United States
Environmental Protection
Agency

Region 1
Environmental Services Division
60 Westview Street
Lexington MA 02173

Date of Audit:
April 10-14, 1989
Date Of Report:
November 17, 1989

EPA

Chemical Safety Audit Report

W.R. Grace
Organic Chemicals Division
Nashua, New Hampshire

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
60 WESTVIEW STREET, LEXINGTON, MASSACHUSETTS 02173

November 3, 1989

Dear Reader:

Attached is the final report of the Environmental Protection Agency Region I's (EPA) Chemical Safety Audit conducted at W. R. Grace & Co., Organic Chemicals Division, Nashua, New Hampshire on April 10-14, 1989.

You will find a summary of the audit team's major observations and recommendations in Section 9 of the report. The recommendations reflect information obtained during the audit and from records provided by the facility. The recommendations are not mandatory and EPA makes no assurances that if implemented the resulting actions will prevent future chemical accidents, equipment failures or unsafe management practices, and/or provide protection from a future enforcement action under any applicable law or regulation.

EPA is pleased to provide its observations and recommendations to enhance safety at W. R. Grace and in the community. Our observations provide a snapshot of the conditions that existed at the facility during the audit period, and are not a substitute for a comprehensive safety evaluation. Safety is an ongoing responsibility of Federal and State government, the community, and industry. EPA will continue to monitor hazardous material planning, community Right-to-Know reporting, and release prevention policies in Nashua, New Hampshire through its SARA Title III program office located in Lexington, Massachusetts.

If you have questions about the report or if EPA can be of assistance, please contact Ray DiNardo, SARA Title III Program Manager at (617) 860-4385.

Attachment:

EPA

Chemical Safety Audit Report

W.R. Grace Organic Chemicals Division Nashua, New Hampshire

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United States Environmental Protection Agency
Region 1 Environmental Services Divison

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EXECUTIVE SUMMARY

During the week of April 10-14, 1989, the U.S. Environmental Protection Agency, Region I (EPA) conducted an in-depth Chemical Safety Audit of the W.R. Grace & Co. Hampshire Facility in Nashua, New Hampshire. EPA was assisted by representatives from the Occupational Safety & Health Administration (OSHA), Region I. The primary purpose of the chemical safety audit was to identify imminent or potential hazards to the community and the environment and to recommend corrective measures for the W.R. Grace Organic Chemicals Division, Nashua, New Hampshire. The scope of the audit did not include conducting a full compliance evaluation for enforcement purposes. Although the Audit team identified numerous safety problems, Grace has demonstrated a commitment to safety and has made substantial improvements to release prevention systems especially over the past 5 years. The Hydrogen Cyanide (HCN) piping and storage facilities as well as the Phosphorous Trichloride (PCl_3) storage tanks have been renewed and modernized and these modifications have greatly reduced the possibility of a large-scale release. The buffer zone between the facility and the neighborhood has been increased through land purchase by the facility, and Grace has aggressively participated in chemical emergency planning and community awareness programs including those required under SARA Title III.

The on-site emergency response team has participated in highly specialized training and is equipped to respond and mitigate chemical releases on Grace property and in the community. Grace has a network of continuous monitors to detect accidental chemical releases, and the facility continuously monitors meteorological conditions. This equipment, coupled with Grace's ability to model download concentrations of accidental releases, provides the facility and community emergency responders with the necessary tools to reduce the likelihood of a catastrophic chemical emergency. However, the Audit team identified several potentially serious safety problems within the plant and has outlined recommendations in this report as a means to further reduce the frequency and severity of chemical accidents which could impact the community and the environment.

The most significant problems were found in the following areas:

- o Reactor No. 5 Hydrochloric Acid (HCl) Release
- o Hydrogen Cyanide (HCN) Storage and Transfer
- o Railcar Unloading Operation
- o Monitoring
- o Phosphorous Trichloride (PCl_3)
- o Sodium Cyanide (NaCN) Storage
- o Emergency Backup Power
- o Chemical Accident Prevention
- o Operations and Maintenance
- o Emergency Venting
- o Environmental Compliance
- o Hazards Analysis
- o Accident Investigation and Followup

This list is not all-inclusive. W.R. Grace should consider conducting a comprehensive plant-wide audit to identify additional safety problems and place a high priority on rectifying all hazards that could impact the community.

Safety is the ongoing responsibility of Federal, State, and local government, the community, and the facility. The EPA will continue to monitor planning, Community Right-to-Know, and release prevention policies in Nashua, New Hampshire, through its Region I SARA Title III program office located in Lexington, Massachusetts.

1 INTRODUCTION

1.1 INTRODUCTION

During the week of April 10-14, 1989, the U.S. Environmental Protection Agency, Region I (EPA) conducted an in-depth Chemical Safety Audit of the W.R. Grace & Co. Hampshire Facility in Nashua, New Hampshire. EPA was assisted by representatives from the Occupational Safety & Health Administration (OSHA), Region I. The Nashua Facility is one of four major chemical facilities operated and managed by the Organic Chemicals Division of W.R. Grace & Co. Most of the products manufactured at this location are based on hydrocyanic acid (HCN) chemistry. The facility consists of four manufacturing plants, a research lab, offices and effluent treatment facilities.

The purpose of the audit was to assess the overall environmental and safety aspects of the site, especially in terms of potential impact on the surrounding community and citizens. Evaluations were based upon a review of documents provided by the facility and on information gathered while on-site, both in conference with plant management and through visits to the various production areas. The intent of the audit was to thoroughly examine process equipment and storage facilities associated with the use or handling of hazardous chemicals in order to provide the Nashua Facility with information to enhance chemical safety practices and reduce the likelihood of future accidents or releases. Recommendations to minimize hazardous emissions at the facility are included in this report. While the Audit team made certain observations concerning compliance with environmental regulatory programs, the team did not conduct a full enforcement inspection.

Observations represent a snapshot of conditions existing at the facility during the audit timeframe, and do not represent planned or anticipated changes already proposed or on-going at the facility. Recommendations made in this report are not a substitute for a comprehensive safety evaluation program, nor should absence of a recommendation be used to halt any on-going evaluation or correction programs, or affect proposed and on-going enhancement of a plant health and safety culture, adhered to by plant management, staff, or any visiting contractors.

The Audit team observed many toxic, corrosive and flammable chemicals received, stored and processed at the site. The three chemicals of most concern because of quantities, toxicities and vapor pressures are hydrogen cyanide, ammonia, and phosphorous trichloride. Plants working with significant quantities of such materials would benefit from extensive plant buffer zones to reduce the possibility of accidental releases of extremely hazardous substances migrating beyond property lines. Because of this facility's close proximity to area residents, the Nashua plant should have equipment, procedures, alarms, redundancy, backup equipment, training and an attitude toward safety that goes beyond industry standards. This is justified given the potential for harm to health and environment if an accident of major proportions were to occur. Strict safety procedures will reduce the possibility of occurrence and the resulting consequences.

This report describes existing processes observed during the audit and provides recommendations to enhance safety through equipment and process modifications. New techniques and practices are discussed as well. Major safety recommendations are outlined in the final chapters of the report.

The Audit was conducted under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA); Clean Air Act (CAA); Resource Conservation and Recovery Act (RCRA); and EPA's Accidental Release Information Program. It was coordinated with the many State and Federal Agencies having jurisdiction over the facility so as to minimize duplication of individual agency tasks and maximize the use of limited resources available during the audit. This process included a comprehensive inter-agency information sharing effort.

The Nashua Facility cooperated in the Chemical Safety Audit, providing knowledgeable personnel and detailed information upon request. Management demonstrated a firm commitment to safety by fully participating in the audit and providing sound documentation of existing or planned safety improvements throughout the Audit period. The plant has taken initiatives to improve health and safety, and significant on-going safety improvements were observed at the facility which enhance both health and safety and emergency preparedness. The Audit team recognizes that numerous operations at the facility meet or in some cases exceed industry standards. However, some deficiencies do exist. The Audit team believes that an extra margin of safety is necessary at the W.R Grace Nashua facility in view of the nature of operations and the close proximity of the facility to the local community.

1.2 REPORT ORGANIZATION

- Section 1 - INTRODUCTION

  This section includes an introduction to the Chemical Safety Audit. It provides information on the report format, a plant description, and an overview of the area surrounding the facility. Some of the key concerns identified by the Audit team are highlighted.

- Section 2 - PURPOSE AND METHODOLOGY

  This section identifies and presents the goals established by the Audit team, and includes a discussion of the methodology used for accumulating information. The limitations of the Audit team are also identified. A schedule of Audit team members is presented, along with their areas of responsibility. This section explains that a multi-disciplinary team approach was used to provide checks and balances to validate observations and document deficiencies as well as ensure maximum coverage of material during the limited audit period.

- Section 3 - FACILITY INFORMATION

  Information is provided in this section as to the general setting of the facility and the surrounding area. A facility description and layout are provided. A brief production overview is followed by a listing of W.R. Grace representatives who participated in the audit, according to titles, job duties, and assigned audit functions. Access to facility personnel not identified in this section was limited and little information was gathered from persons not referenced in this report.

- Section 4 - PAST HAZARDOUS MATERIALS RELEASES

  A brief account is provided of major releases and incidents experienced over the past 2 years at the facility, including a description of the chemical releases, sequence of events, notification procedures, chain of command, follow-up actions, and modifications or training resulting from incident evaluation and corrective actions applied.

- Section 5 - HAZARDOUS CHEMICALS AND TOXICOLOGY

  A comprehensive analysis is provided of the most hazardous chemicals used at the facility along with the potential for harm associated with them as a result of existing operating practices, accidents, or routine releases.

- Section 6 - HAZARDOUS CHEMICALS STORAGE

  This section provides a comprehensive review of the chemical storage facilities on the plant, transport, loading and unloading facilities and practices, material transfer areas and systems, production areas, and tank farms. The focus is on general housekeeping, safe operating practices, containment measures, chemical hazards, storage systems and the need to maximize efforts to prevent chemical accidents from occurring.

- Section 7 - GENERAL PROCESS AREAS

  An overview is provided of the different processes associated with the production of speciality chemicals at the facility. The section examines those areas of the plant that handle hazardous or extremely hazardous chemicals.

- Section 8 - RELEASE PREVENTION AND ENVIRONMENTAL COMPLIANCE

  Plant policies, plans, systems, and equipment are discussed and evaluated in terms of their effectiveness and suitability to prevent chemical releases from occurring. Observations on possible health and safety enhancement measures are included.

On- and off-plant impact from accidental releases are evaluated in terms of quantities of material in storage and production. Observations concerning compliance with several environmental regulatory programs are also included.

- Section 9 - SUMMARY OF MAJOR OBSERVATIONS AND RECOMMENDATIONS

  The Audit team's recommendations for enhancing chemical safety procedures and management practices at the plant are outlined in this section. Specific recommendations for actual changes or modifications are included as well as recommendations to improve general work practices.

2 PURPOSE AND METHODOLOGY

2.1 PURPOSE

The Chemical Safety Audit program is an active outgrowth of EPA's efforts under the Chemical Accident Prevention (CAP) program, originally developed to address concerns regarding chemical facilities, generally after the incidents at Bhopal, India and at Institute, West Virginia.

Audits are conducted to investigate the causes of hazardous substance releases and to identify the particular operating practices, process equipment, operator training, and managerial actions that can be modified, encouraged or required so as to minimize the potential for future releases.

The W.R. Grace facility was selected for an audit based upon the following screening criteria:

- o The plant utilizes and produces several high-hazard chemicals which present the risk of an airborne release with significant off-site consequences [e.g., hydrocyanic acid (HCN), phosphorous trichloride (PCl_3), and ammonia (NH_3)].
- o Seven accidental releases, some with potential for off-site consequences, were reported for the period 1987-1988.
- o The facility is located in a highly-populated area.
- o The surrounding population is very concerned by and aware of the potential consequences of a facility release. An example of this sensitivity is the public and media reaction to the hydrochloric acid (HCl) release which occurred on August 5, 1988, and is described in Section 4.1 of this report.

The Audit was conducted in order to evaluate the releases that occurred at the plant in 1987 and 1988, and to help increase process safety at the Grace facility through recommendations and an exchange of information. The Audit team evaluated the following:

- o Process safety equipment and personnel training;
- o Internal release investigation procedures for both actual releases and "near-misses;"
- o Alert and notification procedures within the plant and outside the facility;
- o Hazardous chemical storage and handling;
- o Standard operating procedures (SOPs);
- o Chemical emergency prevention procedures;

- Potential and consequences of off-site chemical releases;
- Compliance status with Federal and State environmental programs;
- Storage and handling;
- Pumping and piping;
- Flow control/metering/charging of material to reactors; and
- Pressure release venting of both reactors and storage vessels.

The Audit team concentrated its efforts on the most vulnerable areas of the W.R. Grace facility, in terms of potential for an accidental release, and also reviewed areas of the plant that handled the most hazardous materials.

2.2 METHODOLOGY

W.R. Grace was notified of the EPA's intent to conduct a Chemical Safety Audit of the facility prior to the actual audit so as to minimize disruption to the facility. EPA also required that the plant complete and submit an EPA Release Prevention Questionnaire for each of the seven releases under investigation, as well as detailed replies to a series of questions concerning the following:

- Federal and State environmental permits;
- Facility description and operations (including simple process flow diagrams);
- Map of the facility (highlighting buffer zone size);
- Surrounding population density, distribution, and land use;
- Lists of all extremely hazardous substances present in excess of a threshold planning quantity;
- List of all CERCLA hazardous materials in excess of 10,000 lbs used in any calendar year;
- Description and location for the use, treatment, storage, disposal and handling of these chemicals;
- Hazardous material release prevention plans and procedures; and,
- Training activities at the facility related to safety and loss prevention.

W.R. Grace - Nashua Facility - compiled the data requested and provided the material to EPA on September 7, 1988. Following review of this data and other material available regarding the facility, the audit was scheduled for February 1989. This delay was due to EPA budget constraints. The audit was ultimately rescheduled for the week of April 10-14, 1989.

The Audit team assembled by EPA included representatives from numerous technical disciplines including: chemical, mechanical and safety engineering; industrial hygiene; and the environmental sciences. A consulting process engineer with over 30 years experience in cyanide processes was retained to provide observations in the area of plant operations and cyanide chemistry. Other team members were drawn from the EPA, OSHA and EPA contractors.

The Audit itself consisted of a series of presentations made by facility representatives, round table discussions, and facility tours to examine various site elements, including physical infrastructure and safety mechanisms. After the first day's introductions, daily meetings opened with a series of observations presented by the Audit team, based on the previous day's findings. When these issues had been addressed by Facility Representatives, new issues were brought up for discussion, and specific site locations were identified for viewing.

The Audit team toured the facility as a cohesive unit, accompanied by the facility representatives listed in this report. No other W.R. Grace employees were questioned by the Team, or made presentations as to their activities with the exception of the union representative who was interviewed by OSHA.

Topics reviewed by the Audit team included the following:

<u>Chemical Hazards</u>

- o Past hazardous materials release incidents,
- o Chemical handling and storage, and
- o Chemical transfer and waste management practices.

<u>Safety Procedures and Training</u>

- o Standard operating conditions;
- o Emergency spill/emissions procedures;
- o Emergency response, alert, and notification procedures;
- o Detectors and alarms;
- o Safety programs (e.g., Respiratory Protection Program);
- o Safety rules, safety equipment, and safety attitudes;
- o Inspections and drills;
- o W.R. Grace's Emergency Response Procedures and Contingency Plans;

- o Training requirements and practices (new employee, contractor, Hazmat Team, Fire Brigade, Community Relations Groups); and

- o Maintenance (e.g., upkeep of personnel protection equipment, training records, calibration of monitoring instruments).

General Information

- o Environmental permits and licenses;

- o Release modeling;

- o Piping and Instrumentation Diagrams (PIDs), interlocks, relief valves;

- o Equipment integrity checks; and,

- o General maintenance.

2.3 AUDIT LIMITATIONS

While the Chemical Safety Audit conducted at the Nashua Facility was comprehensive given the 1-week time period allotted, several areas were not specifically addressed, namely:

- o A hazards assessment using methods comparable to What if?, Fault Tree, Hazards and Operability Studies, or Failure Mode and Effect and other consequences analyses. Such studies require an extended timeframe and were not within the scope of this audit. The Audit team did investigate the hazards assessment methods in use by the facility. These findings are documented in the report.

- o A detailed review of the design specifications for storage vessels, pressure vessels, reactors, scrubbers, valves, piping, pumps, controls systems, etc. was not conducted with respect to ASME, API, or NFPA codes and standards. The Audit team did investigate critical systems in terms of construction material compatibility, valve and flange gasket compatibility, reactor pressure relief venting requirements, safety system redundancy, storage vessel venting and scrubbing requirements, and tank level indicators.

- o A detailed review of Piping and Instrumentation Diagrams (PIDs) was undertaken. In general, the PIDs reviewed by the Team were process flow diagrams not containing information on mass balance, temperature, pressure, control systems, or equipment specifications.

2.4 AUDIT TEAM COMPOSITION

Table 2-1 depicts the Chemical Safety Audit team (all of whom assisted in preparing the material used in this report), chosen for their expertise in diversified environmental, chemical process, and health and safety disciplines.

