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## **SUMMARY**

On August 20, 1991, the National Institute for Occupational Safety and Health (NIOSH) received a request to conduct a health hazard evaluation (HHE) regarding contract workers formerly employed at the IMC Corporation nitroparaffin plant in Sterlington, Louisiana. The Construction and General Laborers Union Local 762, representing asbestos abatement workers employed by IMC after a May 1, 1991 explosion, initiated the HHE. The Union asked NIOSH to investigate reports of worker illnesses that occurred when the asbestos abatement firm was on-site during the post-explosion renovation activities (May 2 - July 12, 1991).

On October 28-30, 1991, NIOSH investigators conducted an evaluation at the IMC plant. Because conditions at the facility had significantly changed since the asbestos abatement activities, the NIOSH investigation focused on obtaining details regarding: (1) the number of affected workers, (2) symptoms suspected of being work-related, (3) the presence and use of hazardous materials in the work areas, and (4) personal protective equipment and training provided to the workers in the areas of investigation.

NIOSH did not conduct environmental monitoring because plant conditions were not representative of the working environment when contract workers were present at the facility.

During the evaluation, IMC safety, health, and environmental representatives were interviewed to obtain background information regarding the working conditions that existed at the nitroparaffin plant from May 1 through July 12, 1991. Representatives of the general contractor overseeing the renovation operations were also interviewed and records (first-aid logs, OSHA 200 reports) were reviewed. The owner of the asbestos abatement firm was interviewed extensively and daily logs maintained by the asbestos workers were reviewed. Discussions were held with officials from the Occupational Safety and Health Administration (OSHA), who were conducting the explosion investigation. Twenty-five of the asbestos abatement workers were administered questionnaires regarding the illnesses they experienced. Industrial hygiene monitoring reports from the time period in question were reviewed.

No IMC, General Contractor, or OSHA officials interviewed were aware of any health complaint reports or instances of widespread illness among the asbestos abatement workers. No other contractors were aware of illnesses attributed to chemical exposure among their workers.

Records indicated that several workers complained of ill effects and odors on June 17 and 19. The incidents were investigated but no chemical exposure explanation was found. Routine and complaint-based industrial hygiene monitoring was primarily area

monitoring and was not substance specific (except for asbestos). Initial safety training efforts for the asbestos workers did not include the chemicals that were used or present at IMC prior to the explosion.

Twenty-two (88%) of the 25 workers interviewed had symptoms they believed were related to their work at IMC. A wide spectrum of symptoms, including those of the upper respiratory tract, central nervous system, and gastrointestinal system were reported. The most common symptoms were diarrhea (91%), nausea (82%), headache (76%), dizziness (71%), and cough (68%). Among the 22 workers with symptoms, eight (36%) met the case definition for potential chemical-related illness (nausea, vomiting and one of three other symptoms, including headache,

dizziness, or diarrhea). The symptoms could not be linked to any specific chemical release, job task, work location, or food or drink source.

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No conclusions regarding the work-relatedness of the illnesses experienced by the asbestos abatement contractors can be made. Chemical-specific exposure information was unavailable regarding these employees. The characteristics of the illnesses reported by workers did not suggest a common cause.

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**KEYWORDS:** SIC 2869 (Industrial Organic Chemicals, Not Elsewhere Classified) nausea, vomiting, diarrhea; contractor, contract workers, asbestos abatement

## **INTRODUCTION**

On August 20, 1991, the National Institute for Occupational Safety and Health (NIOSH) received a request to conduct a health hazard evaluation (HHE) from an authorized representative of the Construction and General Laborers Union, Local 762. The request asked NIOSH to determine if illnesses experienced by approximately 25 workers (contract asbestos abatement workers employed by DodCo, Inc.) at the International Minerals and Chemical Corporation (IMC) Nitroparaffin plant in Sterlington, Louisiana were occupationally related. Symptoms described in the request included nausea, vomiting and diarrhea.

On October 28-30, 1991, NIOSH investigators conducted an initial site visit at the IMC facility. An opening conference was held with IMC management, union representatives and contractor management to discuss the purpose and scope of the NIOSH project, and to review the history of the post-explosion renovation project at the IMC facility. Following the meeting, the NIOSH investigators interviewed personnel (contractor, Union, IMC) involved in the renovation project, reviewed pertinent records (accident/incident logs, environmental monitoring, chemicals in area) for the time period in question, and administered questionnaires to twenty-five of the asbestos workers who were assembled by the Union.

Because environmental conditions at the facility had significantly changed, environmental monitoring was not conducted. Other actions taken by the NIOSH investigators included inspecting the areas where the asbestos abatement employees worked and reviewing contractor safety and health training programs and personal protective equipment policies.

NIOSH investigators held a closing conference with IMC management, union representatives, and contractor management to discuss the actions taken by NIOSH during the initial survey. During this meeting, preliminary findings and recommendations were presented.

## **BACKGROUND**

### **Facility Description**

The IMC facility in Sterlington, Louisiana consists of two ammonia plants, a nitroparaffin (NP) plant, and a NP derivatives plant. The first Sterlington plant started in 1922 with the operation of a carbon black unit. In 1975, IMC acquired the plant from the Commercial Solvents Corporation. In 1982, the Angus Chemical Company purchased the NP portion of the facility from IMC and simultaneously contracted with IMC to operate the plant. The entire facility covers over 2300 acres and employs approximately 400 workers.

