II. INTRODUCTION

On May 28, 1986, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from employees at the Central Environmental Systems plant of the York International Corporation in Madisonville, Kentucky. NIOSH was requested to evaluate potential worker exposures to trichloroethylene used to degrease parts which are assembled into tube and fin heat exchange units (coils) for commercial and residential heat pumps, and to determine whether health problems reported among workers at the plant could be related to these exposures. The request indicated that exposures were due to improper and unsafe operation of the liquid-vapor degreasing unit in the Coil Department.

A survey to collect environmental and medical data was conducted on June 10-11, 1986. The environmental investigators collected personal air samples over two workshifts to measure exposure to trichloroethylene and phosgene. The medical investigator conducted personal interviews with workers on both workshifts during the evaluation, reviewed the company's OSHA 200 log (record of occupational illnesses and injuries), and appraised the overall health and safety program in effect at the facility.

Interim letters with recommendations, medical findings, and the environmental results were sent to the company and the requestors on July 7, 1986 and November 3, 1986.

## III. BACKGROUND

The Central Environmental Systems (CES), Inc. plant in Madisonville, Kentucky, a wholly owned subsidiary of the York International Corporation since 1986, was completed in 1973, and production began in January 1974. Prior to being owned by York, this company was a subsidiary of the Borg-Warner Corporation. At the time of the evaluation the plant employed a total of 600 workers.

The coil department required a workforce of 40 per shift, with three shifts working per day. This department assembled copper tubing and aluminum fins into heat exchange units, called coils, for the heat pumps manufactured at this plant. The copper tubing, cut to length, and the aluminum fins, pressed from sheet aluminum, were laced together and degreased before they reached the brazing lines. There were five brazing lines receiving these assemblies. There, return bends were brazed to tubing ends to create a single path for fluid through the unit. Next the coils passed through the pressure testing station, where the integrity of the brazing was tested. From there they went to the heat pump assembly area.

Solvent degreasing is a physical method of removing grease, wax, or dirt and is used to clean all of the common industrial metals. The solvent in use at CES at the time of this evaluation was trichloroethylene. Methylene chloride was used originally in this system, but it's use was discontinued in 1980. The degreasing system at CES, manufactured by Baron-Blakesly, was a liquid-vapor, multiple immersion type (two immersions). This system included stills to recover used TCE liquid, and carbon adsorption to trap the overhead vapor. Coils were automatically conveyed to, through, and from the degreaser using an overhead monorail system.

The requestors for this evaluation reported that since the conversion to TCE, system malfunctions, accompanied by excessive emissions of TCE, were common and frequent. They also reported that parts would exit the degreaser with liquid TCE dripping from them. When the brazing was performed on these parts, an irritating atmosphere was created.

During this evaluation, the NIOSH team was informed by management of plans for the relocation and modernization of the coil department, including new degreasing equipment. Start-up of this new department occurred six weeks after our survey.

## IV. EVALUATION DESIGN AND METHODS

### A. Environmental Evaluation

The environmental evaluation consisted of full-shift personal exposure and area air sampling for trichloroethylene (TCE) and phosgene. Personal sampling was concentrated in the brazing area. These samples were collected by placing the sampling media (charcoal tube or phosgene badge) in the worker's breathing zone by attaching it to the collar or lapel of the worker's outer clothing. Area air sampling sites were located throughout the coil department and included the press, coil assembly, degreaser, and pressure testing areas. Short-term personal samples for TCE were collected when workers were required to enter or work on top of the degreaser. A similar environmental evaluation was conducted over the first-shift operations on June 11, 1986. Thirty-three air samples for TCE and 16 air samples for phosgene were collected over two work shifts.

#### 1. Trichloroethylene

Air samples for TCE were collected by drawing air through glass tubes containing 150 milligrams (mg) of activated charcoal at a flowrate of 50 milliliters (ml) per minute using calibrated, battery-operated sampling pumps. The samples were desorbed with 1 ml of carbon disulfide containing 1 microliter of ethyl benzene as an internal standard. They were analyzed by gas chromatography with flame-ionization detection. The limit of detection (LOD) was 0.01 mg/sample and the limit of quantitation (LOQ) was 0.02 mg/sample for TCE using this method.(NIOSH method 1022)[1]

Peak general area concentrations of TCE were measured using Drager color-detector tubes. The measuring range for these tubes is 2-200 ppm.