Table 2-1

Chemical Safety Audit Team

AUDIT TEAM MEMBER	AFFILIATION	RESPONSIBILITY
Ray DiNardo Title III Program Mgr. Environmental Engineer	EPA, Region I	Team Coordinator
Ken Ferber Environmental Engineer	EPA/AARP Region I	Assistant Team Coordinator
Paul O'Connell Safety Engineer	OSHA, Region I	Safety Advisor
Fred Malaby Industrial Hygienist	OSHA, Region I	Industrial Hygiene/ Toxicology Advisor
Jeff Goodman Environmental Scientist	ICF Tech., Inc.	Environmental Control/ Planning Consultant
William Jenks Chemical Engineer	Consultant	Chemical Safety/Processes Consultant
Tom Walsh Industrial Hygienist	EPA TAT - E & E	Response Procedures/ Containment Advisor
Mark Dahm Chemical Engineer	EPA TAT - E & E	Chemical Systems Advisor
Nermin Ahmad Information Specialist	EPA TAT - E & E	Technical Information Controller

3 FACILITY INFORMATION

The Nashua Facility is a batch specialty chemical plant, producing 133 products on a continuous or a seasonal basis according to product demand. Many of the chemicals used in plant production are considered hazardous or extremely hazardous, and their use can result in serious safety and environmental consequences unless proper safeguards and prevention measures are routinely implemented. It is important for a facility of this type to have a firm commitment to safety. Excellent construction materials and proper storage and handling procedures are necessary to reduce the potential for and frequency of serious chemical accidents. Plant housekeeping measures, prevention of chemical releases, and stringent health and safety measures must be a priority for the W.R. Grace operation in Nashua, New Hampshire.

3.1 SITE SETTING

The W.R. Grace & Co.- Conn.'s Organic Chemicals Division - Nashua Facility is located on Poisson Avenue, adjacent to the Merrimack River, and within the city of Nashua, New Hampshire. Local land use is primarily commercial, although three residences are located immediately next to the facility's western entrance. To the east lies the Merrimack River, separated from the facility by the tracks of the Guilford Transportation Industries, Inc. railroad and a narrow strip of land. Across the river lies a golf course, a multi-family residential area, and a quarry. A 5,000-home residential housing development is proposed to be constructed across the river and the development could be within the impact area of a large scale accidental release.

On the western edge, the facility is bound by commercial development (including a motel, a day-care center, and three restaurants), and by additional commercial property to the north. To the south lies another manufacturing plant. The 5-mile radius from the plant includes all the population of Nashua and Hudson, New Hampshire, and a substantial part of the populations of Tyngsboro and Dunstable, Massachusetts. This represents a total population of approximately 108,000. The 5-mile total population figure reflects a rapid growth rate in the area. When the plant was originally constructed, the area was sparsely populated.

There is a steep downgrade slope from west to east (or from the private residences towards the river.) Spit Brook crosses the western boundary of the plant site and flows northeast for some 200 feet before being conveyed beneath the plant through a 6-foot conduit to the Merrimack River which flows from north to south.

Access to the plant is controlled through a guardhouse set at the primary entrance. Three other plant entrances are kept locked and only used in emergencies, or during heavy construction activities. The plant site is surrounded by a fence, and employees have stickers on their cars allowing them access to the on-plant parking area. Visitors must register with the guard, who issues them a visitor's badge. This badge must be displayed at all times while the visitor remains at the facility. Although security is adequate, the Audit team noted that security requires improvement.

The three locked entrances may initially restrict exit of evacuating employees during an emergency. Plant-wide evacuation procedures need to be tested and evaluated by Grace through the conducting of a full field chemical accident simulation.

3.2 SITE DESCRIPTION

The need for a better-than-average commitment to health and safety is emphasized by the location of the plant. The facility is located within an urban area, with an average buffer zone of only 387 feet to densely populated areas. Some residences are directly adjacent to the facility. The greatest buffer zone width is only approximately 4,800 feet to the east. The Merrimack River flows by the facility and four townships, including Nashua, New Hampshire, are within a 5-mile radius of the plant. The plant has recently acquired additional land and is presently situated on some 40 acres. Actual process areas are confined to approximately 5 acres on which the majority of the critical process equipment is housed within several buildings. Raw material storage, unloading, and shipping areas are outside these buildings and these activities are conducted at various locations throughout the plant.

Ancillary operations, including boilers, cooling towers and compressors are distributed throughout the facility. The plant sewer is divided into separate north/south systems of surface drains and underground sewers, both of which feed the wastewater treatment facility located on the northern edge of the plant. A fluidized bed incinerator, utilized for the thermal destruction of the liquid wastestream generated by the facility is located towards the southern end of the site.

3.3 PRODUCTION OVERVIEW

The Hampshire Chemical Corporation began production in 1958, using a newly patented high-technology manufacturing process developed by its two original founders. In 1965, W.R. Grace and Co., a major U.S. specialty chemical producer, bought the plant, making it one of the four major chemical facilities operated and managed by its Organic Chemicals Division. There are currently 325 full-time employees at the plant, including some 200 factory personnel and 125 office and research staff. Nearly 30 percent of the staff has been employed over 15 years with the company, and 80 percent has been employed for over 5 years.

A number of commodity chemicals are processed at this location, including common commercial industrial products such as caustic soda, formaldehyde, amines, and sulfuric and hydrocyanic acids. The products are used to create a wide line of items which include detergent and sanitizer additives, agricultural nutrients, food additives, pharmaceutical ingredients, and beauty products. Major by-products are recovered and sold. The principal chemical products manufactured are:

- **Hampshire Chelating Agents**, or amino acid compounds. These are used for water softeners, in industrial boiler water treatment formulations, detergents, bathroom cleaners, and chemical intermediates.

- **Metal-chelates.** This group is used to provide essential trace elements for plant fertilization in mineral deficient soils as well as for adding essential nutrients to foods, and removing toxic hydrogen sulfide gas in geothermal applications.

- **Hamposyl Surfactants** are developed to enhance the cleaning capacity of detergents and soaps. They can be used in shampoos and rug cleaning formulations.

- **Organo amino nitriles** are used as chemical intermediates.

- **Sodium cyanide** is sold to the metal finishing and electronic industries.

- **Anhydrous ammonia** is recovered for agricultural and industrial markets.

- **Sodium sulfate** is recovered at the facility and sold to the paper industry.

- **Phosphorous acid** is recovered and sold for the production of chemicals used in secondary oil recovery.

The Pilot Laboratory is used for research and development purposes and for the production of small-volume chemical products.

The only wastestream generated and stored as a direct part of process design is MIBKAN (organoaminonitrile) waste, which is designated as Reactive - D003, and stored in a 5,000-gallon storage tank. This tank is located within the 100-year floodplain, and is set in a concrete diked area, whose walls top the floodplain by 2 feet. Other hazardous wastes are produced by off-spec products and raw materials, process wastestreams, and equipment cleaning or maintenance activities. These wastes are drummed and kept in the drum storage area (400 55-gallon drums maximum capacity), which is maintained outside the 100-year floodplain. The wastes include liquid chelating agents with high pH values, classified as EPA Corrosive - D002, and solid sludge residues from cleaning primary liquor storage tanks, including nitriles and free cyanide (1-3%), classified as Reactive - D003.

3.4 FACILITY REPRESENTATION

In order to better assist the Audit team with its activities, the facility made available the persons listed in Table 3-1 to answer questions, identify and provide documentation, and generally assist the team in its efforts.

Table 3-1

Facility Representation

Employee Name	Facility	Title
Jeremiah B. McCarthy	W.R. Grace & Co. Nashua, NH	Plant Manager
Lauchlin V. Hines	W.R. Grace & Co. Nashua, NH	Assistant Plant Manager
William J. Pasko	W.R. Grace & Co. Nashua, NH	Technical Manager
Roderic McLaren	W.R. Grace & Co. Lexington, MA	Manager of Regulatory Services
Mark Stoler	W.R. Grace & Co. Cambridge, MA	Environmental Counsel
James J. Todd	W.R. Grace & Co. Nashua, NH	Safety Director
Eileen E. Conley	W.R. Grace & Co. Nashua, NH	Environmental Engineer

4 HAZARDOUS MATERIALS RELEASES*

4.1 NO. 5 REACTOR RELEASE - 8/5/88

The escape of hydrogen chloride from the No. 5 Reactor caused a release of about 108 pounds of Hydrochloric acid (HCl). Approximately 3,700 persons were evacuated from off-plant locations and 51 people were evaluated at local hospitals. One person was kept overnight for observation; the rest were immediately released. Although this quantity of material apparently did not cause multiple injuries, there was potential for greater harm. The release caused real concern and awareness among the community.

HCl was released into the atmosphere primarily due to failure of the 8-inch butterfly valve on the No. 5 Reactor in Plant #1, during the addition of phosphorous trichloride (PCl_3) to the process. Additional release occurred while abatement was underway for the initial problem.

To prevent re-occurrence of this failure, the plant has replaced the 8-inch manual butterfly valve with an 8-inch Teflon lined, butterfly valve and has installed a second in-line scrubber and a manometer to check pressure, or vacuum in the reactor exhaust vent to the scrubber.

The long-term program includes installation of a vacuum sensor in the exhaust vent to continuously monitor pressure, and an interlock with the PCl_3 inlet valve, in order to prevent flow of PCl_3 to the reactor if less than a 2-inch vacuum pressure is available.

Prevention observations by the Audit team for the No. 5 Reactor include the following considerations for the Grace facility:

- o Investigate the installation of a "Hammer" line blind in the vent line to augment the 8-inch butterfly valve, or an equivalent backup device to assure positive closure.
- o Consider inclusion of a positive lockout valve for material inlet when the 8-inch butterfly valve is open.
- o Pressure test the unit before adding chemicals to assure tightness and no leaks.
- o Interlock the pressure/vacuum recorder to chemical addition and to an alarm, and install a continuous monitoring vacuum gauge with a readout in the control room. A manometer readout, located where it can be continuously monitored during the critical cycles of operation, should also be considered.

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* Please refer to Appendix C, D and E for additional information about the releases described in this Chapter.

- o Consider installation of a product weight indicator such as a load cell or a level indicator for this reactor. This would provide a more accurate measure of the reactants and further reduce the possibility of an accident.

- o Color code and label the incoming chemical lines to the reactor.

- o Provide a positive means of assuring that the agitator is functioning before chemicals are added.

- o Remove paint from the sight glass or blank off the sight glass if appropriate. Painted glass on a reactor is not an acceptable safety practice and does not allow for visual observation of the process.

- o Perform an in-depth hazards review of the No. 5 Reactor and its operations. The major focus of the review would be intrusion of water and accidental mixing with PCl_3.

4.2 AMMONIA RELEASE - 4/6/88

The Operator did not get a signal to indicate that the ammonia scrubber valve was incorrectly set and a valve to atmosphere remained opened. Even after the error was discovered, the Operator became distracted and left the critical valve open for approximately 10 minutes before reacting to the accidental release.

Prevention observations for the April 6, 1988, ammonia release are listed below:

- o Consider installing an alarm system to indicate when a bypass or atmospheric vent is incorrectly left open.

- o Study the feasibility of installing a system for automatically knocking down exhaust fumes when these fumes are accidentally vented to the atmosphere.

- o Research the possibility of including a backup system for monitoring critical valve settings.

- o Review operating procedure for venting to the atmosphere in case of failure of the primary control system. An alternative would include manual bypass to a secondary scrubber.

4.3 HYDROCYANIC ACID (HCN) RELEASE - 3/15/88

During the process of transferring HCN to the #4 holding tank on the roof of Plant #1, a leak occurred at the flange on the bottom of the hydrocyanic holding tank. Because of an incorrect reading from the tank differential pressure (DP) cell, the operator investigated and found leakage around the DP cell flange at the bottom of the holding tank. While the amount of leakage was relatively small (about 30 lbs), the potential existed for a far greater quantity to escape since the holding tank above the leaking flange gasket contained significant amounts of HCN. The leak was detected through both indication of a weight change in the process vessel and through a fixed point HCN detector alarm. The response and mitigation of the accident by Grace were prompt. To prevent future releases, the holding tank system has been removed and replaced with a three valve system of feed, wash, and nitrogen purge.

Audit team prevention observations are listed below:

- Study the possibility of reducing quantities of HCN used, especially in areas where bottom outlets and flanges exist.

- Investigate the possibility of replacing other critical holding tank systems with the three valve option of feed, wash, and purge.

- Determine the possibility of eliminating all but the most vital flanges. Replace non-critical flanges with welded connections.

4.4 SODIUM CYANIDE (NaCN) SOLUTION RELEASE - 1/16/88

A NaCN leak occurred from a flange at the pump near a NaCN storage tank. The bolts on the flange were loose and apparently had not been tightened by the maintenance crew.

Railroad personnel, who were delivering bulk chemicals to the plant, asked about the spill and roped off the area. Upon hearing that cyanide had leaked, they took it upon themselves to notify the local fire department without properly coordinating the notification with on-site response personnel. Very little NaCN did in fact leak and the incident was not a serious one. The potential, however, existed for a much greater spill.

Audit team observations regarding this release include:

- Pressure testing with water, air, or nitrogen of any newly installed, recently replaced or repaired system, prior to chemical introduction is important. Pressure testing minimizes the potential for leaks, especially for systems using toxic, corrosive, reactive or flammable chemicals. Grace personnel should review their procedure for recommissioning equipment used for hazardous material service.

- Ensure well-defined and maintained systems of communication between Maintenance, Operations, and Response personnel. Poor communications between these groups has traditionally been at the root of many chemical industry incidents. In all cases, initial responsibility remains with Operations personnel to ensure that all equipment is tight and secure before chemicals are introduced, valves opened or pumps started. Communications and release notification procedures need to be reviewed.

- Evaluate lock-out/tag-out procedures of critical valve systems. Currently, only tag-out is used for many critical systems.

4.5 NITROGEN OXIDE (NOx) RELEASE - 6/6/87

Iron filing residue from raw material charges had settled out in the piping above the discharge valve on a process vessel. When the gasket on the valve failed, it allowed the escape of 400 gallons of nitric acid solution which reacted with the iron filings. This resulted in the release of approximately 11 pounds of NOx after containment. The on-site emergency response teams responded promptly and knocked down the vapors while diluting the process batch using the plant fire hose system. No injuries, on- or off-site, occurred. However, some adverse publicity was generated toward the plant in the local press and the incident had the potential for greater harm.

The discharge piping and valving from the vessel have been modified to minimize space for iron filings to accumulate in the area of a gasketted flange. The flanged section and shutoff valve at the bottom of the reactor have been removed. This will reduce the possibility of a local reaction taking place.

Increased agitation during the reaction phase has also been instituted to ensure proper mixing and a complete reaction.

The Audit team observed that Grace should:

- o Locate flanges and valves as close to the vessel as possible and wherever feasible to minimize dead ending of material. This is also applicable to Tee take-offs from main-line piping.
- o Minimize the number of flanges used wherever possible to lower leak potential.
- o Institute a formalized periodic gasket renewal and changeout program.
- o Consider the use of a "Super" gasket such as a flexitallic gasket at all critical locations.
- o Investigate the use of "state-of-the-art" variable spray nozzles on fire hoses for improved "knocking" down of vapor clouds during emergencies.
- o Study the use of interlock valves to prevent material additions for this process without agitator operation. This is appropriate in all systems where separation or violent reaction could occur.

5 HAZARDOUS CHEMICALS AND TOXICOLOGY

Although the Grace facility uses and produces a large number of chemicals, the Audit team concerned itself primarily with the hazards associated with the four chemicals described in this section in terms of their toxicological impact. In the event of a release or other incident, these are considered to be the chemicals in use with the most potential for harm to health and the environment.

5.1 HYDROGEN CYANIDE (HCN)

HCN is a colorless liquid, miscible with water, and characterized by a faint bitter almond odor. The boiling point is 78.3°F at one atmosphere. The liquid is lighter than water (sp.gr. 0.688 at 68°F) and the vapor is slightly lighter than air (sp.gr. 0.947 at 88°F). The flashpoint (ASTM-D56) is 0°F and HCN vapor/air mixtures are flammable from 6 to 41 percent HCN by volume.

HCN is highly toxic via the inhalation, ingestion, and skin absorption exposure routes. It is a true protoplasmic poison that combines in the tissues with oxygenation enzymes, interfering with the transfer of oxygen to the cells, including the heart and brain. Acute symptoms include headache, dizziness, a feeling of suffocation and nausea. The OSHA Permissible Exposure Limit (PEL) is 4.7 ppm for a fifteen minute exposure and the lowest published lethal concentration (LCL_0) for humans over a 10 minute exposure is 178 ppm. This concentration would be lethal without emergency medical attention and the administering of a cyanide antidote.

HCN is a Class A poison. It is fast acting and can cause rapid death at low exposures. Dangerous concentrations of HCN may be present without causing warning or discomfort because the weak odor is neither irritating or obnoxious.

5.2 PHOSPHOROUS TRICHLORIDE (PCl_3)

PCl_3 is a clear, colorless, fuming liquid with a boiling point of 165°F. The liquid is denser than water (sp.gr. 1.574 at 70°F) and the vapor is much denser than air (sp. gr. 4.75 at 70°F). PCl_3 is an extremely reactive chemical reacting vigorously with water or acids evolving highly toxic hydrogen chloride gas.

PCl_3 is highly toxic via the ingestion and inhalation exposure pathways and highly irritating to the skin, eyes and mucous membranes. The OSHA time weighted average (TWA) for PCl_3 is 0.5 ppm.