Four basic NPs (1-nitropropane, 2-nitropropane, nitromethane and nitroethane) are produced at this facility. These are made in the NP plant from nitric acid and propane. Component separation and refining are via a series of distillation/fractionating towers. The NP plant is located at the north end of the IMC complex. At the NP derivatives plant, byproducts, including aldehyde and alcohol compounds, are processed.

### **Explosion and Renovation Project**

At 1:10 p.m. on May 1, 1991, an explosion occurred in the NP plant, beginning on the east and north sides of the control station. According to IMC officials, a faulty compressor was responsible for initiating the explosion, which involved nitromethane. The explosion devastated the NP plant killing the plant manager and seven other IMC employees who were responding to the compressor fire. Over 100 workers and persons in the vicinity of the plant were injured. The adjacent NP derivatives plant and ammonia plants were relatively unaffected.

Officials from the Occupational Safety and Health Administration (OSHA), Region VI, arrived within hours to conduct an investigation. Additionally, Louisiana Department of Environmental Quality officials immediately went to the site. The entire NP plant was shut down and fenced off as a "restricted area." For the first eight days after the explosion, personnel entering the restricted area were required to wear Tyvek® disposable suits and half-mask air-purifying respirators equipped with high efficiency particulate air (HEPA) filters and organic vapor cartridges. Of primary concern was the presence of large amounts of asbestos insulation that had been disturbed by the explosion.

All activities within the restricted area were closely monitored by OSHA. IMC contracted with an environmental firm to coordinate and conduct equipment decontamination and hazardous waste removal from the affected area. Removal of chemicals from damaged vessels was an immediate priority. Several tanker trucks were brought on-site and all chemicals from tanks, towers, or other vessels in the NP plant were transferred and removed. Contractors from various trades were hired by IMC to assist in the renovation. On June 1, IMC hired Bechtel Corporation's contractor group, BeCon, as the general contractor overseeing all subcontractors. The total number of personnel involved in the explosion investigation, renovation, and environmental control was approximately 700 by the first week of June.

The asbestos abatement firm (DodCo, Inc.) was hired on May 2, 1991, to contain and ensure proper removal of asbestos. To address manpower needs, DodCo contacted the Construction and General Laborers Union and requested workers trained in asbestos abatement. Initially, there were only a few DodCo employees. However, by July 1, DodCo had approximately 180 employees on-site conducting asbestos work 24 hours per day (2 shifts). Each employee had to furnish DodCo with their record of training (completion of 40-hour asbestos course) and a copy of their medical evaluations required by the OSHA Construction Standard for Asbestos Workers (29 CFR 1926.58). DodCo employees initial actions included spraying encapsulant from a man-lift on a crane to help "lock-down" loose asbestos, and combing the area to pick up materials suspected of containing asbestos. Asbestos removal operations did not begin until late June, except for small-scale, short-term tasks such as removing small amounts of insulation from a valve.

On July 12, BeCon terminated DodCo's contract and hired another asbestos abatement firm, Basic Industries. According to BeCon representatives, DodCo was terminated because of "a poor safety record and poor record-keeping practices."

When DodCo was on-site they were instructed not to work with or handle any IMC chemicals. Any contaminated or suspect-contaminated material was turned over to the hazardous materials contractor for decontamination. All protocols regarding chemical handling, equipment decontamination, and removal activities were mutually agreed upon by OSHA, IMC and representatives of the Oil, Chemical and Atomic Workers Union (OCAW) (OCAW represents the permanent employees of IMC at the Sterlington facility). Decontamination consisted of "steaming out" pipes or vessels within the restricted area, or crane removal of pipes or vessels for cleaning in a dedicated decontamination area set up on the north-west side of the facility. Most liquid chemicals were removed by mid-June. Environmental monitoring for a variety of contaminants, including the nitroparaffins, total hydrocarbons, and asbestos was conducted by the hazardous materials contractor, OSHA, and an environmental consultant employed by IMC. This was mostly area monitoring conducted to: determine personal protective equipment requirements, check confined spaces prior to entry, comply with asbestos health and safety standards, and establish "clear" areas prior to entry by contractors, such as DodCo. The entire restricted area was initially treated as a site covered by the OSHA Hazardous Waste Operations and Emergency Response Standard (CFR 29 1910.120).<sup>1</sup> Under the emergency response section of this standard, site control, environmental monitoring, personal protective equipment and decontamination procedures are required. Initially, the hazardous materials contractor conducted

continuous environmental monitoring for "hydrocarbons" and explosive atmospheres. Monitoring for other materials was also conducted on request whenever the presence of a contaminant was suspected. OSHA ceased sampling by June 15, after determining there was no longer a chemical exposure concern.