#### 2. Phosgene

Worker breathing zone exposure to phosgene was measured using a passive dosimeter manufactured by SKC Inc. The phosgene dose is determined by comparing the color change of the dosimeter to a calibrated color wheel supplied by the manufacturer. The LOD for the method is 2 parts per million-minutes (ppm-min). Exposure concentrations are obtained from ppm-min by dividing by the exposure time in minutes.

### B. Medical Evaluation

The medical evaluation consisted of personal interviews with 13 workers during the second shift on 6/10/86 and 15 workers during the first shift on 6/11/86. Coil handlers, brazers, system operators, and foremen were interviewed. Workers were asked their name, age, and job title, and if they had experienced symptoms of acute trichloroethylene intoxication within the past month. Specified symptoms included headache, dizziness or incoordination, nausea or vomiting, sleepiness or a loss of consciousness, and eye-nose-throat irritation. Additionally, the NIOSH medical investigator asked whether they had ever been told by a physician that they had an irregular heartbeat or had experienced any other symptoms besides the ones mentioned. The company's OSHA 200 log was reviewed and an appraisal was made of the overall health and safety program in effect at the facility.

## 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 permissible exposure limits (PELs). Both NIOSH recommendations and ACGIH TLVs usually are based on more recent information than are the 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 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 or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

A. Toxicologic Effects of Exposure

1. Trichloroethylene

Trichloroethylene is a colorless, volatile, nonflammable liquid that is immiscible in water, has a vapor density of 4.45 and a boiling point of 87°C. It is a powerful degreasing and dry cleaning agent and has been used in commercial products such as printing inks, paints, lacquers, varnishes and adhesives. A pharmaceutical grade of TCE was formerly used as a general anesthetic in surgical and obstetrical procedures[2] and as an analgesic for short operative procedures.[3] It has also been used to extract caffeine from coffee.

The predominant physiological response is one of central nervous system depression. This is particularly true as a response from acute or short-term exposure. Among the symptoms most often described are: headache, nausea, vomiting, dizziness, vertigo, fatigue, mental dullness, sleepiness, feeling of light-headedness, insomnia, and burning eyes. High acute doses have also resulted in cardiovascular and respiratory effects with a number of deaths attributed to respiratory arrest, cardiac arrhythmias, including ventricular fibrillation and primary cardiac standstill. Respiratory distress has been observed often, with such symptoms as chest tightness and labored breathing.[4] The dangers of acute exposure to trichloroethylene may lead to poor manual manipulation and, therefore, unsafe mechanical operation. Prolonged skin contact may cause local irritation and blister formation. Under industrial conditions, repeated emersion of the hands in TCE has caused paralysis of the finger.[5] While TCE will penetrate intact skin, it is unlikely that absorption of toxic quantities would occur by this route.[6] TCE is absorbed readily from the gastrointestinal tract. Liver and kidney injuries in humans attributable to overexposure to TCE are rare.[7] The effects of chronic exposure to humans of TCE have not been extensively studied and thus are not well characterized.

Intolerance to alcohol is a well-characterized phenomenon among TCE-exposed workers.[8] Not only do many TCE workers become inebriated with consumption of small quantities of alcoholic beverages following exposure, but they also are subject to vasodilatation of superficial skin vessels, resulting in skin blotches, a condition known as "degreaser's flush".[9] Flushing is most prominent on the face, neck, shoulders, and back. This condition appears to be a benign dermal phenomenon of short duration, but has lasted for up to 6 weeks after exposure to TCE for 5 days at 200 ppm.