5.3 ANHYDROUS AMMONIA

Anhydrous ammonia is a very water soluble, colorless gas with an extremely pungent odor. The gas may be liquefied by compression; it is typically stored at ambient temperature at 150 to 175 psig. As a liquid, ammonia is less dense than water, (sp.gr. 0.817 at 32°F) and the vapor is less dense than air (sp.gr. 0.6). Mixtures of ammonia and air are flammable at ammonia concentrations of 16 to 25%.

Ammonia is a powerful irritant to the eyes and mucous membranes of the respiratory tract. Acute symptoms include irritation of the eyes, conjunctivitis, swelling of the eyelids, coughing, and vomiting. The OSHA Time Weighted Average (TWA) is 50 ppm.

5.4 SODIUM CYANIDE/SODIUM CYANIDE SOLUTIONS (NaCN)

NaCN is a white, crystalline powder with a specific gravity of 1.60 at 72°F. The solid is readily water soluble.

NaCN, cyanide dust, and cyanide solution are toxic via the inhalation, ingestion and dermal contact exposure routes. The OSHA time weighted average (TWA) is 5 mg (CN)/m^3. Toxicity by ingestion as given by LD_{50} is below 50 µg/kg.

Employees, on- and off-site emergency responders, planners, and the community should be thoroughly familiar with the quantities, locations, and health effects of the chemicals listed in this section. The chart in Table 5-1 lists the chemicals and storage capacities for the largest volume hazardous chemicals at the facility.

Table 5-1

CHEMICAL STORAGE FOR THE THREE MOST HAZARDOUS CHEMICALS

HAZARDOUS CHEMICALS	STORAGE CAPACITIES
Hydrogen Cyanide	30,000 gallons 30,000 gallons
Phosphorous Trichloride	6,000 gallons
Anhydrous Ammonia	3 x 30,000 gallons

6 HAZARDOUS CHEMICAL STORAGE AND HANDLING

6.1 STORAGE AND HANDLING OF HYDROGEN CYANIDE (HCN)

One of the key areas of concern for the Audit team was an assessment of the storage and handling of HCN at the W.R. Grace facility. The following sections provide an in-depth examination of each of the critical storage vessels, and the handling and pumping procedures followed for HCN as observed by the Audit team.

6.1.1 Storage

Overview of facility operations revealed that W.R. Grace has reduced the total HCN storage capacity at the facility from over 100,000 gallons to a present capacity of (60,000 gallons) divided equally among two storage tanks designated as A and B. When constructing a new more conservative storage system, the facility took the opportunity to install new piping, pumps, and tank monitoring instrumentation. Further HCN capacity at the facility is provided by five railcars, each with a 20,000-gallon capacity. These cars are typically parked at the plant. The plant operates a fleet of 31 cyanide railcars whose primary function is delivery of HCN to the plant site from suppliers.

6.1.1.1 B HCN Storage Tank

The B Storage Tank (nominal capacity of 30,000 gallons) is a high quality installation. It is well-designed and constructed and was located on-site within the last 2 years. It is an ASME code vessel, with no bottom outlet, fully insulated and placed within a partially below-grade concrete dike enclosure. The safety features of this system were reviewed both in the field and through the use of process flow diagrams.

The tank is padded and purged with nitrogen from a dedicated nitrogen tank. It is maintained under a nitrogen blanket with nitrogen circulated to all tank ports. A scrubbing system continuously circulates caustic through a venturi, removing HCN vapors from the storage tank vent system. The venturi scrubber also helps maintain the tank under a slight vacuum. The system operates from an electric driven pump without emergency power backup. If power were lost for an extended period, the HCN tank could overheat and create excessive vapor pressure. There is space maintained equivalent to one storage tank in an on-site HCN railcar, kept empty in case the tank develops a leak and needs to be pumped out. The tank is maintained at a maximum of 46°F by circulating the HCN through a circulating fluid coolant heat exchanger using a submerged pump. The three submerged pumps are a redundant system and offer back up for circulation, cooling and pump-out.

One "StaTox" fixed HCN monitor (set at 10 ppm) is mounted immediately above the vessel. This continuous ambient monitor is 1 of 17 in place throughout the plant, all of which are tied to a central control panel. The HCN storage tank is equipped with three independent level sensors: a bubbler meter, a capacitance meter, and a high-level alarm. The storage tank is sampled several times a week for color, stability, and contaminants. Low-pressure rupture discs are designed to discharge into a diked area so that liquid entrainment would be confined. A discrepancy of 10 percent was noted between the two separate level indicators for the storage tank. This discrepancy was discussed with plant personnel, who indicated a willingness to evaluate and correct the problem. In addition to the two gauges, a backup high-level alarm is in place for the tank.

The potential for a major HCN spill or vapor release would be as a result of a large leak in the tank or a "run-away" polymerization of HCN. Polymerization of a tank would result in high temperatures and the possible vaporization of liquid HCN out of the emergency rupture disk. However, emergency acid addition facilities are in place at the facility in case the HCN begins to lose stabilizer. The potential for a catastrophic event is minimized at the Grace facility through safety devices, redundancy, and surveillance.

Observations:

Several modifications to the B HCN storage vessel would serve to enhance the safety of the storage system and improve the mitigation response, should a release occur. These observations are itemized below:

- The facility could install an additional water gun, capable of 400-600 gpm, with a fog nozzle, to be located in the area south of the storage tank. The additional water gun, in combination with an existing gun on the west side of the tank, would result in enhanced coverage of the tank area during a release. In the event of either a catastrophic tank failure or a high volume release from the tank emergency vent stack (which discharges into a diked well surrounding the HCN tank), the additional water coverage would be used to remove HCN vapor from the air and to dilute liquid phase HCN which may be released from the tank. A deluge system should also be considered.

- Grace should consider providing for means to ignite HCN if the water gun system fails to mitigate the vapor cloud. When HCN burns, it produces water, nitrogen, and carbon dioxide. Flare pistols are available at the site for this purpose, but a spark ignition system should be investigated. A review of the emergency procedures for igniting HCN is desirable.

- Grace should continue close analytical surveillance of the HCN storage tank contents. Samples should be taken at least three times a week to assure product quality and stability. This is necessary to provide assurance that water from line washings is not excessive. Excess water can cause HCN instability and a potential release. Sample boxes should be used when drawing samples to avoid employee exposure. These procedures should be clearly documented in the standard operating procedure (SOP) manual.

- Grace should look into providing containers of stabilizer acid at the emergency addition station to enable faster mitigation.

- Installation of closed circuit television monitors and an additional P/A speaker for the HCN storage area should be considered. Such a system would be monitored in a central control room, allowing operators to accelerate their response to problems and emergency situations.

- Installation of additional "StaTox" HCN monitors in the HCN storage area. These could be located opposite existing continuous ambient HCN monitors in order to provide redundancy and better vapor detection in case of a wind shift.

- Installation of either a fixed or portable backup power supply for the HCN tank scrubbing system pump. Backup power would ensure the continuous scrubbing of the storage tank vent and prevent the release of HCN in the event of power interruption or failure.

- Purchase of a large portable electric generator that could operate the HCN tank circulation pump and refrigeration unit should be considered.

- Installation of warning lights and beacons to be activated during HCN railcar unloading operations would serve to augment the small stand-up warning sign presently in use.

- Continuation of the maintenance of at least one empty HCN railcar available for filling from a potentially leaking HCN storage tank.

- At a minimum, gauges should be routinely checked, recalibrated, and replaced when necessary.

- A detailed process hazards review of the HCN storage tank area should be considered.

6.1.1.2 A HCN Storage Tank

The A HCN Tank (nominal tank capacity of 30,000 gallons) was placed into service within the past 3 years. The tank is very similar in design to the B HCN storage tank, being ASME code with no bottom outlet and equipped with a partially below-grade diked containment area. It is nitrogen-blanketed, fully-insulated, cooled, with a HCN scrubber on the tank vent line. The vessel is also equipped with one "StaTox" HCN monitor and three independent level sensors. The A HCN Tank is similar to the B HCN Tank except that it is shorter and stubbier due to spacing constraints.

The observations outlined in reference to system safety for the B HCN Tank in Section 6.1.1.1 apply to the A Tank as well.

6.1.1.3 HCN Tank Cars

Thick steel tank cars each having a nominal capacity of 20,000 gallons of stabilized liquid HCN with very low-water content are shipped to the plant by rail. W.R. Grace leases a fleet of 31 tank cars. Most of the tank cars are less than 2 years old. For safety, it is extremely important that there is no significant intrusion of water or other contaminates. If contamination occurs, it could destabilize the HCN and this could lead to a vapor cloud release. The highest potential for water intrusion is at the source and during unloading operations. Mechanical integrity of cars is also important for preventing a tank rupture and chemical release.

Observations:

- Grace should perform a process hazards review of all aspects of car loading in order to assure a stable HCN product in the car at all times.

- The facility should continue to review procedures for mechanical checking of cars and internal inspections and testing.

6.1.1.4 HCN Railcar Unloading Area

The HCN unloading system for 20,000-gallon railcars was reviewed through a study of the SOP and by inspecting equipment and procedures at both the A and B railcar unloading stations.

Railcars are positioned at the unloading stations, brakes are set, and wheels are chocked to prevent accidental railcar movement during the connection of piping and flexible metal hose. To reduce accidental bumping or movement of the offloading car by another car, rail engine or trackmobile, the incoming rail switch is locked in the off position. The key for this rail switch lock is kept with the person conducting the unloading operation.

Because neither of the unloading locations is located at a dead end of the rail spur, there is opportunity for an accidental intrusion and bumping of the car. The geometry of switches and track at the A location (which also serves the NaCN loading dock) is such that it is possible for the operator to lock-out the wrong switch.

W.R. Grace should consider the following:

- Revision of the unloading procedures and check list to include specific switch lock-out. Formalize written standard operating procedures to include specific switch-out routines.

- Installation of derails for lock-out at the north ends of both the A and B unloading positions.

- Study of these areas to determine the need for diking. The topography of the A unloading area slopes gently down towards the Merrimack River, whereas the B area is somewhat protected by a berm between the tank cars and the river. Installation of a diked pad with a collection sump at both stations would greatly minimize the surface area available for HCN volatilization and provide additional protection to the river in case of a catastrophic railcar failure or a release during unloading operations.

6.1.1.5 HCN Pipe Connections

The first step after opening the dome cover of the railcar attachment area is to remove the pipe plugs in the car unloading angle valves. This is a potentially hazardous step because if the angle valve is not in the "closed" position when the plug is unscrewed, HCN could escape to the atmosphere.

The facility should consider the following procedures:

- o Check for valve closure by pulling with a valve wrench before removing the pipe plug.
- o Measure the distance from valve handle to valve body before removing the pipe plug. This distance will be at a minimum when the valve is in the closed position.
- o Assure that the pipe plug is removed slowly and cautiously. If there is any indications of leakage, the plug should be immediately re-tightened. In any case, the person wearing protective equipment should always be prepared to close the valve.

The second step is to screw the pipe nipple into the angle valve using a remote operated safety shut-off valve. Too long a pipe-thread section on the nipple creates a potential for leaks since it allows the end of the nipple to strike against the internal shoulder of the angle valve before the threads themselves have made a tight seal.

- o Grace should take steps to ensure that none of the pipe nipples used have threaded sections which are too long.
- o After connection of the entire unloading piping and flexible metal hose system, the whole system must be pressure tested in order to avoid HCN leakage. According to Grace, this procedure is routinely followed.

6.1.1.6 HCN Product Unloading

Nitrogen pressure on the vapor space of the HCN car causes transfer of liquid HCN to the storage tank. As the storage tank level rises, HCN vapor moves to the caustic vent scrubber. When the last amount of liquid HCN leaves the car, a surge of HCN and nitrogen flows to the storage tank which could result in a temporary overload of the caustic scrubber. Persons in the vicinity of the scrubber vent may be exposed to HCN vapors.

Field observations by the Audit team are listed below.

- o Grace should continue the practice of checking to make certain the vent scrubber is functioning properly and that the percent caustic remains above 12 percent.
- o Red flashing lights should be installed to inform people that HCN loading is underway.
- o Additional signs should be installed to warn people to stay away during unloading operations.
- o Increased policing should be considered to assure that unauthorized visitors or personnel not directly concerned in the unloading operation do register with the control room and are prohibited from wandering through the area.

6.1.2 HCN Handling and Transfer

HCN is transferred in stainless steel piping from the storage tanks to the individual processes by submerged pumps in the storage tanks. The HCN delivery piping systems are designed either on a loop circuit back to the tank or as a one-way system to the process areas with a water wash and nitrogen blow back sequenced automatically. Both systems avoid leaving HCN stagnant in the piping system for extended periods. This prevents destabilization or freezing. It is important that all flanges and valves remain tightly secured at all times, and that there is no opportunity for process or reactor material to back up into the storage tanks and initiate a runaway polymerization reaction.

6.1.2.1 HCN Feed System

W.R. Grace has recently installed a circulating loop HCN feed system which conveys HCN to Plant #1 and to individual reactors within the facility from the HCN storage tank. HCN is introduced to individual reactors through flow meters. Rotometers are also used as a redundancy backup device. The circulating loop system allows Grace to pump HCN at low pressure to the various reactors. This is in contrast to a system that charges a substantial amount of HCN to a reactor system from remote storage thereby requiring substantial pressure.

The existing design of the HCN circulating loop does not allow for stagnation or dead-ending of HCN lines, thereby reducing the potential for polymerization and subsequent over-pressurizing of piping. The lines branching off the loop system are sloped, allowing HCN to drain and further preventing HCN stagnation.

The circulating loop HCN feed system services all of Plant #1. The system replaces an older system of HCN weigh tanks and hold tanks previously used for introducing HCN into reactor vessels.

The remainder of the facility operations depend on the older, one-way design HCN feed systems. Grace is considering installing the circulating loop system plant-wide.

Observations:

- o Grace should consider implementing a schedule for installing a circulating loop HCN feed system in all processes throughout the facility.

- o A process hazard review on each existing system should be conducted in order to assess the following:
  - minimized flange connections;
  - minimized valves;
  - ideal locations for HCN detectors;
  - measures to prevent backflow of reactor material to the storage tank;
  - maintenance;
  - emergency shutdown in case of leak; and
  - release mitigation.

- o A reassessment of pipe routing and protection of all HCN piping from external damage should be considered. This assessment could include the following:
  - Determination of whether all HCN pipes are at the highest possible level over roadways and whether all pipe supports are adequately protected from accidental impact.

- o A periodic changeout of critical gaskets to guard against age deterioration or leaks should be considered. The new Durco Teflon gasket with metal inner ring currently in use at the facility should serve to prevent massive gasket failure. However, this type of gasket requires careful evaluation since it is not very resilient. The flanges must have good alignment, they must be parallel, and uniform torquing is required.

- o All flanges should be covered in the vicinity of work areas. Some flanges were observed uncovered.

6.1.3 General Safety Features

6.1.3.1 HCN Vapor Detectors

Vapor detectors are critical to early indication of a leak. The "StaTox" HCN detector currently in use would sound an alarm for a detected leak in the vicinity of the monitor. A large or major leak would activate several "StaTox" HCN monitors simultaneously.

Observations:

- o Additional "StaTox" HCN detectors should be installed throughout the plant, at carefully planned and appropriate locations.

- o Standardization of routine maintenance and calibration is necessary.

- Grace should perform a process hazards review of the procedure, plans, and actions to be taken upon sounding of an alarm. This would include representation of what pumps are to be shutdown, by whom, and should include an analysis of other vapor mitigation actions to be undertaken such as flaring or water dilution.

6.1.3.2 Integrity of Overall HCN Systems

It is important that all equipment containing or used for the transfer of HCN be metallurgically sound. Of equal importance is the proper functioning of redundant instrumentation and interlocks.

Observations:

Grace should consider the following:

- Undertake periodic inspections of tank interiors to check for solids build-up, corrosion, pitting, and impingement erosion to prevent tank leakage. This should be undertaken by a materials specialist.

- Keep all critical instrumentation in proper operating condition. This includes at a minimum: load cells, level gauges, level alarms, temperature recorders, alarms, and flow meters.

6.1.4 First Aid and Medical Treatment for HCN Exposure

The toxic effect of HCN is the inhibition of the oxidation process in body cells by restricting oxygen transfer from the blood to body tissue. Poisoning can result from breathing HCN vapors, absorbing them through the skin, or by ingesting liquid cyanide.

It is extremely important to prevent leaks or exposure to cyanide vapors or liquid solutions. However, the potential for a leak always exists. A leak creates the need to administer immediate treatment to individuals or a group of persons for cyanide poisoning. The key to successful treatment and full recovery is prompt treatment.

No more than 4 minutes elapsed time should occur between exposure and initiation of treatment. A longer time period jeopardizes recovery of the exposed individual. This is one reason why location, number, and proper operation of HCN monitors are extremely important. It is also important that all workers in the HCN areas "know" and recognize the odor of HCN, be familiar with a standard, and understand the "sniff test." A brief inhalation of 300 ppm HCN or more in air can result in rapid loss of consciousness and death unless first aid is immediately and effectively administered.