### **EVALUATION PROCEDURES**

The NIOSH evaluation consisted of the following items: (1) interviews with contractor and IMC representatives who worked in the same areas, during the same time periods as the DodCo employees who became ill, and with those individuals responsible for coordinating and overseeing the renovation efforts, (2) confidential medical interviews using a standardized questionnaire for employees who became ill to determine case characteristics (symptoms, time, place, activities), (3) a review of records, including medical reports, workers compensation claims, accident investigations, industrial hygiene and biological monitoring data, (4) a review of DodCo employee's safety practices, (5) a review of chemicals used in the facility where DodCo employees were working and, (6) a site inspection of the plant areas where DodCo employees had worked.

This evaluation strategy was used to assist in characterizing events and conditions during the time DodCo employees were at IMC. It should be noted that the unusual circumstances arising from a massive explosion resulted in the rapid mobilization of large numbers of people from diverse groups. Conditions also changed rapidly as the explosion investigation and renovation progressed.

### **Interviews**

To determine what plant conditions were like during the post explosion renovation efforts of May 1-July 12, 1991, the following personnel were interviewed:

- IMC Safety Supervisor
- IMC Corporate Safety and Health Manager
- IMC Environmental Manager
- President, DodCo Corporation
- BeCon General Manager
- BeCon Safety Supervisor
- Industrial Hygienist (environmental consultant to IMC)
- OSHA chief investigator and industrial hygienist assigned to DodCo

The interviews covered site security practices, personal protective equipment policies, chemicals present, plant conditions, hazardous materials and hazardous waste procedures, incidents and accidents, environmental monitoring, and employee training (contractor).

### **Medical Questionnaires**

The union requestor was asked to assemble as many of the asbestos workers as possible for interviews. This proved difficult as many of these workers had come from other parts of Louisiana. Because they no longer worked for DodCo or IMC, many had left the area. The Union requestor, based in Lafayette, Louisiana, gathered 25 ex-DodCo employees and supervisors who had experienced adverse health effects during the IMC job. Employees of other contractors present at the same time as the DodCo employees were not interviewed. There was no evidence that these workers had experienced possible chemical-related illnesses, and most of these workers were no longer employed at IMC.

Questionnaires were administered on October 28 and 29, 1991, at the Laborers Local 831 Union Hall in Monroe, Louisiana. The interview covered safety and health training, use of personal protective equipment, job title and location, knowledge of chemical exposures, consumption of food provided on-site by DodCo, Inc., and illness characteristics (e.g., date of occurrence, duration, symptoms). To aid in analysis of the symptom data, a case definition was established. A case of potential chemical-related illness was defined by the presence of nausea, vomiting and one of three other symptoms, including headache, dizziness, or diarrhea. This definition was based on the symptoms described in the HHE request, which were consistent with reports in the scientific literature of workers with overexposure to 2-nitropropane.<sup>2,3</sup> Although there was no evidence indicating that exposure to this chemical occurred, it is one of the four main products of the NP plant. Systemic effects have not been reported in humans exposed to the other three nitroparaffins manufactured at the facility.<sup>4</sup>

### **Records Review**

To further characterize conditions and events regarding the post-explosion renovation project, the following records were requested and reviewed:

- Workers Compensation claims filed by DodCo employees
- First-aid logs (contractor and IMC)
- Daily logs (DodCo, Inc.)
- Environmental consultant monitoring records
- Industrial hygiene consultant investigation report regarding one DodCo employee who was hospitalized
- Medical records from DodCo employees who sought medical attention -Attendance logs for the DodCo employees
- Occupational Safety and Health Administration OSHA 200 forms  
(Federally mandated worker injury and illness forms - all "Recordable" injuries and illnesses must be recorded on these forms)

### **Health and Safety Training**

Policies, procedures and training logs were reviewed to determine the extent of health and safety training received by DodCo employees. Questions about training and personal protective equipment also were included in the medical interviews of workers. The DodCo hazard communication program was assessed, as was employee access to material safety data sheets (MSDSs) for the chemicals that may have been present in the renovation area.

### **Chemical Review**

A list of chemicals present in the NP plant when DodCo employees were on site was reviewed. This list included feed and process chemicals used in the NP plant, as well as any contractor chemicals (e.g. paints, adhesives, etc.) that were brought on-site. The toxicological characteristics of these chemicals were reviewed to determine if symptoms associated with exposure correlated with the illnesses experienced by DodCo employees. The IMC Environmental Manager was interviewed to obtain information regarding hazardous waste products, contaminated soil removal activities, and hazardous materials releases requiring reporting under the Superfund Amendments and Reauthorization Act (SARA).

### **Environmental Monitoring**

Although no environmental monitoring was conducted during the NIOSH investigation, NIOSH investigators reviewed the monitoring strategies used by personnel at the IMC facility. This included assessing the contaminants selected for monitoring as well as the sampling and analytical protocols used.

## **EVALUATION CRITERIA**

### **General**

In general, NIOSH field investigators use established environmental criteria for the assessment of a number of chemical and physical agents. These criteria 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.

The primary sources of environmental evaluation criteria for the work place are: (1) NIOSH Criteria Documents and recommendations, (2) the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), and (3) the U.S. Department of Labor Occupational Safety and Health Administration (OSHA) standards.<sup>5,6</sup> Often, NIOSH recommendations and ACGIH TLVs may be different than the corresponding OSHA standard. Both NIOSH recommendations and ACGIH TLVs are usually based on more recent information than OSHA standards due to the lengthy process involved with promulgating federal regulations. OSHA standards also may be required to consider the feasibility of controlling exposures in various industries where the hazardous agents are found; the NIOSH recommended exposure limits (RELs), by contrast, are based primarily on concerns relating to the prevention of occupational disease.