On March 21, 1975 the National Cancer Institute reported preliminary results of a carcinogen bioassay which indicated no carcinogenic effects in rats but the induction of hepatocellular carcinomas in mice.[10,11]

2. Phosgene

Phosgene is an easily liquified, colorless, non-flammable gas with an odor resembling that of newly mown hay. Its molecular weight is 98.92 and specific gravity at 0°C is 1.432. The boiling point is 8.2°C, the melting point is -128°C and the vapor pressure is 1215 mm Hg at 25°C. It is slightly soluble in water, but freely soluble in benzene, toluene, glacial acetic acid, and most liquid hydrocarbons.[12] Occupational exposure to phosgene may result not only from its use in the chemical industry, but as a result of the decomposition, in the presence of air or oxygen, of many chlorinated organic compounds. Trichloroethylene vapor in air may be largely converted to phosgene by the action of short ultraviolet light, which may be present in the close vicinity of processes such as welding and brazing.[12]

Phosgene, after a minute or so of exposure to low concentrations (1 to 2 ppm), may cause cough and discomfort in the chest and irritation of the nose and throat. Higher concentrations may cause painful coughing with respiratory irritation. Phosgene may cause pulmonary edema with coughing, shortness of breath, and production of frothy sputum. Pulmonary edema may occur many hours after exposure. The gas may irritate the eyes. If liquid phosgene is splashed on the skin or eyes, it may cause burns.[13]

C. Environmental Criteria

1. Trichloroethylene

NIOSH's initial recommendation for a TCE standard was issued in 1973.[14] This recommended standard, and the current OSHA standard[15], both an 8-hour TWA of 100 ppm, were based upon TCE's known toxic properties at that time and did not include an assessment of its carcinogenic potential. After reviewing the NCI study, NIOSH recommended that TCE be considered a suspect human carcinogen and transmitted this message to industry via a Current Intelligence Bulletin[16] and a Special Occupational Hazard Review.[4] Information at that time regarding engineering feasibility indicated that TWA personal exposures of 25 ppm could be readily attained. However, it was not felt that this should serve as a final goal. Rather, industry should pursue further reductions in worker exposure as advancements in technology research allowed. Since there is no known safe level of exposure to a carcinogen, the goal is to minimize exposure to the lowest extent possible.

2. Phosgene

The NIOSH REL for phosgene is a 0.1 ppm concentration averaged over a workshift of up to 10 hours per day, 40 hours per week, with a 15-minute ceiling level of 0.2 ppm.[17] The current OSHA standard for phosgene is an 8-hour TWA of 0.1 ppm.[15]

## VI. RESULTS AND DISCUSSION

### A. Environmental Evaluation

Trichloroethylene exposure results are presented in Table 1. The full-shift, personal breathing-zone trichloroethylene exposures experienced by the brazers on the second shift on June 10th ranged from 31.1 to 38.4 ppm, and averaged 34.2 ppm (standard division (SD), 2.4). All of the full-shift exposures to trichloroethylene exceeded the 25 ppm level which NIOSH feels is achievable using good control technologies. None exceeded the OSHA standard of 100 ppm. The system operator on this shift received a potential exposure of 88.6 ppm. Contributing to this was a short-term exposure of 107 ppm during a 24-minute time period when he was working on top of the degreaser. He wore a self-contained breathing apparatus (SCBA) during this time period, so his actual exposure was probably much lower.

On the second survey day, June 11, 1986, the system operator's exposure was 33.3 ppm, which included a 14-minute exposure of 137 ppm while working on the degreaser. He wore no respiratory protection during this time. The tester had an exposure of 37 ppm for the full-shift with a 10-minute exposure to 117 ppm trichloroethylene, also while servicing the degreaser. He also wore no respiratory protection. Exposures to the other workers on this day ranged from 19.7 to 45.9 ppm, and averaged 34.9 ppm (SD, 7.3). These workers included the brazers and pushers from the coil lines and one coil handler from the press area.

The diffusion monitors for phosgene indicated that the workers in the brazing lines were exposed to phosgene at concentrations of 0.01 ppm and less.

During the first shift evaluation of June ll, we measured peak TCE concentrations between 50 and l00 ppm, using Draeger detector tubes, in areas of the coil department. These levels were caused by an upset in the degreaser operating conditions, which had begun during the previous work shift, and lasted through nearly half of the first shift. Workers reported that this has been a common occurrence since changing degreasing solvents, from methylene chloride to TCE, in l980. We saw parts wet with solvent exiting the degreaser. Brazing of the metal parts while they are wet with TCE is the source of phosgene in this plant.