In response to leaks at the plant, Grace plant personnel who have been trained and have practiced the procedure during simulation exercises, generally administer first aid using Amyl Nitrite and oxygen. This is an interim measure until medical help arrives. Medical treatment can involve injections and more sophisticated measures which must be administered by qualified medical personnel. Even if a nurse or doctor is immediately present, first aid is sometimes administered while preparation is made by the medic to provide more sophisticated treatment. Rapid initial first aid may be sufficient to save lives.

Observations:

Grace should consider the following:

- o Emphasize the importance of immediate and proper first aid for cyanide exposure through training sessions and safety meetings.
- o Study the need for and use of the amyl nitrite antidote and oxygen resuscitation by those responding to an exposure.
- o Station additional antidote and resuscitation kits in accessible places to help reduce the time from exposure to treatment.
- o Develop a schedule for installation of additional "StaTox" HCN detectors.
- o Increase the number of available portable Monitox detectors, and encourage routine use of this equipment.
- o Maintain air monitoring even while wearing air masks because of vapor ingestion through skin.
- o Continue to periodically perform "man-down" drills for HCN exposure to check for response time, ability to respond, and first aid skills. Use time and video tape drills for review and discussion.
- o Perform periodic larger scale field simulations to evaluate emergency response and proper actions by personnel, including involvement of neighboring residents.
- o Review all "Buddy" positions and areas to ensure proper use and coverage.
- o Provide periodic review of the HCN "Sniff Test" and associated procedures to be followed upon recognition of a release.

6.2 STORAGE AND HANDLING OF PHOSPHOROUS TRICHLORIDE (PCl_3)

PCl_3 storage capacity at the facility is limited to one 6,000-gallon tank housed in a diked building with a chain link fence serving as the building walls. Since PCl_3 is water-reactive, extreme care must be exercised in its handling and storage to assure that it never comes into contact with water. Grace should consider fully enclosing the storage area to further minimize the potential for precipitation and water accumulation within the diked area.

6.2.1 Storage

PCl_3 is stored in a 6,000-gallon thick-walled, carbon steel tank situated over a concrete pit, under a roofed area with open sides. The tank is not a pressure vessel and does not conform to ASME code. A second empty tank is maintained under a nitrogen blanket beside the primary tank for use as a transfer vessel in case of a leak, for repairs, or for routine inspection and maintenance. Neither tank has a bottom outlet.

The major environmental and safety concern is to prevent leaks or contact with moisture in the air or with water. Contact with moisture would produce hydrogen chloride gas.

Although the PCl_3 storage area and scrubber water drain are diked, they are located inside the enclosed storage area. At a minimum this drain should be covered and the containment area sloped in order to insure that water will always flow away from the storage area. This safety measure should be designed to accommodate pluggage of the drain line.

Water accumulation was observed by the Team during the audit.

Observations:

- Grace should at a minimum, cover up the scrubber water drain, and slope the containment area in order to insure that water will always flow away from the storage area.

- The PCl_3 scrubber water overflow discharge should be directed outside the PCl_3 storage area to preclude the possibility of water contact with a PCl_3 release.

- Grace should develop an action plan for implementation in case of a large PCl_3 spill in order to avoid or mitigate a serious environmental incident. Current procedures do not address this possibility in sufficient detail.

- A process hazards review of the total PCl_3 system, including unloading, storage, and transfer to process, should be conducted.

6.2.2 Handling Observations

- The facility should consider restricting traffic in the immediate area during unloading of tank trucks to the storage tank through use of safety ropes or barricades.

- Grace should establish procedures to minimize the opportunity for truck movement, in addition to the wheel chocks already being used, while PCl_3 transfer is underway.

6.3 STORAGE AND HANDLING OF AMMONIA

The Grace facility has two 30,000-gallon anhydrous ammonia storage tanks. These installations and the associated ammonia piping in the plant are relatively new. Aqueous ammonia is generated during the majority of the saponification reactions conducted in the plant and in the neutralization reaction of the nitrile process effluent, prior to incineration. The dilute aqueous ammonia streams are distilled in the ammonia distillation tower, producing 97 to 99 percent anhydrous ammonia. This product is stored in three storage vessels and most of it is sold.

6.3.1 Storage

High strength (in excess of 95 percent) ammonia is stored in two 30,000-gallon pressure tanks equipped with relief valves. Low strength ammonia is stored in several atmospheric pressure tanks. The ammonia tanks are not diked for spill containment.

Observations:

- o The facility should consider installing a dike around the two high-strength pressurized ammonia tanks in order to minimize the affected area in the event of a large leak or spill. This would also reduce potential for ammonia evaporation and contamination of the river. This safety measure should be considered given the unusual proximity of the plant to populated areas and to the Merrimack River.

- o Grace should consult with the Ammonia Institute and/or study potential discharge from the relief valves mounted on top of the tanks. This study should include evaluation of height of discharge, and installation of a scrubber or other control device. The facility should determine whether fire hoses with spray nozzles should be used to reduce vapors in case of a severe leak.

- o Grace should conduct a study to determine if an emergency flaring system should be installed on the storage tank vent lines.

- o A hazards analysis of the storage system should be considered.

6.3.2 Handling

A tall distillation column at 200 psig is used to enrich the low-strength ammonia to a high concentration suitable for loading and shipping in railroad tank cars.

Observations:

Grace should consider the following:

- o Perform a process hazard review on the ammonia distillation column. The column operates at 200 psig. Even a relatively small opening or leak, especially in the top section of the tower, could carry vapors off-plant without their being detected in the vicinity of the column.

- o The tank car being loaded should be protected with a locked derail.

- o Grace should emphasize routine and preventive maintenance on all aspects of the distillation column, storage tanks, pipelines and car-loading systems.

6.4 STORAGE AND HANDLING OF SODIUM CYANIDE (NaCN)

NaCN is produced in several of the caustic soda scrubbers as a by-product, and is also produced in the plant as a salable product. The NaCN is loaded into thick, steel-walled railroad tank cars for transfer from the facility.

6.4.1 Storage

A new tank and dike system is being constructed for NaCN storage. The plans call for a substantial upgrade of the NaCN storage facility. The existing system was observed to be substandard and in need of repair.

Audit team observations include the following:

- o Grace should complete the new tank and dike system as rapidly as possible.

- o The current NaCN storage tank has a low curb to direct leakage or overflow to a drainage system. This drainage system was seen to be covered over with soil and needed cleaning in order to avoid possible run-off and contamination of adjacent areas. When the new facilities are completed, the existing facility should be removed and decontaminated.

- o Grace should avoid situations which serve to deplete the slight excess of free caustic soda in the solutions so as not to produce hydrogen cyanide gas. A minimum pH of 12 percent should always be maintained.

- o A study should be conducted to assure that no opportunity exists for spillage or run-off to mix with acidic material in the sewer system and elsewhere on or off plant property.

6.4.2 Handling

NaCN is a Class B poison and can be lethal in small quantities if it enters the body. NaCN solution can be absorbed through the skin from contaminated clothing or from direct contact between the solution and the skin. The main concern in handling the material is the danger posed through accidental mixing of NaCN solution with acids, enabling generation of toxic hydrogen cyanide gas.

Observations:

- During loading of railcars with NaCN solution, the car should be positively protected from accidental bumping or movement which could cause disconnections in the loading hoses. This could result in a leak or spill.

7 GENERAL PROCESS AREAS

7.1 KETONE AMINO NITRILE (KAN) PROCESS

The KAN process area is one of the newer installations at the plant and appears to be well designed and located. Hydrogen cyanide (HCN) is supplied through a take-off line from the HCN loop originating at the B HCN storage tank. After the HCN has been charged to the reactor, the HCN line is blown back with nitrogen. The line is sloped for proper drainage which reduces the possibility of an accidental release of residual product.

Observations:

- o Periodic checking of all HCN line slopes for proper drainage and avoidance of low spots should be part of routine standard operating procedure (SOP).

- o The proper operation and sequencing of the agitator in the reactor during chemical addition should be emphasized in the SOPs. The agitator must always be running, with mixing taking place before chemicals are added. It may be useful to consider installation of interlocks along with power or amperage meters.

- o An interlock or other equipment should be considered for installation to ensure that the scrubber is fully functional before any operation can begin.

- o The KAN reactor is on load cells so that chemical additions can be verified by weight. This requires flexible connections. The alignment of some of these appear to be at the limit of the bolt guides and this condition should be checked and corrected.

7.2 IMINODIACETIC ACID (IDA) AREA

The process area itself is located inside a building. This has the advantage of minimizing the danger of freeze up of the solutions. There is, however, a disadvantage of potential vapor accumulation. Product storage tanks are outside and are not diked.

Observations:

- o Building ventilation systems should be checked to establish if they are adequate to control vapors in case of a leak.

- o Plans for action should be available and fully understood for responding to severe leaks of chemicals.

- o An additional "StaTox" HCN detector should be located in the IDA building.

- o A process hazards review on the addition of HCN to the reactors should be performed. This would include study of interlocks and fail safe systems.

7.3 NITRILOTRIACETIC ACID (NTA) AREA

The NTA area has a HCN feed system that minimizes the quantity of HCN in the area and reduces the potential for a chemical accident. It consists of a pipeline supplying HCN from the storage tank to the reactor, with an automatic wash back of the HCN line to the tank with water, as well as a purge back to the tank with nitrogen.

The reactors and other equipment are inside a building, in a set-up similar to the IDA area. The operational control room is 1960's vintage. The technology used is outdated and less safe than the sophisticated solid-state controls presently available.

Observations:

- Grace should consider interlocking the HCN feed to assure the correct sequence and amount of chemical.
- Additional "StaTox" HCN detectors in appropriate locations in the building should be considered.
- Grace should evaluate additional control room modifications beyond the upgrades completed. Modernizing and upgrading the control room equipment will minimize operator error, while enhancing safety, mitigation, and accident prevention activities.

8 RELEASE PREVENTION AND ENVIRONMENTAL COMPLIANCE

8.1 SAFETY MANAGEMENT PROGRAMS AND EQUIPMENT

8.1.1 Process Hazards Review

A Process Hazards Review is a formalized method of "looking" for unsafe conditions that could occur. Once identified, appropriate means of prevention and mitigation can be implemented. Methods commonly used are Checklist, Hazards and Operability Studies, What If, Failure Mode and Effect, and Fault Tree analyses.

Observations:

Grace should consider performing Process Hazard Reviews on a periodic basis (at least annually), and with greater frequency in the more hazardous areas. These would be conducted in addition to the reviews undertaken as a result of serious incidents, accidents, or near-misses. An Inspection and Audit team from within the company, as well as an independent group, should be retained to review operating and safety procedures in order to identify potential hazards and suitable remedial action.

Person(s) from outside the facility often see things from a different viewpoint, and may uncover hazards not readily detected by people close to the site or from within the facility. Therefore, Grace should organize an occasional review of the facility and site by one or more outside people in order to benefit from an in-depth study of potential safety and environmental problems.

New, altered, or recycled equipment as well as any equipment which has been out of use for a period of time should be inspected by a committee prior to acceptance for use and startup. The committee would generate written recommendations and appropriate user operating procedures for startup and standard use.

Process modifications and changes can have far-reaching implications beyond the obviously expected. Written approval should be obtained from the Safety Section and upper management prior to any physical change in equipment or changes in operating procedures affecting hazardous materials.

8.1.2 Serious Incident or Near-Miss Reporting and Accident Review

The facility has in place a method of reviewing plant conditions and incidents through daily morning meetings between area supervisors and the plant manager. Any safety or environmental concerns are discussed at this time, and follow-up action is discussed.

Observations:

Grace should investigate and write up all incidents, near-misses, accidents and spills. These reports can be useful for safety meetings, training sessions, and can form the basis for changes in processes, equipment, or procedures. The reports should also be periodically reviewed for any indication of trends, potential equipment deterioration, personnel training needs, or de facto changes in operating procedures.

8.1.3 Unobserved Operations

There are many areas in the different process plants where the operators cannot observe the operations due to congestion (as in Plant #1), or remoteness (as in reactor #5 Control Room, tank farms, etc.). While television monitors are in use for some of these areas, Grace should consider installing additional monitors to allow for continuous monitoring of reactors and other potentially hazardous areas. Use of such monitors allow control rooms to be located away from hazardous or explosive areas.

8.1.4 Equipment Storage

Equipment used in work areas around the plant was seen to be improperly stored during periods of non-use. For example, hoses were lying on the ground (some with rocks and dirty debris in the hose ends) in the hydrocyanic acid rail unloading area and in the phosphorous trichloride and KAN reactor areas. Because of the serious consequences from accidental contamination by some of the chemicals used, it is suggested that hoses, pipes, and other similar items never be left on the ground. This equipment must be properly maintained, temporarily decommissioned, and suitably stored.

Observations:

- o The facility should consider making storage racks available and accessible for hoses and pipes in all user areas. Storage containers and racks should also be made available for other equipment frequently used at specific work areas (e.g., railroad chucks.)

8.2 SAFETY MANAGEMENT PROGRAM AND PERSONNEL

8.2.1 Communications

When hazardous chemicals are inhaled or released, clear, timely, and accurate communication is imperative both on and off the plant. Proper procedures thoroughly instilled into plant employees can often help prevent or mitigate the escalation of small, relatively insignificant chemical incidents into major accidents with potential for on- or off-site injuries and environmental harm.

Observations:

- o Grace should ensure that the Public Address system is clearly audible in all areas of the plant, including the more remote and noisy areas.

- While the head count system of using time cards to account for plant personnel during evacuations is good, the system used to account for visitors, contractors, and non-time card personnel should be upgraded.

- Grace should improve the system for alerting neighborhood residents in case of a vapor release and work to further improve community relations. Such measures will reduce the likelihood of panic in the event of a serious incident.

8.2.2 Contingency Plan and Emergency Response Teams

A contingency plan has been developed to cover response by the two designated Emergency Response Teams to any type of emergency which might occur on the plant. Management has the responsibility for keeping the material in the plan up-to-date. Emergency Response Team members are responsible for keeping current on necessary actions to be taken in case of emergency. The plan includes general instructions on activating an alarm during an emergency, alarm locations, and evacuation procedures. Response team responsibilities are provided, with specific instructions which include the following:

- First aid in HCN poisoning,
- Fire service team procedures,
- Communications and emergency phone numbers,
- Alarm system operations,
- Emergency response equipment,
- Plant preparation for severe storm or flood conditions,
- Press relations,
- Post emergency actions,
- Proper handling of chemical spills, and
- Release and reporting requirements.

Observations:

- A clear record should be maintained of personnel trained and specific training levels achieved. Refresher training should be provided routinely and documented accordingly.

- Site emergencies should be evaluated using a "post mortem" discussion of actions taken, mistakes made, and proposed future action and simulations under similar conditions. Mock emergencies and simulations should be conducted.

- Grace should keep detailed records of all incidents, whether practice or actual, in order to facilitate identification of failures.

- Contractor training in safety and hazardous materials should be expanded in order to reduce accident potential and the danger for Emergency Response Teams who rely on trained personnel for technical assistance operating during a chemical release.

8.2.3 Training and Safety Operations

The plant has formalized a set of Safety Rules and Regulations directed at every employee on the facility. These procedures have been established to enhance personnel safety and improve plant response during an emergency situation. The rules and regulations enable the Emergency Teams to focus on areas of greatest need. The rules contain information on the following:

- Emergency Alarms and Procedures
- Communications Equipment
- Personnel Protection Equipment
- No Smoking Zones
- Buddy Areas
- Pilot Plant Safety Procedures
- Tank and Vessel Entry
- Monitox HCN Detector
- Hot Work Permits
- Tags and Lock-out Systems
- Equalization and Holding Basin Area
- Contractor Area Permit Procedure
- Medical and First Aid
- Chemicals
- General Plant Safety Rules

Training in operations is important at any facility, especially for a plant using extremely hazardous chemicals. The Training Manual for NTA Operators was reviewed by members of the Audit team. It contained time schedules, test levels, outlines of safety and emergency procedures, chemical identification, and equipment operation procedures. This manual was identified as the first in a series of manuals. The other manuals in the series remain unwritten at this time. No specific information was available in several areas, especially regarding: actual use of the manual, numbers of sessions given, attendance, and test results. In general, it was reported that most of the operators relied upon their job experience, which averaged 15 years of experience at the facility.

Re-training is an important part of a safety program. It serves to ensure that all employees understand any changes in procedures and operations, especially resulting from changes in equipment, modifications of their operational ability, or new output requirements. It is important that each employee understands the rationale behind the changes, the reason for each procedure and safety rule, and has an opportunity to provide feedback and engage in discussion about further modifications or procedures.

Observations:

- SOPs should be maintained up-to-date with immediate incorporation of changes in procedures, and periodic reviews should be conducted to ensure that compatibility is maintained between the SOPs and actual practices.

- o Standard Operating Conditions (SOCs) Sheets should always be maintained up-to-date.

- o Grace should incorporate SOP changes into existing training programs.

8.3 SAFETY MANAGEMENT PROGRAMS

8.3.1 Maintenance

Adequate maintenance of all equipment in the chemical plant is crucial to avoiding environmental releases or injury. Preventative and predictive maintenance programs are essential to minimize equipment failures. Timely and planned servicing is desirable as opposed to relying on emergency repair.

Observations:

Grace should consider the following:

- o Promote periodic change of gaskets to reduce and avoid sudden gasket failure.

- o Develop or find improved gaskets for use in critical areas.

- o Minimize the number of flanges used in all systems by welding sections together.

- o Minimize the number of valves and remove unnecessary ones.