Conditions had significantly changed since DodCo employees worked at IMC and the NP plant was in the rebuilding stage when the NIOSH investigation took place. Therefore, substance-specific evaluation criteria were of limited value and could only be used for comparison with previously obtained monitoring data.

### **Specific**

Nausea, vomiting, headache, dizziness, and diarrhea are non-specific symptoms that can be caused by a variety of chemical, biological and physical stressors. These include many common solvents, viruses, bacteria and physical agents, such as heat.<sup>7</sup> Overexposure to some of the chemicals that were potentially present in the restricted area could cause some or all of these symptoms. These include acetone and hexane, which were present in the spray adhesives used by the asbestos workers, as well as IMC chemicals such as the NP Heads mixture, Straight-Run Kerosine, and 2-nitropropane.<sup>(8-11)</sup>

Toxicologically, 2-nitropropane has been shown to be carcinogenic in laboratory animals (liver cancer) and there is suspected carcinogenic potential for humans.<sup>(4,12)</sup> NIOSH recommends that exposures to 2-nitropropane be reduced to the lowest feasible level.<sup>(13)</sup>

To assess the monitoring strategies used to determine airborne contaminant concentrations during the IMC renovation project, the sampling and analytical method, sampling location, and the components selected for sampling were reviewed. Selection of the proper sampling protocol requires consideration of the contaminants and concentrations expected, environmental conditions, and the presence of potential interferences. For each compound selected for monitoring, validated sampling and analytical techniques must be used to ensure, so far as possible, that the data collected represents true conditions. Misleading conclusions can be drawn if improper techniques, or improperly calibrated equipment, are used.

## **RESULTS AND DISCUSSION**

### **Interviews**

Interviews with appropriate personnel involved in the renovation activities revealed a general lack of knowledge about widespread illness among DodCo employees. Two limited episodes of unknown origin, however, were described. Details of these episodes are provided in the sections on the DodCo daily logs and the industrial hygiene consultant investigation. Officials interviewed by NIOSH also were unaware of any widespread illnesses among personnel of other contractors. It should be noted, however, that no attempts were made by NIOSH to interview individual employees of other contractors. Because most of the illnesses among DodCo employees were not brought to management's attention, it is conceivable that similar illnesses were present among other contractors, but were not recognized.

The interviews provided little information regarding the possible presence of chemical contamination in the areas where DodCo employees worked. OSHA conducted monitoring for a variety of substances, including hydrocarbons, nitroparaffins, and asbestos. OSHA ceased sampling by June 15, after determining there was no longer a threat of chemical exposure. Some soil was removed in the north-east portion of the facility due to the release of "stripper bottoms" and "NP-heads" during the explosion. According to the company Material Safety Data Sheets (MSDSs), "NP heads" contains acetone (48-53%), acetaldehyde (13-17%), acetonitrile (9-13%), and nitromethane (5-8%). NP "stripper bottoms" contains formaldehyde (0.5-1%) and nitric acid (1-1.5%).

### **Questionnaire Results**

Twenty-three of 25 interviewed workers (92%) were male. The average age of the workers was 30 years, ranging from 20 to 55. Eleven of 25 workers (44%) worked one week or less, eight (32%) worked one to four weeks, and six (24%) worked more than four weeks. Eighteen of the workers were directly involved in asbestos removal; the remaining seven performed various support functions including scaffold erection, equipment distribution, food preparation, and crew assignments and supervision. Workers were not located in any one area of the explosion site and were unaware of any specific chemicals they encountered other than the glue used to construct asbestos containment areas. The majority of workers (68%) reported general chemical odors and leaks present on the site.

All workers reported that they received asbestos abatement training either for the IMC job or for past jobs, but only nine (36%) reported that they had received safety training specific for the IMC job. Nearly all workers reported wearing cotton gloves, disposable coveralls, and half-face respirators with cartridges designed for protection from asbestos exposure. Eight workers (32%) indicated that yellow cartridges were provided for protection from chemical exposures. Yellow is the color designated by OSHA (29 CFR 1910.134) for respirator cartridges that provide protection against acid gases and organic vapors.

Twenty-two workers (88%) had symptoms they believed were related to their work at IMC. For all but one worker, symptoms first occurred while working at the site. The median time of symptom onset was seven days from the first day on the job. Workers' illnesses occurred throughout the period of Dodco employment (Figure 1.)

A wide range of symptoms was reported by the 22 symptomatic workers. The most common symptoms were diarrhea (91%), nausea (82%), headache (76%), dizziness (71%), and cough (68%) (Table 1). Only eight (36%) workers with symptoms met the case definition for potential chemical-related illness.



Six of the 22 sick workers lived in motels during their time on the job. The remaining 16 sick workers lived at home. Thirty two percent (5/16) of these reported that they had family members who had gastrointestinal illnesses during the time they were working at IMC.

All workers ate food provided by DodCo, Inc. throughout the job. A trailer, which functioned as a break room and lunch room, was set up on the job site outside the restricted area. Sandwiches and cold beverages were prepared and served by a break room attendant employed by DodCo.