During the degreaser malfunction the system operator donned a self-contained breathing apparatus and entered the degreaser. He was assisted by another worker with an SCBA, who stayed at the entrance to the degreaser tunnel. However, other procedures standard in industry for confined space entry were not followed. Entry into a confined space should be by permit only. This type of permit is an authorization and approval in writing that specifies the location and type of work to be done, and certifies that all existing hazards have been evaluated by a qualified person, and necessary protective measures have been taken to ensure the safety of each worker. Since this was a Class "A" confined space, one that presented a situation that was immediately dangerous to life or health, the standby person should have had a unobstructed lifeline attached to the worker in the confined space.

### B. Medical Evaluation

A summary of reported symptoms is contained in Table 2. Among 28 workers interviewed, 20 (71%) experienced headache, 20 (71%) dizziness, 18 (64%) nausea, 16 (57%) sleepiness, and 15 (54%) eye, nose, or throat irritation during the preceding month. Among the four job categories the brazers reported the highest prevalence of the symptoms.

Early into the first shift on 6/11/86, during the degreaser malfunction, the NIOSH medical investigator escorted two employees from the workplace to the outside of the plant at their behest. Both were ill (nauseated) from suspected TCE exposure. One employee exhibited a fine oscillating resting tremor of both hands, which can occur following high TCE exposure for considerable duration. Later in the shift another employee reported to the medical officer that he had become nauseated and vomited. All three employees had sought "fresh air", and their conditions had improved considerably later in the shift. While talking with a brazer, the NIOSH medical investigator experienced torpor and dizziness. Similar symptoms were reported by the NIOSH industrial hygienist. All of these people were apparently experiencing the anesthetic effects of TCE at 1/2 to 3/4 of the current OSHA PEL, but at 2-3 times the NIOSH REL.

A search of the company's OSHA 200 log for incidents described during the medical interviews indicated that the log was not completed in the detail provided in the form and instructions therein. Specifically, the log failed to report that employees have gone to the local emergency room from the workplace on many occasions, and some have subsequently been hospitalized, after becoming ill while working in the brazing area of the shop.

## VII. CONCLUSION

Based on the findings of this evaluation, the NIOSH investigators concluded that a heath hazard existed in the coil department of York Industries' Central Environmental Systems plant in Madisonville, Kentucky, due to overexposure to trichloroethylene.

## VIII. RECOMMENDATIONS

The following recommendations were made at the closing conference, June 11, 1986, and in a subsequent interim report dated July 7, 1986. The NIOSH investigators felt that the situation in the coil area required immediate attention. While these recommendations resulted from the evaluation of the coil area in place at the time, they will also be applicable to the newer area.

l. Every effort should be made to keep the degreaser operating in a controlled fashion to prevent emissions of TCE into the work area.

2. If a system upset occurs, a detector tube measurement of 50 ppm or greater should prompt emergency evacuation procedures.

3. A safety committee consisting of representatives from management and employees from various areas of the plant should be formed in order to identify and abate safety and chemical hazards at York International. An additional function of this committee should be the education of employees who work with potentially hazardous materials as to safe work practices.

4. It would be beneficial to have a professional on staff to exclusively handle safety and health and environmental matters, including the hazard communication program, OSHA and EPA compliance, and to act as liason between management and workers concerning these programs.

5. A confined space entry procedure should be developed as outlined in the NIOSH Criteria for a Recommended Standard . . . Working in Confined Spaces, which was provided to the company.

6. Written standard operating policies/procedures should be prepared for contingencies which may involve the workforce. These should be easily available to all employees. These include:

   a.) building evacuation and
   b.) emergency first.