- o Apply high-quality preventative maintenance to:
  - pumps;
  - interlocks;
  - detectors;
  - alarms;
  - level and flow meters for temperature and pressure;
  - electric circuit breakers;
  - pressure release valves (sizing should be checked through DIERS - Design Institute for Emergency Relief Systems); and
  - tank, vessel, and pipeline integrity.

8.3.2 Facility Control Rooms

The control centers are normally occupied by two or more persons. Equipment is controlled through instruments with displays of process condition or status on panel boards or computer screens. While none of the control rooms could be categorized as a "Safe Haven" in the sense of a hermetically sealed, air-fed environment, they are located in areas that would permit personnel to conduct emergency shutdown operations under most conditions. Their location facilitates accounting for personnel and enables dissemination of emergency instructions from the control room.

Observations:

- No personnel beyond those assigned to a given area should enter the area without checking into the control room, to sign in or receive a pass for the duration of their stay. This procedure would serve to increase the accuracy of accounting for personnel.

During a tour of the NTA control room, the low-pressure air alarm activated several times. The "acknowledge" button was pressed, and no further action was undertaken. The justification was that another area was using too much air.

- Operators should not accept or be allowed to continue the practice of acknowledging an alarm situation on an on-going basis without initiating a correction.

- A written report should be submitted each time an alarm acknowledgment is made without correction, and reviewed at the daily staff meeting.

- The alarm pressure setting should be adjusted if the present setting is too high for normal operation. As an alternative, the correct pressure could be supplied with supplemental air via a temporary compressor or from another source until the problem can be corrected.

8.3.3 Prevention of Leaks and Vapors

Certain points and sources at the facility are more prone to leaks and chemical releases than others. It is necessary that adequate procedures and equipment be in place and maintained to deal effectively with chemical releases and their resultant vapors, fires, and plumes. SOPs, adequate training, and equipment are necessary to deal with possible incidents, and must be maintained or readily available in all critical plant areas. Typical situations and areas of the plant that would require effective chemical emergency response include the following:

- Scrubber failure,
- Relief valve discharge,
- Rupture disc discharge,
- Excess discharge from vents,
- Gasket failures,
- Hose failures,
- Corrosion or cracking of equipment,
- Faults,
- Pumps and pump seals,
- Packing gland releases,
- Failure of refrigeration and cooling systems,
- Over-filled tanks and reactors,
- Sampling system leaks,
- Explosions or fires, and
- Human error.

Prevention systems in use at W.R. Grace are discussed below.

8.3.4 Fire Fighting and Vapor Suppression

Grace has recently installed a comprehensive red fire pull station and smoke detector system throughout the facility. Activation of these alarms and detectors provides automatic response from the Nashua Fire Department. Green pull stations are located throughout the facility for other emergencies that do not require immediate outside assistance. The alarm systems activate two plant teams who are trained to respond promptly. The site has a 350,000-gallon water storage tank equipped with a backup 1,100 gpm diesel pump in case of electric power failure. This tank and pump system ensures water supply to the hoses for fire protection or vapor suppression.

Observations:

- o Grace should consider installing a pumping system to enable equipment to pump water from the river to fight a major fire.
- o The facility should consider installing deluge systems in certain high-risk areas. These areas could be determined through process hazards surveys.
- o Grace should provide fire hose nozzles with variable positions to enable use in a straight water stream, as a spray, or in a fog pattern. Position settings would depend upon the type of emergency.
- o Grace should consider installing a fixed-water monitor gun with a variable nozzle at the A and B HCN unloading areas.
- o The facility should assist the Nashua Fire Department in establishing a Hazmat team knowledgeable in mitigation techniques specific to Grace. This team would serve to supplement in-house response units.

8.4 EMERGENCY PREPAREDNESS AND PLANNING ACTIVITIES

The Audit team reviewed W.R. Grace's facility emergency response system, public alert and notification procedures, Title III activities, and community involvement philosophy. Team observations are listed below.

8.4.1 Emergency Response Systems

The written emergency plan developed by the plant safety officer contains explicit directions and instructions in the event of a variety of emergency scenarios. The plan is comprehensive and well organized. A recent addition to these emergency procedures is a quick reference manual outlining the protocols to be followed in the event of an actual hazardous materials release at the plant. This manual is in the possession of two supervisory personnel at all times of plant operation

(24 hours per day/7 days per week) to ensure that rapid and correct notification procedures are followed. This action reference manual includes the names and telephone numbers of contact persons at the Local Emergency Planning Committee (LEPC), State Emergency Response Commission (SERC), NRC, and Federal and State Agencies.

8.4.2 Public Alert and Notification Procedures

The plant has two distinctly separate alarm systems. One is dedicated to fire incidents, while the other is to be used for all non-fire emergencies. There are color-coded alarm pull-stations (red/fire, green/non-fire) strategically located throughout the facility. The fire alarm system is tied into the Nashua Fire Department, with an anticipated arrival time of about 3 minutes. The second alarm system, used for plant incidents and emergencies notifies the plant Emergency Service Teams (ESTs), composed of four to seven trained plant personnel. While the EST is responding to the incident, plant personnel must listen for a second alarm which signifies a need to immediately report to designated rallying areas and for on-going announcements over the public address system. These announcements provide further information and instructions.

In the event of an incident with potential for off-site consequences, the following procedures are followed:

- o Plant emergency alarm is sounded;
- o Plant Emergency Service Team(s) respond;
- o Shift supervisors assess situation, notify plant management;
- o Fire Department is notified;
- o LEPC is notified (within 5 minutes of the incident);
- o NRC is notified; and
- o Superfund Amendment and Reauthorization Act (SARA) notifications are initiated.

8.4.3 Title III Activities and Environmental Compliance

The facility has been very active in Title III activities. W.R. Grace management encourages its supervisors to join the Local Emergency Planning Committee (LEPC) in their respective communities. Facility representatives have consistently taken a leadership role in the Nashua LEPC and in the State Emergency Response Commission (SERC). At the local level, Grace personnel participate in plant development and awareness seminars. They cooperate with local fire departments in joint- and plant-sponsored training efforts for spills, fire, and hazardous releases within the plant or in the local community. They are active participants in a Nashua LEPC Subcommittee and have acted as the Chairperson of the SERC Subcommittee.

The facility has responded to SARA Title III requirements, including submission of Tier II lists and a Section 313 report of toxic air emissions, with Confidential Location sheets used for most of the chemicals. The Section 313 compilation was a rigorous effort, costing the company some 1,000 man hours.

While the Audit team investigated the accidental chemical releases discussed in Section 4, the team did not make a determination of Grace's compliance with the emergency notification requirements of Title III and the Superfund statute.

The following sections discuss the Audit team's findings regarding significant environmental compliance issues identified during the audit. It is organized according to the major environmental areas reviewed.

The Audit team's assessment represents a review of certain information relating to the W.R. Grace facility, obtained during the audit, which did not include sampling or monitoring at the facility. While the Audit team used reasonable care to avoid reliance on data or information that is inaccurate, the team is not able to verify the accuracy or completeness of all data and information made available to the team. Some of the conclusions drawn could be different if the information upon which they are based were determined to be false, inaccurate, or incomplete. The Audit team makes no legal representations whatsoever concerning any matter, including but not limited to ownership of any property or the interpretation of any law.

8.5 POLLUTION CONTROL AND WASTE MANAGEMENT

8.5.1 Air Pollution Control

Air emission sources at the Grace facility in Nashua that are subject to regulation include two 500-horsepower (hp) gas-fired boilers;[1] one 600-hp gas-fired boiler; one 800-hp gas-fired boiler; an ammonia tower hot oil heater; a lime waste treatment, fluidized bed incinerator; nitrilotriacetic (NTA) production equipment; and iminodiacetic (IDA) production equipment. Grace has a current operating permit issued by the State for each of these emission sources. Most of these permits are current through September 1991. The permit for the 800-hp boiler was temporary and expired in September 1989.

These permits impose, as applicable, maximum operating feed rate limits (incinerator and boilers), opacity limits (incinerator and boilers), particulate emission limits (incinerator), sulfur dioxide emission limits (boilers), and requirements for carbon monoxide monitoring (incinerator only). The permits for the NTA and IDA production equipment impose limits on HCN and ammonia boil-off emissions, and limits on dust emissions. The equipment appears to be operating in accordance with the terms and conditions of their permit requirements. This determination did not include stack testing. Most of the emitted air streams are scrubbed to meet emission limits. Grace has experienced problems with the operation of the incinerator's carbon monoxide and opacity meter and is investigating replacements. Grace is

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1. All boilers at the Grace facility are on interruptable natural gas service. When gas is interrupted, boilers are equipped to operate on No. 6 fuel as a backup energy source.

currently negotiating with the state for the ability to increase the solids feed rate to the incinerator from the current limit of 35 percent to as much as 50 percent.

There are asbestos-containing materials (ACM) at this facility. According to Grace memoranda on the subject, there appear to be about 1,000 feet of pipe insulation known to contain asbestos that should be removed because of the potential for exposure. About 550 feet of ACM insulation has already been removed and disposed of properly. Asbestos is also known to be present in the wall siding and roofing at Plant #1 and in the louvres on the cooling tower. Grace personnel are uncertain as to whether asbestos is present in the insulation surrounding many of the production reactors. To remedy this uncertainty, Grace should undertake a comprehensive asbestos survey to identify ACM throughout the facility.

8.5.2 Water Pollution Control

Plants like the Nashua facility, which discharge directly to a river or to other surface water, must meet limitations described in permits issued as part of the National Pollutant Discharge Elimination System (NPDES) or the State program counterpart. The Federal and respective State NPDES programs operate under authority of the Clean Water Act. The Nashua plant currently holds a permit for direct discharge under NPDES to the Merrimack River after treatment of the wastewater stream in an on-site wastewater treatment plant.

Concentrated wastewaters from all cyanide reaction vessels, referred to as primary liquors, are currently piped to aboveground storage tanks for further treatment. These liquors contain nitriles, sulfuric acid, and some unreacted cyanide. Primary liquors undergo treatment to destroy cyanides and ultimately thermal incineration to burn off organic constituents in a fluidized bed incinerator. The lime/incineration process is referred to as Phase II wastewater treatment. The compliance status was not reviewed by the Audit team.

All other wastewaters enter the on-site wastewater treatment plant. Entering wastewaters receive continuous cyanide monitoring. Assuming cyanide concentrations are below levels of concern, the wastewaters enter a double lined equalization basin for pH adjustment. Wastewaters with elevated cyanide levels are diverted to a lined holding basin where they then receive cyanide treatment before being released to the equalization basin. These parts of the treatment system are referred to as Phase I wastewater treatment.

From the equalization basin, wastewaters undergo biological treatment which combines extended aeration with activated sludge. After passing through a clarifier, treated wastewater is discharged to the river unless elevated ammonia levels require that the wastewater pass through the ammonia stripping tower. Wastewater treatment plant sludge passes through a filter press and is shipped off-site as a non-hazardous waste. This portion of the system is referred to as Phase III wastewater treatment.

Operating and monitoring records for the on-site wastewater treatment plant indicate minor exceedances of the permit conditions in 1987 and 1988 for which no notice of violation or citation was issued or penalties/fines assessed. No permit exceedances were noted to date in 1989, and past exceedances do not appear to indicate an inability to meet the permit limits. Monitoring and record keeping requirements are being met. No effluent samples were taken or analyzed by the Audit team.

All stormwater from the process areas at this plant flows to the on-site wastewater treatment plant and is treated before discharge. Stormwater flow from the parking lots discharges into Spit Brook. The integrity of the plant-wide sewer system should be reviewed and evaluated.

8.5.3 Hazardous Waste Management

The Resource Conservation and Recovery Act (RCRA) and associated Federal and State regulations specify the procedures to be followed at facilities which generate, treat, store, dispose, and transport hazardous wastes. The Grace plant in Nashua is regulated both as a hazardous waste generator and as a storage facility. It has a generator identification number as well as a Part B Permit for its storage facility.

Some RCRA compliance problems were noted by the Audit team. The hazardous waste drum storage area sign "Danger-Unauthorized Personnel Keep Out" cannot be readily seen when the gate door remains open. Not all the drums were found to be labeled as per the terms of Grace's storage permit (i.e., not labeled as to plant of origin, incomplete hazard warning labels, and no notation as to whether a given drum was full or not.) One drum was found to be leaking in this area, but Grace's records indicate that this drum contained a non-hazardous waste. Several drums were noted to be not in "good condition" (i.e., rusted.) The RCRA hazardous waste storage tank in the KAN Plant was not labeled as containing hazardous wastes nor were the requisite "Danger-Unauthorized Personnel Keep Out" or "Danger-Restricted Area - No Open Flames" signs posted. A safety concern was noted in that electrical cords were located in close proximity to pools of water in the hazardous waste storage area. The forklift truck used in the waste drum storage area was not an intrinsically safe design.

A file review indicates that the Nashua plant is subject to RCRA corrective action, and a RCRA Facility Assessment (RFA) has been performed. Twenty-six Solid Waste Management Units (SWMUs) and three Areas of Concern (AOCs) were identified by EPA. Several of the potential SWMUs were determined to be process units, part of the facility's waste minimization programs, or units that managed intermediates from one process which are used as feedstock for another process.

From a volume perspective, the most significant solid waste management units are the former unlined wastewater treatment lagoons. From 1958-1976, these lagoons served as the facility's only wastewater treatment system with the exception of separate cyanide treatment for primary liquors. Several groundwater monitoring wells surround the area of the former north lagoon referred to in the RCRA Facility Assessment (RFA) report. The former lagoon sites have been turned into the equalization basin, a holding basin, and a biological treatment plant.

A brief review of recent groundwater monitoring data presented to the Audit team by Grace indicated elevated levels of cyanide (about 5 ppm in the worst well) and formaldehyde (18 ppm in the worst well) in April 1988. According to the October 1988 sampling, these values had fallen to less than 1 ppm for cyanide and no detectable formaldehyde. Grace environmental staff offered no explanation for the rise in groundwater contaminants in April 1988. It is unclear what future groundwater contaminant patterns will look like.

Two additional areas that were identified in the final RFA report that may also be of concern are another lagoon and a buried drum area. These areas were reported to EPA (RCRA) on February 2, 1989. A wastewater treatment lagoon previously located at the southern end of the facility was apparently part of the original lagoon system constructed in 1958. This lagoon was presumably unlined and similar to the other three lagoons at the northern end of the facility.

At one of the SWMUs, an unknown number of waste drums was reportedly buried at the northern end of the facility north and west of the current hazardous waste drum storage area in 1964. EPA (RCRA) was notified of this condition on February 2, 1989. Grace staff believe these drums to contain non-hazardous shampoo-type wastes or off-specification product. According to Grace staff, all known drums had presumably been excavated and removed previously; however, during some maintenance or improvement activity last year, additional drums were uncovered. At the time of the Audit team's visit, an area of the parking lot west of the current hazardous waste drum storage area was partially dug up and several half buried drums were visible.

Additional soil and groundwater sampling of the SWMUs identified as having releases will be performed during the corrective action process to characterize the nature and extent of any potential soil and groundwater contamination associated with past waste management activities at the facility. A RCRA Corrective Action Permit, issued September 29, 1989, established requirements for this sampling activity.

8.5.4 Solid Waste Management

Regulation of solid waste disposal has traditionally been a State responsibility. Although EPA has recently proposed Federal regulations for solid waste management facilities under Subtitle D of RCRA, states will continue to define regulatory requirements until the Federal regulations are promulgated. The Grace plant in Nashua does not operate its own on-site solid waste management facility. Generally there are no substantive state requirements on generators of non-hazardous solid waste who send such waste off-site for disposal. No solid waste management problems were observed by the Audit team.

8.5.5 Underground Storage Tanks

Records show that 16 underground storage tanks have been operated at Grace's Nashua plant, as listed in Table 8-1. The capacities of these tanks range from 500 to 20,000 gallons and all but two contain or once contained petroleum product. Two of these tanks are double-lined steel tanks; the remainder are or were constructed of bare steel. Three of the tanks were closed in place and five tanks have been removed. One additional tank was taken out of service in November 1988, but has not yet been subject to closure. All in-service USTs are being integrity tested at the required frequency. Grace indicates that all their remaining USTs will be taken out of service on a timetable consistent with UST regulatory requirements. No underground storage tank problems were discovered by the Audit team.

8.5.6 Pesticide Use and Storage

Pesticide storage and use is regulated under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). The Grace plant in Nashua contracts out its pest management and weed control functions; consequently this plant does not store or use pesticides. As a result, no FIFRA problems were observed by the Audit team.

8.5.7 PCB Inventory Management

There are no PCB-contaminated or PCB-containing transformers in service or in storage at the Nashua plant. All in-service transformers have been tested and contain PCB concentrations well below 50 parts per million. Grace reports that there are several PCB capacitors still in service, although the Audit team was unable to view the area in which these units operate and did not determine the size of these units. Federal regulations under the Toxic Substances Control Act (TSCA) require that after October 1, 1988, PCB large-high and large-low voltage capacitors cannot be used where there is a risk of exposure to food or feed.

In addition, the use of such units is prohibited after that date unless the capacitor is used within a restricted-access electrical substation or in a contained and restricted-access indoor installation.[2] These capacitors should be marked and labeled as containing PCBs in accordance with the TSCA regulations. The Audit team did not note any violations of applicable PCB regulations.