Only two sick workers sought medical care for their illness. Physicians of both workers were contacted, and one provided a medical record for review. No new information was obtained from the record.

## **Records Review**

### **1. Workers Compensation**

According to the owner of DodCo, Inc., no workers compensation claims were filed as a result of chemical exposure. BeCon representatives also reported that no claims were filed by employees of other contractors for illnesses attributed to chemical exposures.

### **2. OSHA 200 Records**

A review of DodCo, Inc.'s 1991 OSHA 200 Log found no illnesses attributed to chemical exposures recorded. Note that only disorders requiring medical treatment, hospitalization, prescribed medication, or a modified work regimen would be considered "Recordable." The incident involving the one DodCo employee who was hospitalized was recorded on the OSHA 200 log as a heat-related disorder.

### **3. First-Aid Logs**

First-aid logs maintained for BeCon (June 24-July 21) employees (not including DodCo) indicated that out of 92 total first aid visits, 13 (14%) were chemically related. The majority (11) of these chemically-related visits were due to direct skin or eye contact with a primary irritant (e.g. acid) or an unknown substance, where treatment was at the point of contact. Two of the 13 visits were due to inhalation of what was believed to be formaldehyde. These two individuals were working in a ditch on July 13, and experienced chest pain. They were treated with oxygen for five minutes and returned to work.

IMC first-aid logs from the time period of June 24-July 10 were reviewed. A total of 6 first-aid visits were logged. None of the visits were due to illnesses or accidents associated with exposure to chemicals in the NP plant.

### **4. DodCo Daily Logs**

Daily logs written by DodCo supervisors indicated that on the night of June 17, two DodCo employees, who were wiping down and encapsulating pipes, complained of stomach pains and diarrhea. They were sent home by their supervisor at 8:00 p.m. Representatives from the environmental firm (SEC/Keter) and MMG investigated reports of odors in the area. Non-specific area monitoring did not indicate the presence of any chemical contaminants detectable by the sampling method used. The remaining DodCo workers were instructed to replace their HEPA filter respirator cartridges with dual HEPA/organic vapor ("piggyback") cartridges. The DodCo supervisor noted that he walked through the area and did not detect any problems or odors. At approximately 9:30 p.m., one of the DodCo crews was noted as still detecting strange odors that made them sick. The environmental group and MMG again conducted non-specific

area monitoring (monitoring device would respond to a wide range of organic compounds) but could find no evidence of a problem. No attempt was made to collect air samples for subsequent identification or quantification, and no further investigation was conducted. The DodCo supervisor moved the crew to another area in response to the workers' concerns. At 11:30 p.m., another DodCo employee left work with a "bad headache." No other details regarding this incident were available.

On June 19 (night shift), there was a notation regarding worker complaints of odors and a "bad taste in the mouth" at approximately 11:00 p.m. The log indicated that IMC representatives were regularly checking the area and could not find an explanation. The procedure followed for "checking" the area was not determined. Another notation in this log indicated that at 3:30 a.m. that same night, the IMC representative "found a little something", and the DodCo workers moved out of the area. It is not known what was detected. According to the log, all DodCo workers were using the "piggyback" respirator cartridges on June 19.

Personal protective equipment protocols by DodCo workers during this time (mid-June) consisted of disposable coveralls with hoods, rubber boots, hard hats, safety glasses, gloves, and respirators with HEPA filters. Entrance into the restricted area was via a sign-in station at all three checkpoints. Decontamination consisted of washing boots with water upon exiting the regulated area and proceeding to a decontamination trailer for showering.

### **Health and Safety Training**

Safety and health training or orientation responsibilities for contractors involved with the post-explosion renovation changed over the course of the project. According to DodCo's president, the training and orientation process for DodCo workers consisted of the following:

1. All employees had to show the necessary certificates verifying they had completed a 40-hour asbestos course.
2. DodCo provided hazard communication/safety orientation training to all of its workers and MSDSs for the encapsulant and adhesives used were available.
3. Qualitative respirator fit-testing, using irritant smoke in a booth, was provided to employees. The DodCo respirator policy requires all respirator users to be clean-shaven. Note that the fit-testing and training of employees was not confirmed by the worker interviews. Most of the employees interviewed indicated that they had only been fit-tested at the asbestos training school.

Initially, IMC personnel provided a contractor safety orientation for contractor employees. Each DodCo worker was required to sign a statement that they had received this orientation, which consisted of basic safety items and requirements, such as evacuation procedures and emergency reporting. Chemical-specific training for IMC materials was not initially provided. Apparently, this was because IMC personnel did not intend for DodCo workers to encounter IMC chemicals. According to the BeCon safety supervisor, after BeCon assumed responsibility for the DodCo workers, a site-contractor Hazard Communication program was written and implemented on June 10, 1991. All DodCo employees hired after this date were required to attend this training, which covered the IMC chemicals that were used in the NP plant. A systematic approach was taken to ensure DodCo workers hired before June 10 were trained. The BeCon safety supervisor estimated that approximately 75% of the DodCo work force received this chemical-specific training. In addition to training, the BeCon program included a collection of MSDSs for all chemicals in the NP plant.