7. A respirator policy, consistent with American National Standards Institute Z88.2 and 29 CFR 1910.134, and the NIOSH Guide to Industrial Respiratory Protection (DHHS(NIOSH) Pub.# 87-116) should be cooperatively developed. The minimum points which need to be addressed include:

   a.) Written operating procedures governing the selection and use of respirators.

   b.) Selection of respirators on the basis of hazards to which the worker is exposed.

   c.) Instruction and training in the proper use of respiartors and their limitations.

   d.) Regular cleaning and disinfection of respirators. Those issued for the exclusive use of the worker should be cleaned after each day's use, or more often if necessary. Those used by more than one worker should be thoroughly cleaned and disinfected after each use.

   e.) Storage of respirators in a convenient, clean, and sanitary location.

   f.) Routine inspection of respirators during cleaning. Worn or deteriorated parts should be replaced. Respirators for emergency use, such as self-contained breathing devices (SCBA's) should be thoroughly inspected at least once a month and after each use.

   g.) Appropriate surveillance of work area conditions and degree of employee exposure or stress.

   h.) Regular inspections and evaluations to determine the continued effectiveness of the program.

   i.) Determination that workers are physically able to perform the work and use the equipment before assigning them to tasks requiring the use of respirators.

   j.) Use of approved or accepted respirators when they are available. Appropriate National Institute for Occupational Safety and Health/Mine Safety and Health Administration approved respirators are recommended.

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## X. AUTHORSHIP AND ACKNOWLEDGEMENTS

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## 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. Confidential Requestor
2. York International, Central Environmental Systems
3. NIOSH, Cincinnati Region
4. OSHA, Region 5

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
Personal Trichloroethylene Exposure Results
York International Corporation
Madisonville, Kentucky
June 10-11, 1986
HETA 86-380

| Job | Duration | Volume (liters) | Concentration, ppm |
|---|---|---|---|
| <u>June 10, 1986</u> | | | |
| System operator | 1511-2255 | 23.1 | 88.6 |
| System operator | 1622-1646 | 4.7 | 107* |
| Brazer, line #5 | 1515-2255 | 22.0 | 33.8 |
| Brazer, line #4 | 1518-2255 | 21.8 | 35.8 |
| Brazer, line #3 | 1520-2255 | 21.4 | 33.0 |
| Brazer, line #2 | 1523-2255 | 22.7 | 31.1 |
| Brazer, line #1 | 1531-2255 | 21.8 | 32.4 |
| Pusher, mobile | 1525-2255 | 20.7 | 35.1 |
| Pusher, mobile | 1528-2255 | 22.3 | 38.4 |
| <u>June 11,1986</u> | | | |
| System operator | 0800-1453 | 20.7 | 33.3 |
| System operator | 1412-1426 | 2.7 | 137 |
| Tester | 0806-1459 | 20.6 | 37.0 |
| Tester | 1227-1237 | 2.0 | 117 |
| Brazer, line #5 | 0730-1454 | 22.3 | 35.0 |
| Pusher, line #5 | 0729-1456 | 20.3 | 34.8 |
| Brazer, line #4 | 0733-1455 | 21.5 | 32.9 |
| Brazer, line #3 | 0742-1458 | 21.5 | 45.9 |
| Pusher, line #3 | 0740-1454 | 21.6 | 37.9 |
| Brazer, line #2 | 0747-1453 | 20.7 | 36.0 |
| Pusher, line #2 | 0750-1455 | 20.1 | 37.0 |
| Coil handler, press 72-A | 0840-1454 | 18.9 | 19.7 |
| | Criteria | NIOSH | 25 |
| | | OSHA | 100 |

* - potential exposure, worker wore self-contained breathing apparatus

Table 2

Health Symptom Summary
York International Corporation
Madisonville, Kentucky
June 10-11, 1986

HETA 86-380

| Job | Headache | Dizziness | Nausea | Sleepiness | E-N-T Irritation |
| --- | --- | --- | --- | --- | --- |
| Coil Handler<br>n=l2 | 7(58%) | 9(75%) | 7(58%) | 7(58%) | 3(25%) |
| Brazer<br>n=12 | 12(l00%) | 10(83%) | 11(92%) | 6(50%) | 12(l00%) |
| System Operator<br>n=2 | 1(50%) | 1(50%) | 0 | 2(l00%) | 0 |
| Foreman<br>n=2 | 0 | 0 | 0 | 1(50%) | 0 |