Grace has disposed of additional PCB-containing capacitors in the past. Records indicate compliance with pertinent Federal and State requirements governing the disposal of PCBs.

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2. A restricted-access electronic substation is an outdoor, fenced or walled-in facility that restricts public access and is used in the transmission or distribution of electric power. A contained and restricted-access indoor installation does not have public access and has an adequate roof, walls, and floor to contain any release of PCBs within the indoor location.

Table 8-1

W.R. GRACE UNDERGROUND STORAGE TANKS

Tank No.	Substance Stored	Tank Capacity (Gallons)	Construction Material	Date of Installation	Date of Last Integrity Testing	Date of Next Scheduled Integrity Test	Tank Removal Date	Remarks
V-211	NH_3 Tower Hot Oil	5,000	Bare Steel	1966	7/88	--	11/87	Closed in place
V-408	#2 Fuel Oil	10,000	Bare Steel	1957	--	--	?	Removed
V-409A	#6 Fuel Oil	12,500	Bare Steel	1965	--	--	11/89	
V-409B	#6 Fuel Oil	15,000	Bare Steel	1968	9/85	--	11/85	Removed
V-410	#2 Fuel Oil	15,000	Bare Steel	1968	10/85	--	11/85	Closed in place
V-426	#6 Fuel Oil	15,000	Bare Steel	1966	10/85	10/90	11/91	
V-436	Gasoline	5,000	Bare Steel	1968	10/85	10/90	11/93	
V-437	Gasoline	5,000	Bare Steel	1968	10/85	10/90	11/93	
V-438	Diesel	10,000	Bare Steel	1972	2/86	2/91	11/97	
V-439	Diesel	7,000	Bare Steel	1969	2/86	2/91	11/94	
V-441	#6 Fuel Oil	20,000	Double Lined Steel	1986	2/86	2/91	11/2011	
V-442	#6 Fuel Oil	15,000	Double Lined Steel	1986	2/86	2/91	11/2011	
V-401	Waste Oil	500	Bare Steel	1973	--	--	11/86	Removed 11/88
TF-120	HCN	Confidential	Bare Steel	1962	--	--	7/87	Removed
TF-15-101	HCN	Confidential	Bare Steel	1975	--	--	7/88	Removed
---	HCN Scrubber	--	Bare Steel	--	6/88	--	Pre-1985	Closed in place

9 SUMMARY OF MAJOR AUDIT OBSERVATIONS AND RECOMMENDATIONS

9.1 REACTOR NO. 5 HYDROGEN CHLORIDE (HCl) RELEASE

On August 5, 1988, Grace accidentally released HCl into the atmosphere as a result of equipment failure, human error, and inadequate response procedures. Although the magnitude, duration, and concentration of the release did not seriously affect health and the environment, it caused a community-wide emergency and evacuation. This release demonstrated a breakdown in communications, training, accident investigation procedures, and corrective action. Grace concentrated its efforts on mechanical corrections to Reactor No. 5 rather than on initiating a comprehensive hazards analysis. In spite of the mechanical corrections, the EPA Audit team identified further deficiencies. Field evaluation results are listed below:

- A permanently mounted pressure monitoring device with continuous recording should be installed on the reactor.
- Incoming chemical lines were not properly labeled or color coded. The sight glass was non-functional.
- A 2-inch material inlet pipe, ball valve was not capped.
- The Control Room was inadequate in several respects: space requirements, controls, check lists for critical operation parameters, and gauges for agitator operation.
- A load cell or a level indicator should be installed.
- The reactor was not equipped with interlocks (e.g., material inlet and scrubber operation.)
- Grace should consider installing a blank or backup valve to assure closure of the 8-inch inlet dilution pipe which was involved in the release.
- The agitator current should be monitored to assure proper agitator operation and speed.

9.2 HYDROGEN CYANIDE (HCN) STORAGE AND TRANSFER

The Audit team observed a highly sophisticated system for the storage and transfer of HCN at W.R. Grace. However, some areas of the HCN storage and transfer system need improvement to minimize the chances for a release of this extremely hazardous substance.

- An additional water gun equipped with a fog nozzle should be installed at the A and B HCN storage tanks; a deluge system should be considered.
- A spark ignition system should be installed as a means to ignite the HCN in the event that the water guns do not mitigate the

vapor cloud. A flare gun and water spray would remain as supplemental and backup systems.

- Containers of stabilizer acid should be readily available at the emergency addition facility to enable rapid response and mitigation.

- Additional HCN ambient monitoring devices should be installed in the storage area to provide backup and additional coverage during periods of variable wind direction.

- Coverage by the public address system must be improved in the HCN storage areas. In addition, the area needs expanded coverage from the closed circuit TV monitoring system.

- Flashing lights, additional signs and beacons are needed during railcar unloading operations at both the A and B stations.

- Additional safeguards are needed to assure backup power for the HCN scrubbing system. It is also important to ensure that the proper level and percent of caustic solution is available at all times.

- The circulating loop HCN transfer system should be expanded to include service to the entire facility.

9.3 RAILCAR UNLOADING OPERATIONS

The hazardous material railcar unloading area is in close proximity to the Merrimack River. The topography of the B unloading area slopes gently down toward the river. The A station is partially protected by an earthen berm. Grace should install a diked pad with a collection sump at both unloading locations to minimize the environmental and safety impact from a catastrophic railcar failure or release during bulk unloading operations.

9.4 MONITORING

A study should be conducted to assess the adequacy of the number and locations of the continuous monitors to detect accidental gas releases. For example, additional HCN monitors are needed in the IDA and NTA buildings. Expanded use of television monitors is recommended.

9.5 PHOSPHOROUS TRICHLORIDE (PCl_3)

In addition to preventing PCl_3 leaks from the storage tanks, the chemical must not come in contact with moisture or water. The Audit team observed deficiencies in the PCl_3 storage area and recommends the following:

- Grace should direct all scrubber overflow and standing water to flow outside the PCl_3 storage area. The scrubber water drain should be covered.

- The facility should institute an internal tank test program.

- Grace must enhance the contingency plan to include mitigation and response procedures for a large spill or release from PCl_3 storage and transfer operations.

- Unloading trucks must be firmly secured to insure no movement when unloading hoses are connected and product is being transferred.

9.6 SODIUM CYANIDE (NaCN) STORAGE

The existing NaCN storage tank farm is not diked, and the facility is equipped with a low curb so that any leakage or overflow would be directed to a drainage system. The drain was observed covered with soil. It was plugged and the drain had deteriorated. These tanks should be diked to avoid run-off and environmental contamination from an accidental spill or release, or improper operating practice.

9.7 EMERGENCY BACKUP POWER

The process part of the facility is supplied by only one main 34.5 KV power service line. Adequate provisions have not been made for emergency backup power for critical process equipment. Grace should initiate a study to determine what backup utilities are needed to prevent a chemical emergency in the event of a power failure or the loss of a critical utility for hazardous and extremely hazardous material process lines. For example, the pumps to the HCN scrubbers should be protected by a backup generator. Long-term utility failure would require backup refrigeration capability to prevent a chemical emergency.

9.8 CHEMICAL ACCIDENT PREVENTION

Accident prevention must be accomplished through proper safety equipment, procedures, training, and management techniques. Prevention deficiencies identified by the Audit team include the following:

- The emergency warning and public address system is not audible in all areas of the plant.

- Grace needs to develop an efficient means of alerting the neighborhood in the event of a chemical emergency.

- The facility needs to work more closely with community emergency responders to increase knowledge, capabilities, equipment and coordination.

- Lock-out and tag-out programs for out-of-service equipment need to be improved to prevent human error or equipment failure that could lead to an accidental release. The facility should increase the use of lock-out procedures rather than rely solely on tag-out.

- Grace needs to routinely conduct chemical emergency simulations which involve neighborhood services and mutual aid.

- The facility should conduct an interlock study to promote proper sequencing of process operations for reactions and other hazardous materials equipment to assure fail-safe operations. For example, the rail spur used for HCN unloading should have locked derails. Interlocks in the KAN and NTA areas could include use for HCN feed, the reactor, and for agitator speed to promote fail-safe operation.

- The control room in the NTA building is 1965 vintage. Grace should develop and follow a schedule for control room upgrades to promote accurate process monitoring and safer operations.

- Labeling of tanks and color coding of hazardous materials process lines should be improved for proper emergency identification during an incident.

- Agitator current should be monitored on the KAN reactor to assure proper speed and operation and to reduce the possibility of a chemical accident.

- Wheel chocks must be used to prevent movement of hazardous materials railcars during unloading operations. Mechanical and electrical safeguards to prevent truck movement during unloading operations should be employed to enhance accident prevention procedures.

9.9 OPERATION AND MAINTENANCE

The Preventative Maintenance program for equipment used with hazardous materials should be upgraded to include routine replacement of critical parts based on a history of failure, rather than on observation of actual signs of failure. For example, critical gaskets should be changed at regular and predetermined frequencies. Grace should conduct a study allowing the facility to, over time, reduce the number of values and flanges on hazardous materials lines in order to minimize leak potential.

9.10 EMERGENCY VENTING

Grace needs to reevaluate the size and locations of emergency and pressure relief vents and assess whether or not relief devices should be vented to a flare, other air pollution control equipment or secondary containment. This method of control is especially necessary for highly-toxic or explosive gases. Pressure relief sizing should include consideration of multiphase flow using DIERS technology. A relief valve study should start with the KAN reactor pressure relief system since this device appears to be undersized based on field observations by the Audit team.

9.11 ENVIRONMENTAL COMPLIANCE

The Audit team reviewed facility operations to assess environmental compliance status. Results of this review show problems with the continuous air pollution monitoring equipment (carbon monoxide and opacity) for the lime, waste treatment, and fluidized bed incinerator. This equipment should be repaired or replaced. Asbestos is found in materials throughout the plant and should be removed and disposed of properly to prevent the material from becoming airborne. Grace should undertake a comprehensive asbestos survey and initiate immediate removal of all friable material in remaining affected areas.

Drum labeling was deficient in the hazardous waste drum storage area. Several hazardous waste storage drums were found with surface rust and some were in poor structural condition. There is a need for improved drum inspection and leak detection procedures. An electrical cord was being used improperly in the waste storage area, in close proximity to water. The forklift was not an intrinsically safe design. The forklift truck and the cord both present a potential fire hazard and are considered a safety hazard.

An unknown number of waste drums were buried at the northern end of the facility. Some have been excavated and removed. At the time of the audit, an area of the parking lot west of the current hazardous waste drum storage area was partially dug up and several half-buried drums were visible. This situation warrants prompt action to characterize any potential contamination associated with past waste management activities at the facility.

The integrity of the plant-wide sewer system should be reviewed and evaluated. A review of groundwater monitoring data in the area of the former wastewater treatment lagoons showed elevated levels of cyanide and formaldehyde in April 1988. This should be investigated further by Grace and the regulatory agencies.

9.12 HAZARDS ANALYSIS

Grace does not routinely use sophisticated hazards analysis techniques for process equipment in hazards material service. Formal hazards analysis techniques, such as hazards and operability studies, failure modes, effects, and criticality analysis must be routinely used to identify existing plant hazards before an accident occurs. Analysis must be performed for certain hazards material lines at the research and development stage, during conceptual and detailed design, and at the operational phase. Such analysis should be conducted for any planned or actual changes in process equipment. For example, a comprehensive hazards and risk analysis should be conducted for: Reactor No. 5, HCN Storage and Transfer Operations, IDA & KAN Reactors, the ammonia distillation column, railcar unloading operations, PCl_3 storage, and other critical hazardous materials operations. Comprehensive plant-wide safety audits should be routinely conducted by Grace personnel and experts not employed at the Nashua location in order to benefit from a different perspective.

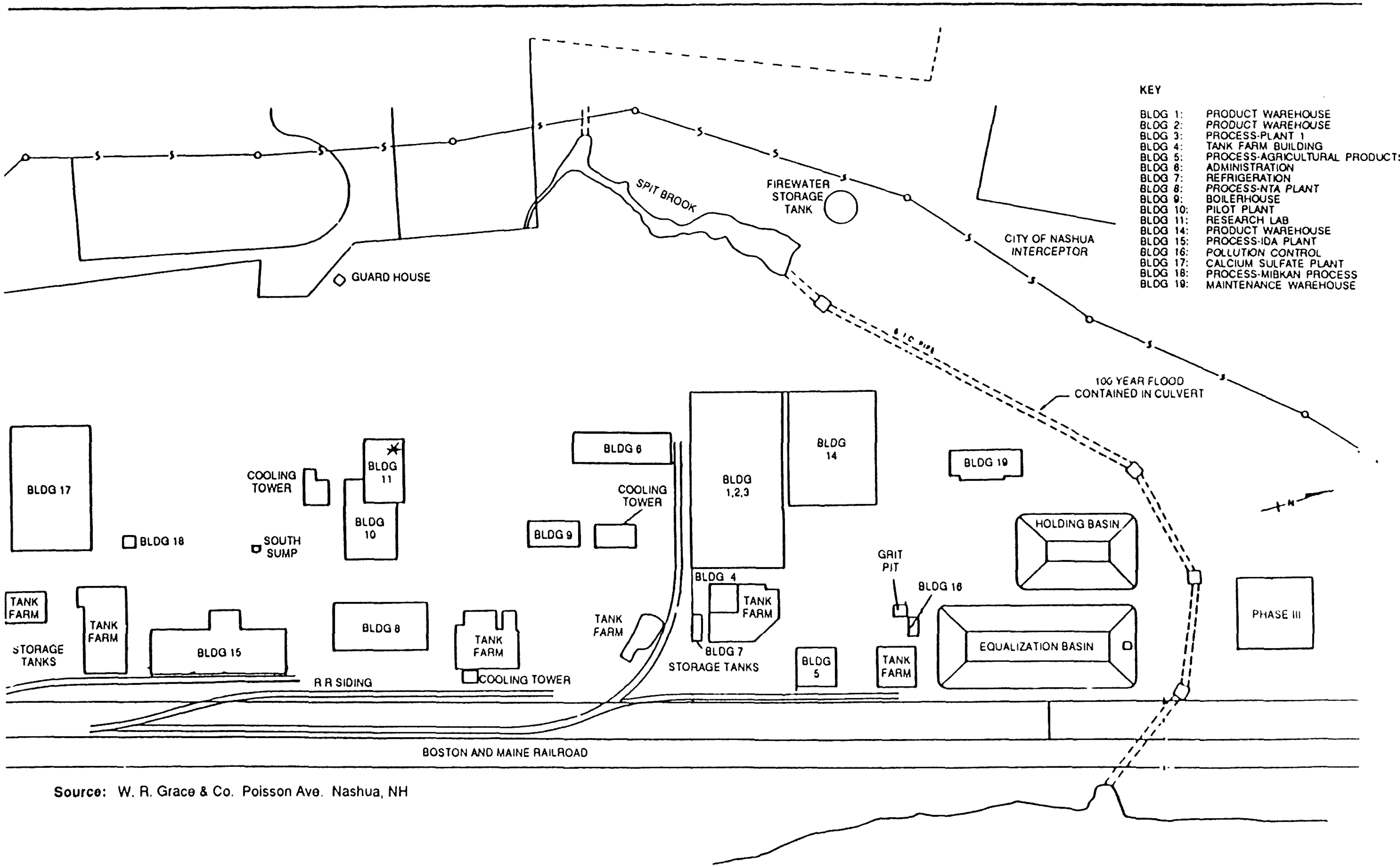
9.13 ACCIDENT INVESTIGATION AND FOLLOW-UP

Chemical investigation procedures are inadequate. Grace does not have a suitable program to investigate potential, actual, or near-miss incidents using checklists, codes, standards, and formal hazards analysis techniques. Existing accident investigation techniques fail to adequately access system reliability, state-of-the-art corrective technology, or the magnitude and probability of any incident reoccurring.

Accident investigation techniques at Grace must be improved and formalized using a systems approach to minimize the potential of an accident reoccurring or a failure in other parts of the hazards material line. Accident and near-miss reports must be completed, filed, and evaluated for trends and followup. These reports must be readily available to outside investigators and Audit teams for review and evaluation.