### **Chemical Review**

DodCo employees worked with an encapsulant for sealing, or "locking down" asbestos, and a spray adhesive which was used to attach polyethylene sheets to framing when constructing enclosures. According to the MSDS, the encapsulant is a high molecular weight material containing ethylene glycol. This is an odorless, relatively alkaline (pH = 10) material of low volatility.

Two types of spray adhesives were used. These adhesives contained the solvents acetone, 1,1,1-trichloroethane and hexane using a propane/isobutane blend as a propellant. The solvents contained in these adhesives are volatile and become aerosolized by the nature of their use.

### **Environmental Monitoring Records**

Routine, continuous area monitoring was conducted by MMG throughout the restricted area. Monitoring was conducted with direct reading survey instruments (Foxboro Century® Organic Vapor Analyzer, AIM meter and a monitor utilizing a photoionization detector). The monitoring was for total organics only, and no attempt was made to identify specific compounds. According to the manager of MMG, it was confirmed with the manufacturers that the monitors would respond to the nitroparaffin compounds. All results were logged on data collection forms and summary activity reports were also written. In addition to the area monitoring, MMG conducted monitoring for confined space entry purposes (oxygen deficiency and explosive concentrations). These results also were recorded on the data collection forms.

According to the manager of MMG, the monitoring equipment was not calibrated specifically for any one compound. Each monitor was checked with span gas provided by the manufacturer at the beginning of each shift to ensure proper function.

Total organics monitoring is a non-specific technique that encompasses a wide range of volatile materials. Although the results are reported in parts per million (ppm), this is only a relative indicator and not a true concentration as neither the number of compounds, nor their identity, is known. To obtain a true concentration measurement for a given contaminant, specific analytical techniques that can exclude potential interferences are necessary. Often, total organic monitoring is used to determine the presence or absence of emission sources by comparing the meter reading (i.e. needle deflection) with background levels. The proximity of the monitor detector to the source also will have a substantial impact on the meter reading.

The DodCo work areas were monitored prior to June 27, however, the readings were not systematically recorded. Beginning on June 27, the monitoring form was expanded to include four Dodco areas (Dodco East, West, North and Break Area). The majority of the records indicated that no "organics" were detected. Some of the records, however did indicate that detectable levels of organic compounds were found, with varying degrees of detector response.

The summary activity logs for June 17-19 were reviewed to obtain details regarding the monitoring conducted in response to the DodCo complaints of odors. The MMG report indicates that work area sweeps were conducted after hearing complaints from the DodCo workers of nausea, diarrhea, and chest pains on the evening of June 17. The monitoring, using a Foxboro Century® Organic Vapor Analyzer, did not identify the presence of any contaminants detectable by this instrument. The MMG investigator reported that the workers "may be associating the smell of burned plastic and rubber with a hazardous substance." The investigator further notes that an intestinal virus is suspected. On June 18 (5:00 p.m.), the MMG report indicates that levels, "ranging from 2-9 ppm" were detected in one area. The MMG employee advised the DodCo workers to stay clear of that area. On the morning of June 19, some detectable levels of organics were found in the DodCo work area. However, the MMG report indicates that there were no complaints of discomfort or odors in these areas.

As only non-specific area monitoring results are available for these incident investigations, only limited conclusions regarding exposures experienced by the DodCo employees can be made. The available results indicate that volatile contaminants were present at various times in various concentrations at the IMC site during the renovation activities. The source, type, or concentration of the contaminants is not, however, known. The number of workers potentially exposed, and the duration of exposure, was not determined.

OSHA periodically conducted area monitoring with on-site analysis for 2-nitropropane after May 14. This monitoring was conducted utilizing a portable gas chromatograph equipped with a flame ionization detector (GC/FID). According to the OSHA official conducting the monitoring, sampling was conducted for site characterization rather than specific investigative purposes.<sup>14</sup> The OSHA official indicated that no 2-nitropropane was detected in the samples collected. The limit of detection for this technique was 1 ppm. The OSHA official also indicated that the monitor chromatograms were examined, qualitatively, for indications of 1-nitropropane and nitroethane. This was accomplished by determining the resolution time for these compounds and looking for peaks on the chromatograms. These compounds were not detected in the samples collected.

### **Industrial Hygiene Consultant Investigation**

On July 11, 1991, a DodCo worker experienced symptoms of headache, nausea, and vomiting, and was subsequently hospitalized at Sterlington Hospital. After treating the ill worker, some of the health care workers experienced similar symptoms, and the possibility of chemical transfer from the patient to the health care workers was suspected.

The DodCo worker (day shift) was cutting polyethylene and sealing the material to wood framing using a spray adhesive when he became ill. He was transported to Sterlington Hospital where he was admitted. Approximately 1 hour after treating the DodCo worker, several health professionals became ill with similar symptoms. A chemical contaminant was suspected and IMC was contacted. The clothing that the DodCo employee was wearing at the time of the incident was placed in a sealed plastic bag. On July 14, 1991, IMC retained an industrial hygiene consultant to investigate this incident. The industrial hygiene consultant placed an organic vapor passive dosimeter inside the bag containing the employee's clothing, for approximately seven hours. A non-specific direct-reading instrument was used to screen the clothing for the presence of flammable compounds, "ionizable" compounds, carbon monoxide, chlorine, %LEL (lower explosive limit) and % oxygen. The consultant reported that the coveralls indicated contamination. A sample collected inside the bag containing the boots indicated 18 ppm of carbon monoxide.