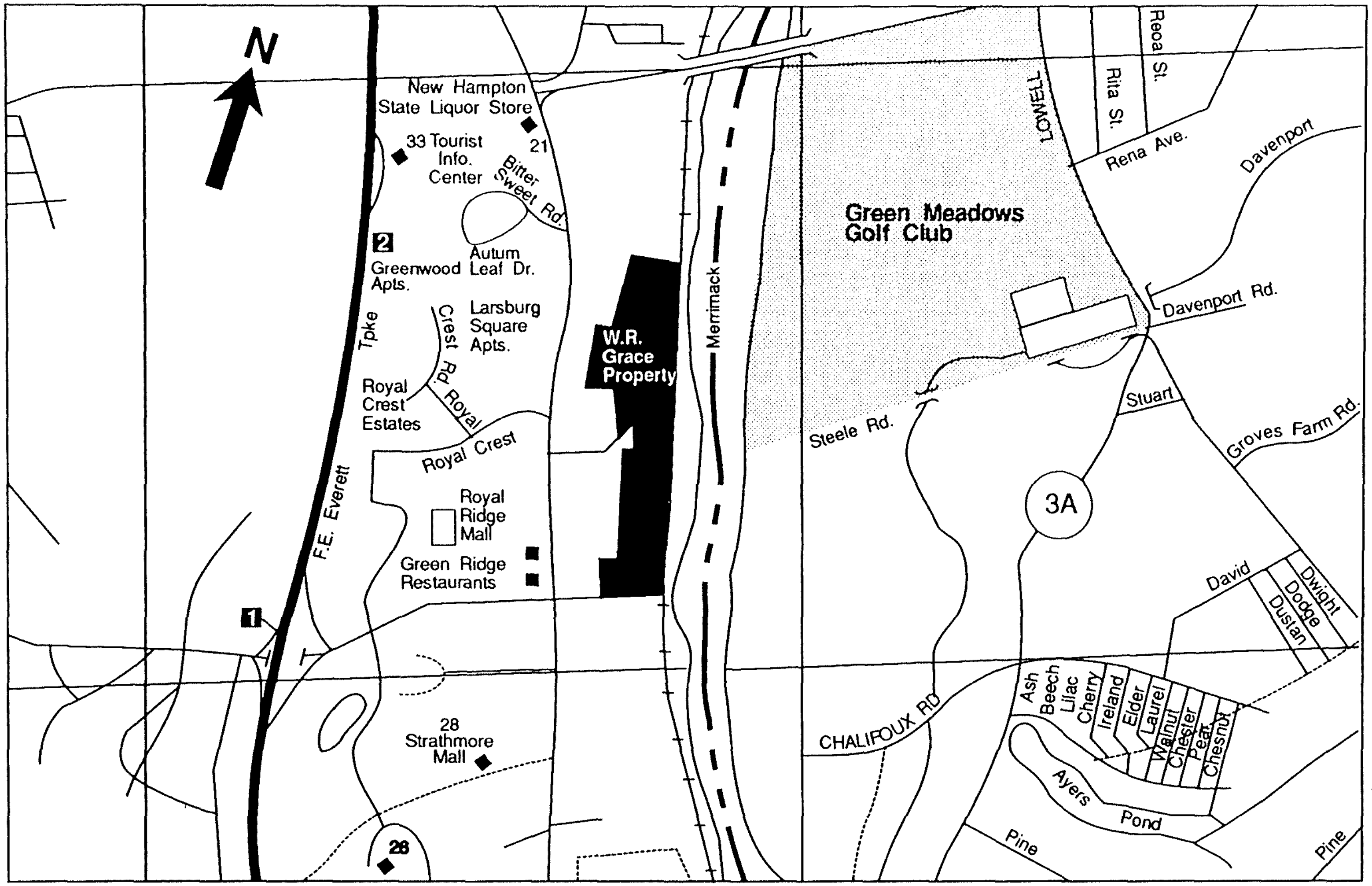
Appendix A

Site Plans and USGS Survey Map



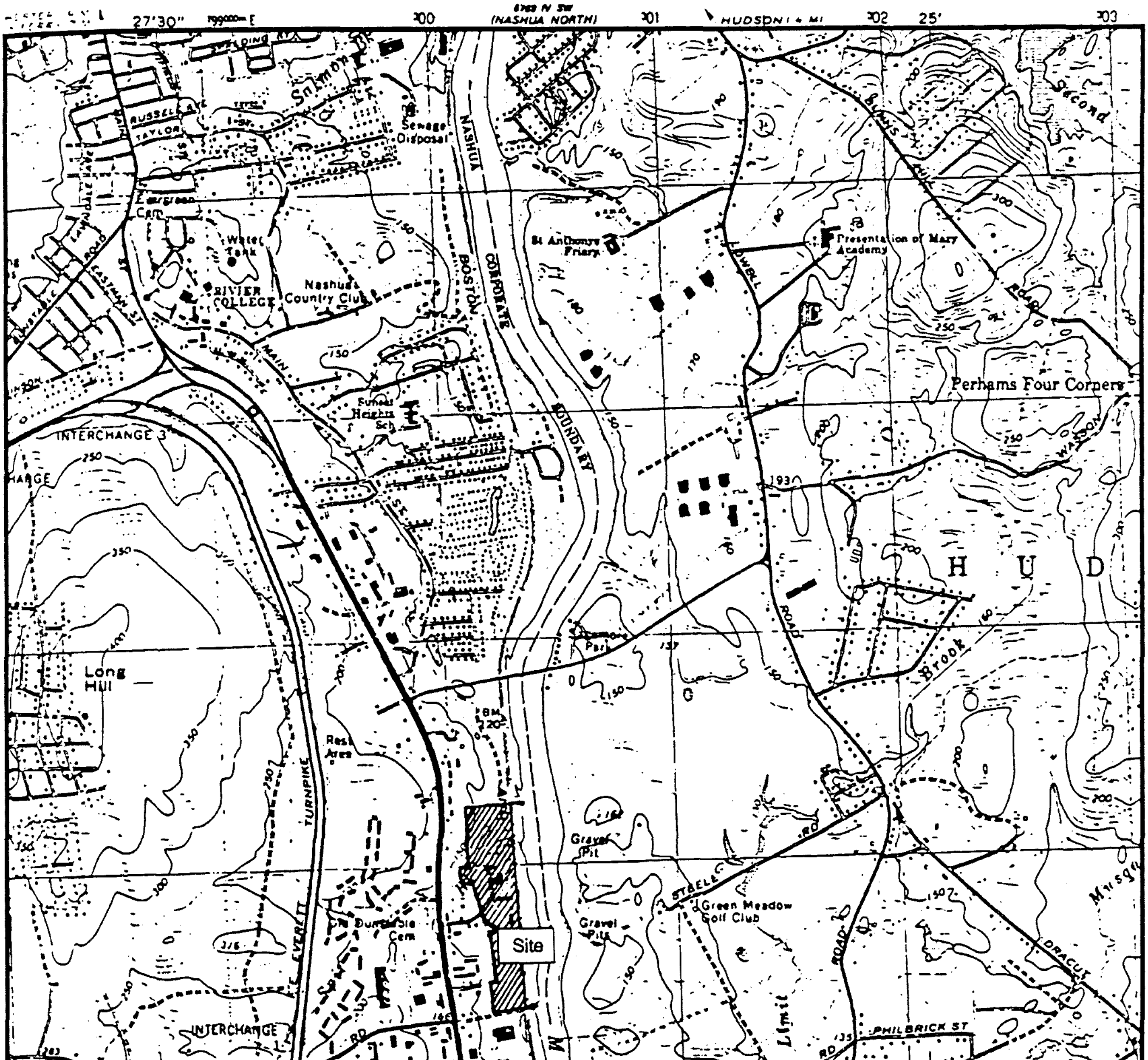
Source: W. R. Grace & Co. Poisson Ave. Nashua, NH

Figure A-1 Site Map



Source: W.R. Grace & Co. Poisson Ave. Nashua, NH

SCALE: 1/32" = 15.3 yds



Source: U.S.G.S. Nashua South Quadrangle New Hampshire - Massachusetts
7.5 Minute Series (Topographic)

Figure A-3 Topographic Site Map

Appendix B

Photographs of the Facility
taken during the
April 10 - 14, 1989
Audit

Photographic Log

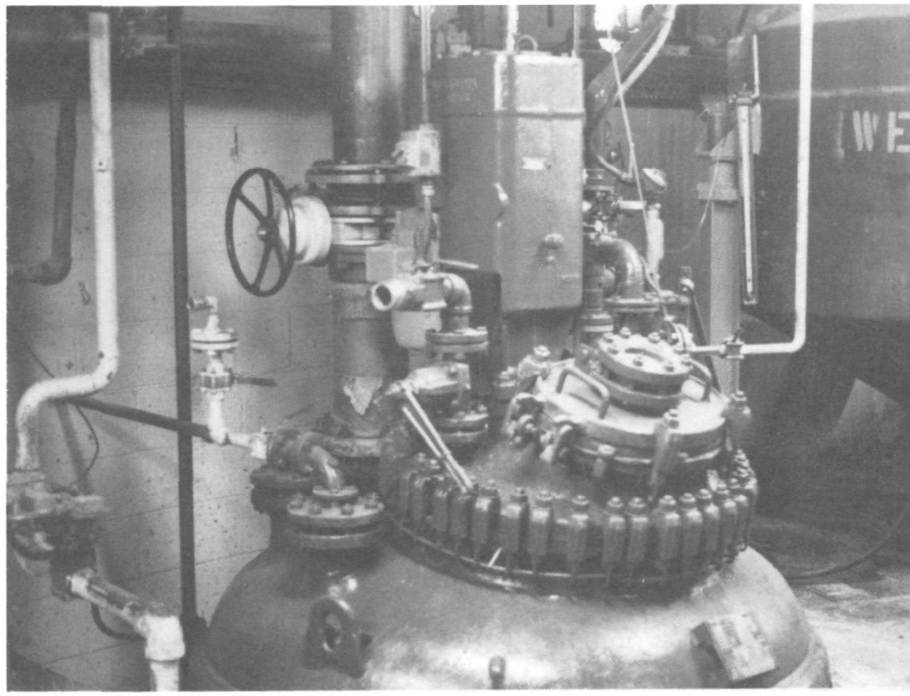
Date: April 10, 1989

Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
Site Audit Team Member

Brief Description:
#5 Reactor - side/top view



Number 3 of 45

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ 49
Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Date: April 10, 1989

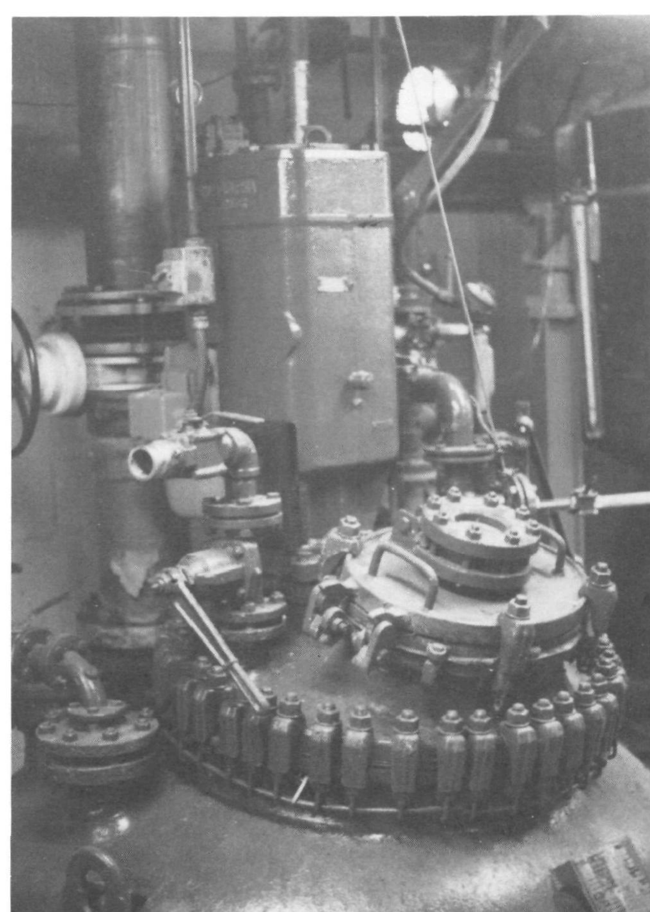
Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
#5 Reactor - closer view from the side of the top

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ49
Project: Audit April 10-14, 1989
Number 2 of 45



Photographic Log

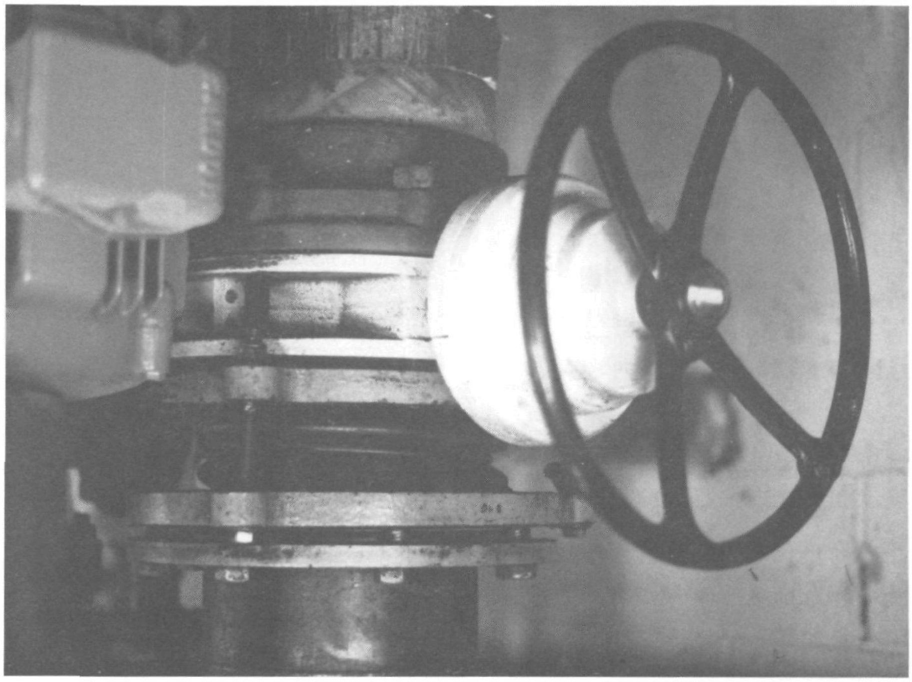
Date: April 10, 1989

Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
#5 Reactor - 8" Butterfly
valve



Number 1 of 45

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ49
Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Date: April 10, 1989

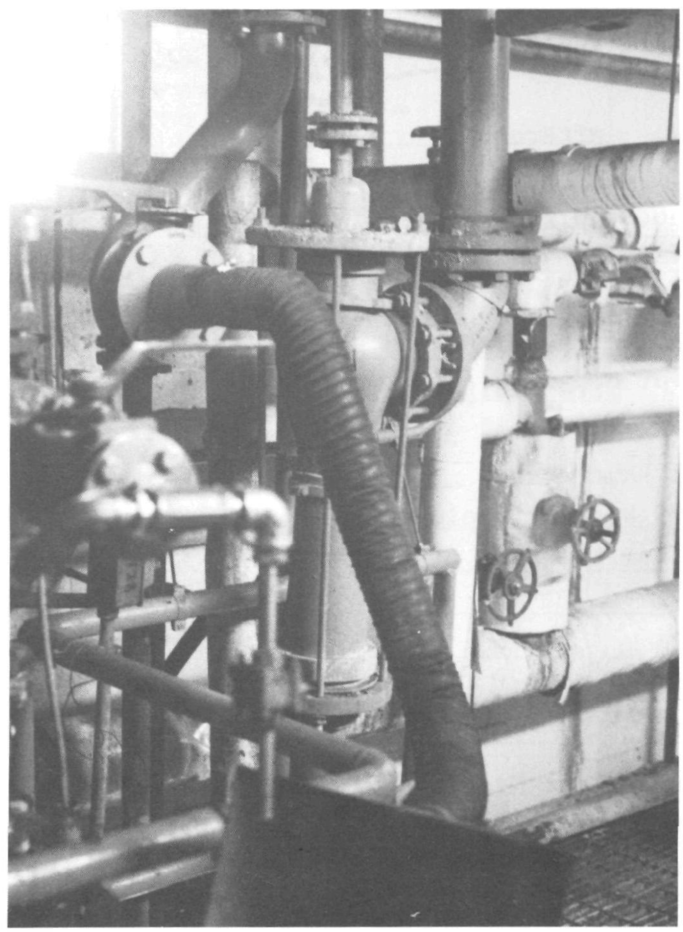
Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
#5 Reactor - Dust Exhaust
System

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ49
Project: Audit, April 10-14, 1989
Number 7 of 45



Photographic Log

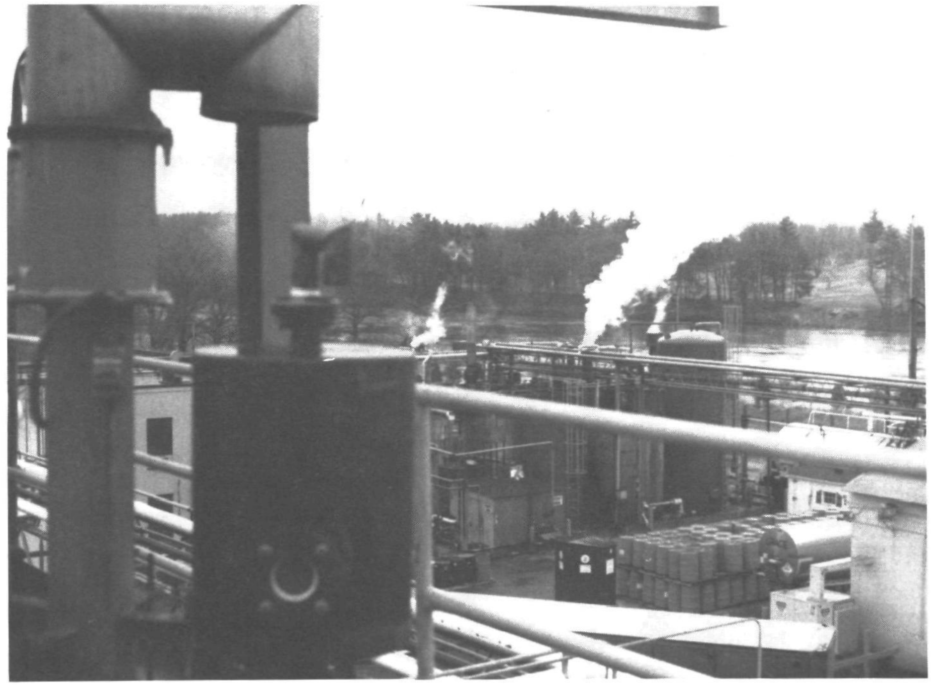
Date: April 10, 1989

Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
#5 Reactor Roof vent -
view to east