Information regarding the type or extent of the "contamination" detected on the overalls, or the results of the passive dosimeter monitoring, was not available for review. Carbon monoxide is a colorless, odorless, gas that is a byproduct of incomplete combustion. Excessive levels of carbon monoxide are typically found in areas where the byproducts of fuel combustion (e.g., gasoline engines, etc.) can collect (e.g., poorly ventilated areas). The source of the carbon monoxide detected in the boots is not known, nor would the presence of this gas be expected as carbon monoxide would rapidly dissipate. It is possible that another substance caused the meter to respond when in the carbon monoxide detection mode.

The consultant also conducted monitoring in the DodCo employee's work area on July 15. This monitoring consisted of sampling for the components in the spray adhesive (1,1,1-trichloroethane, acetone, ethyl ether) and the nitroparaffin compounds (nitromethane, nitroethane, 1-nitropropane, 2-nitropropane). These samples were collected using established monitoring protocols and were analyzed by a laboratory accredited by the American Industrial Hygiene Association. The results of this monitoring indicated the presence of low concentrations

of 1-nitropropane (0.26 ppm) and 2-nitropropane (0.04 ppm) in one of the four samples collected for the nitroparaffin compounds. The components of the spray adhesive were not detected in the sample collected. It is not known if the spray adhesive was being used at the time of the sampling.

## **CONCLUSIONS**

Based on the results of this investigation, no conclusions can be reached regarding the work-relatedness of the illnesses experienced by DodCo employees at IMC. The symptoms experienced by DodCo employees could be attributed to a wide variety of factors, both occupational and non-occupational. The most frequent symptoms involved the upper respiratory tract, gastrointestinal tract, and the central nervous system. The wide spectrum of symptoms is not indicative of one specific causal agent. Thus, it is possible that several factors were operating simultaneously to cause the reported illnesses. Gastrointestinal illnesses have a variety of causes, including poisoning by toxic chemicals, bacterial contamination of food or water, and communicable viruses.

Chemical poisoning cannot be ruled out. Available area monitoring records show that detectable levels of "total organic compounds" were present at varying concentrations at various times in the restricted area. However, chemical-specific exposure data were not available regarding the DodCo employees. It is conceivable, however, that some of the symptoms could have been related to unreported, intermittent, chemical contacts.

Food poisoning is usually recognized by the sudden occurrence of illness among a high percentage of exposed individuals. The temporal pattern of illnesses among the DodCo employees does not follow this pattern. A communicable virus could have caused some of the symptoms, particularly in light of the crowded conditions in the break and lunch room trailer, which would have been favorable to viral transmission.

In addition to gastrointestinal symptoms, other systemic symptoms included fever, headache, dizziness, and symptoms of upper respiratory tract irritation. Some of these symptoms could have a chemical explanation; they are consistent with known acute effects of the nitroparaffins and components of the NP heads and stripper bottoms.<sup>(4,9,10)</sup> As previously mentioned, however, there was no evidence of exposure to these substances. Another plausible explanation for some of these symptoms is heat exhaustion. Clinical features of heat exhaustion include some degree of elevated body temperature, fatigue, nausea, and headache.<sup>7</sup> Temperature and humidity levels common for Louisiana in the summer months can result in situations where workers experience high heat loads. Under high heat load conditions, employees may be affected by heat unless precautions are taken (i.e., worker acclimatization, work-rest regimens, heat alert programs, sufficient fluid replenishment and worker training). Additionally, the use of personal protective equipment can exacerbate the effect of exposure to heat due to a diminished ability to dissipate heat through evaporative cooling, or the additional energy expenditure necessary to complete tasks when burdened by protective equipment.<sup>(7,14)</sup>

## **RECOMMENDATIONS**

1. The IMC contractor training program should be examined and modified to ensure that all contractors present receive chemical-specific training for materials that they may encounter in their work area, even if they are not directly working with those materials.
2. Worker concerns regarding illnesses associated with chemical exposures should be brought to the attention of management personnel immediately to ensure that they are adequately resolved. This provides an opportunity for all personnel involved to investigate the problem

on-site, at the time of occurrence. These site-investigations should be thorough and as conclusive as possible.

3. Investigations in response to concerns regarding chemical exposures should include a mechanism for determining concentrations of specific contaminants. Instrument readings have limited value where contaminants are unknown. Although direct reading non-specific survey instruments can be useful, they should be supplemented with compound-specific sampling strategies. These sampling strategies can include monitoring with selective media for subsequent laboratory analysis, compound-specific detectors for real-time monitoring, and analytical techniques that can differentiate and identify compounds present in unknown atmospheres (e.g., gas chromatography/mass spectroscopy). Where unknown and multiple contaminants are potentially present, the following guidelines apply:<sup>15</sup>
  - A. Instruments should be calibrated according to the manufacturer before and after use.
  - B. Develop chemical response curves if these are not provided by the manufacturer.
  - C. Non-specific readings are of limited utility. Readings of unknown contaminants should be recorded as "needle deflection" or "positive response", and not in specific concentrations (e.g., ppm). Conduct additional monitoring where a positive response occurs.
  - D. Non-detectable readings should be reported as "no instrument response" and not zero because quantities of chemicals may be present that are not detectable by the instrument.

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2. President, DodCo, Inc.
3. Special Representative: Laborers Local 762
4. Director, Safety and Environment, IMC Fertilizer, Inc.
5. OSHA Region VI Office
6. PHS/DPHS Region VI Office
7. PHS/DPHS/NIOSH Region IV Office
8. Louisiana State Health Department

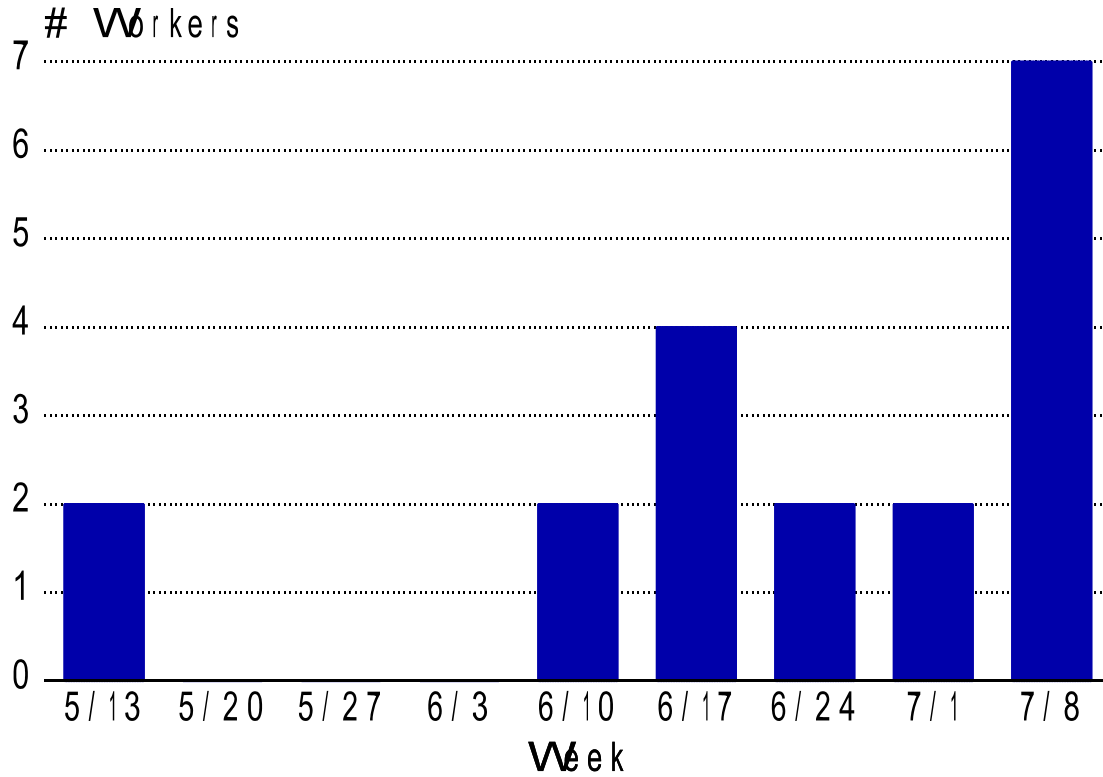
For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.



FIGURE 1

ONSET DATE OF REPORTED ILLNESSES AMONG 22 DODCO EMPLOYEES<sup>a</sup>  
(5/13/91 - 7/15/91)

HETA 91-338  
IMC CORPORATION  
STERLINGTON, LOUISIANA



<sup>a</sup> Onset date was unknown for three employees.

Note: DodCo contract was terminated on 7/12/91

TABLE 1  
 FREQUENCY OF SYMPTOMS REPORTED BY DODCO EMPLOYEES<sup>a</sup>

HETA 91-338  
 IMC CORPORATION  
 STERLINGTON, LOUISIANA

Symptom	Cases <sup>b</sup>		Others		Total	
	No.	%	No.	%	No.	%
Diarrhea	8	100	12	86	20	91
Nausea	8	100	10	71	18	82
Headache	7	100	9	64	16	76
Dizziness	4	57	11	79	15	71
Cough	5	63	10	71	15	68
Sore throat	6	75	8	57	14	64
Runny/stuffy nose	6	75	7	50	13	59
Fatigue	5	71	6	43	11	52
Shortness of breath	3	43	7	50	10	48
Excessive sweating	3	43	7	50	10	48
Skin rash	4	57	6	43	10	48
Eye irritation	5	63	4	29	9	41
Abdominal pain	4	50	5	36	9	41
Vomiting	8	100	0	0	8	36
Fever	3	43	3	21	6	29

<sup>a</sup>Twenty-five workers were interviewed; the frequencies shown in this table are among the 22 workers who became ill during the job.

<sup>b</sup>A potential chemical-related illness was defined by the presence of nausea and vomiting and one of three other symptoms, including headache, dizziness, or diarrhea.