Number 5 of 45

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ49
Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Date: April 10, 1989

Time: afternoon

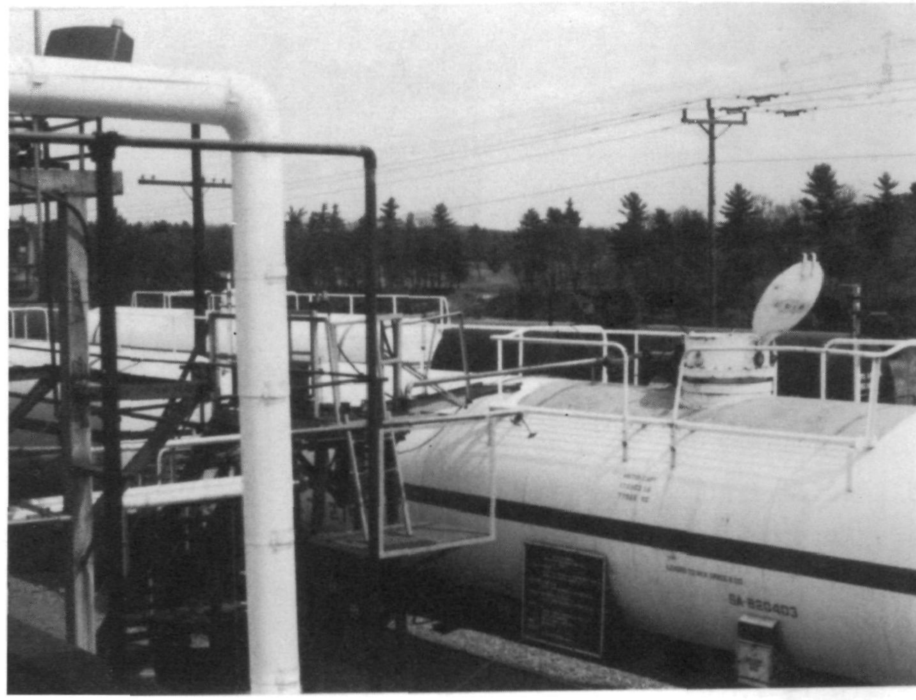
Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
#5 Reactor Roof vent -
dilution blower

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ49
Project: Audit, April 10-14, 1989
Number 4 of 45

Photographic Log



Date: April 13, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description: Plant #1: hydrocyanic acid rail car unloading - a general view

Number 38 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Date: April 13, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description: Overview of Grace rail siding, facing north

Number 43 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R Grace, Hampshire Chemicals Co., April 10-14, 1989

Photographic Log

Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
Rear wheels of hydrocyanic acid rail car at Plant #1 "A" unloading area

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8
Project: Grace Audit, 4/10-14/89
Number 17 of 45

Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
Front wheels with chocks and hydrocyanic acid rail car unloading platform Plant #1 - "A"

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8
Project: Audit, April 10-14,'89
Number 20 of 45

Photographic Log

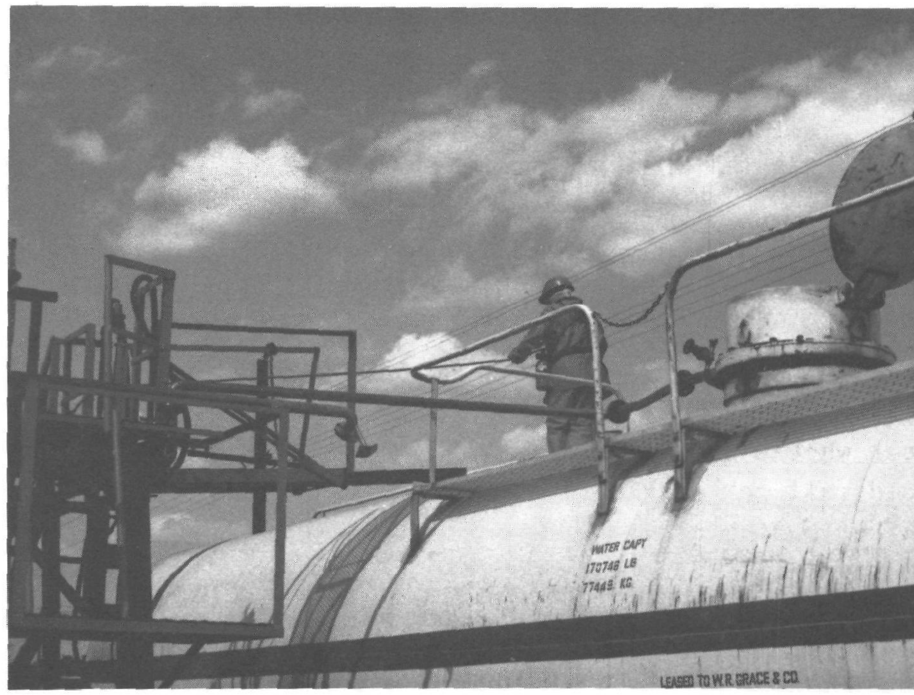
Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description: Plant #1:
Hydrocyanic Acid Rail Car
unloading operation:
termination of transfer by
Dick Farrel, Grace Employee



Number 21 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

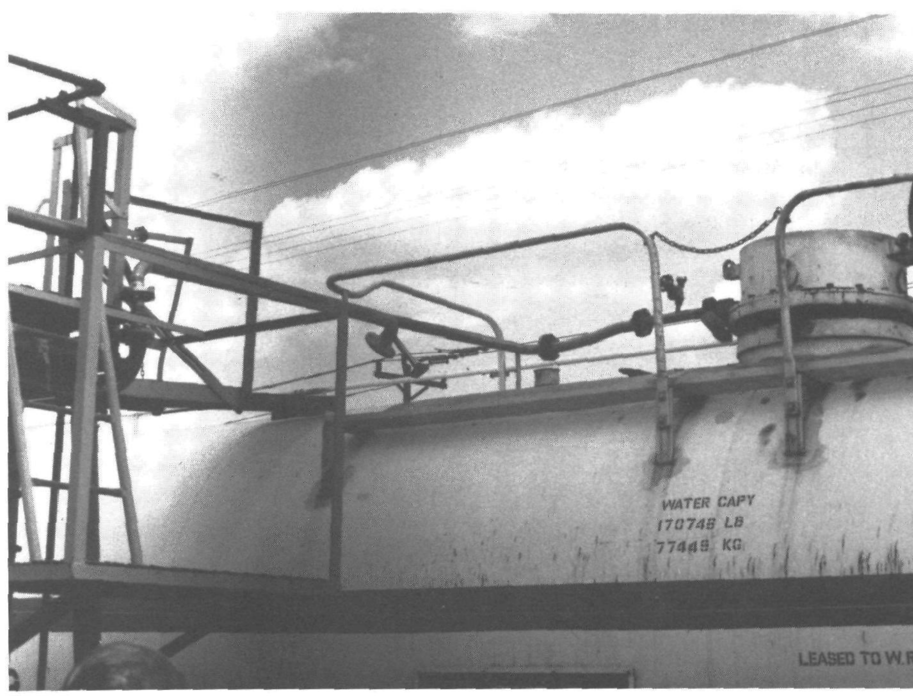
Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description: Plant #1:
Hydrocyanic Acid Rail Car
Unloading operations:
platform



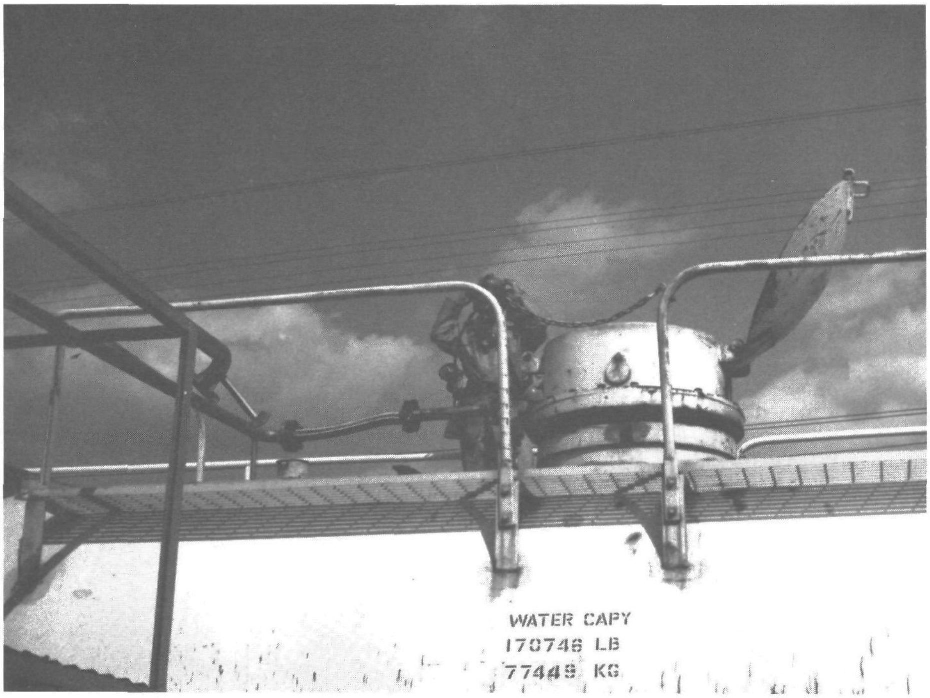
Number 26 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R Grace, Hampshire Chemicals Co., April 10-14, 1989

Photographic Log



Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description: Plant #1:
Hydrocyanic Acid Rail car
unloading operations:
termination of transfer by
Dick Farrel, Grace
employee

Number 22 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description: Plant #1:
Hydrocyanic Acid Rail car
unloading operations:
termination of transfer by
Dick Farrel, Grace
employee

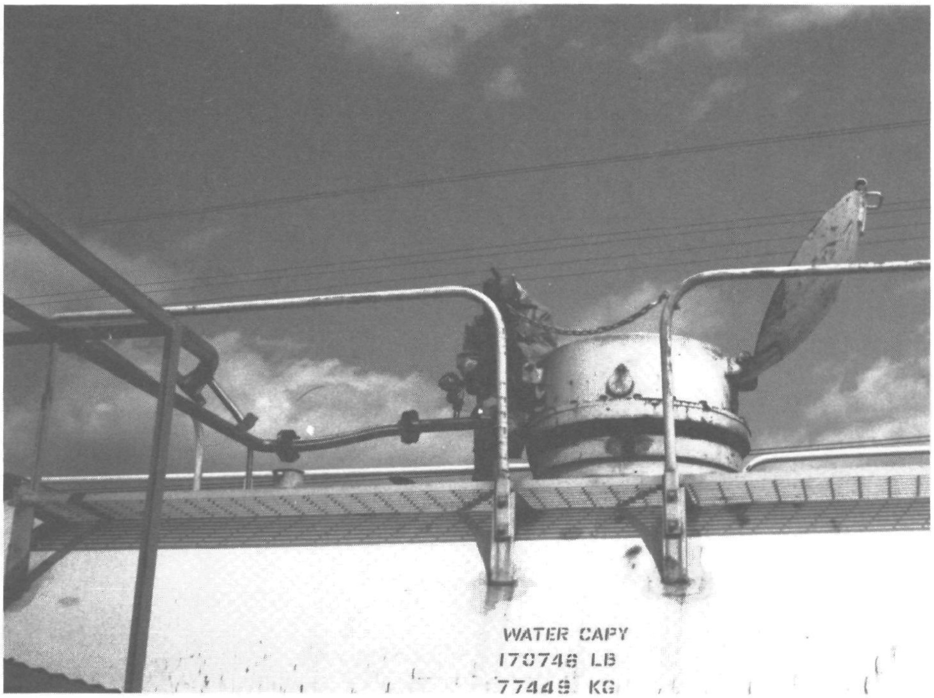
Number 23 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hmapshire Chemicals Co., April 10-14, 1989

Photographic Log



Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

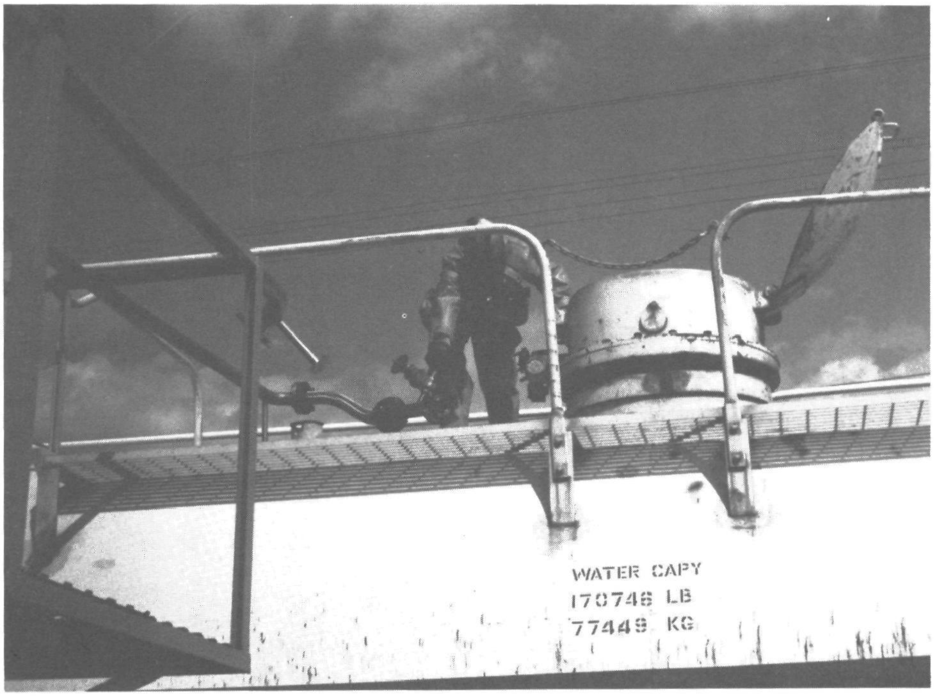
Brief Description: Plant #1:
Hydrocyanic Acid Rail car
unloading operations:
termination of transfer by
Dick Farrel, Grace employee

Number 24 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ø 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10 - 14, 1989



Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description: Plant #1:
Hydrocyanic Acid Rail car
unloading operations:
termination of transfer by
Dick Farrel, Grace employee

Number 25 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC Ø 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Photographic Log

Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT EPA Site Audit Team Member

Brief Description: Plant #1: Hydrocyanic Acid Rail car unloading operations: termination of transfer by Dick Farrel, Grace employee

Number 27 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT EPA Site Audit Team Member

Brief Description: Plant #1: Hydrocyanic Acid Rail car unloading operations: termination of transfer by Dick Farrel, Grace employee

Number 28 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R Grace, Hampshire Chemicals Co., April 10-14, 1989

Photographic Log

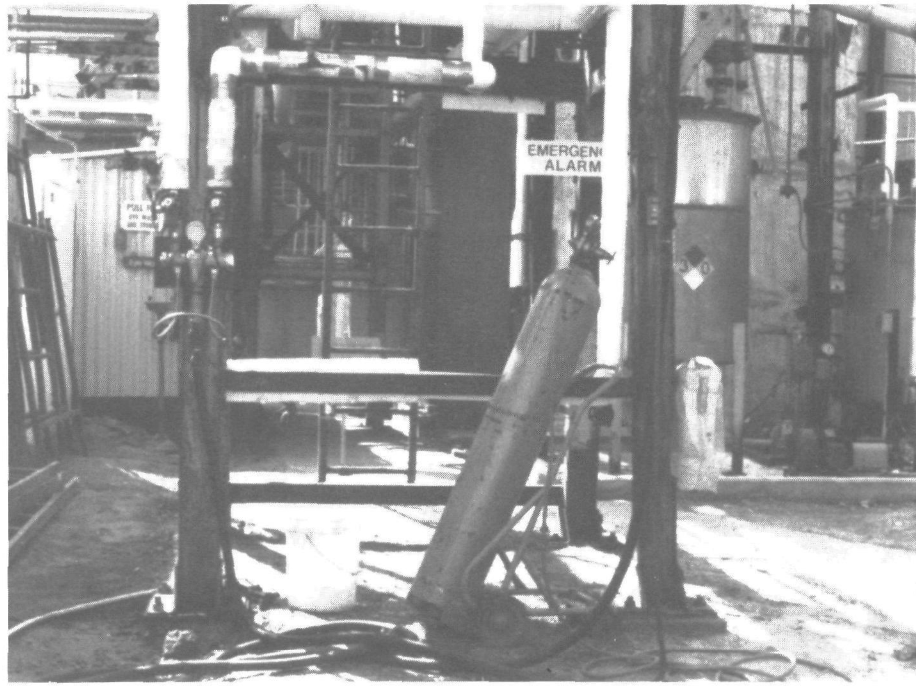
Date: April 12, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description: Plant #1:
Bottled breathing air supply
for hydrocyanic acid rail car
unloading operations



Number 29 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Date: April 13, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description: Warning
sign for Plant #1 HCN
unloading activities
during operations

Number 40 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R Grace, Hampshire Chemicals Co., April 10-14, 1989

Photographic Log

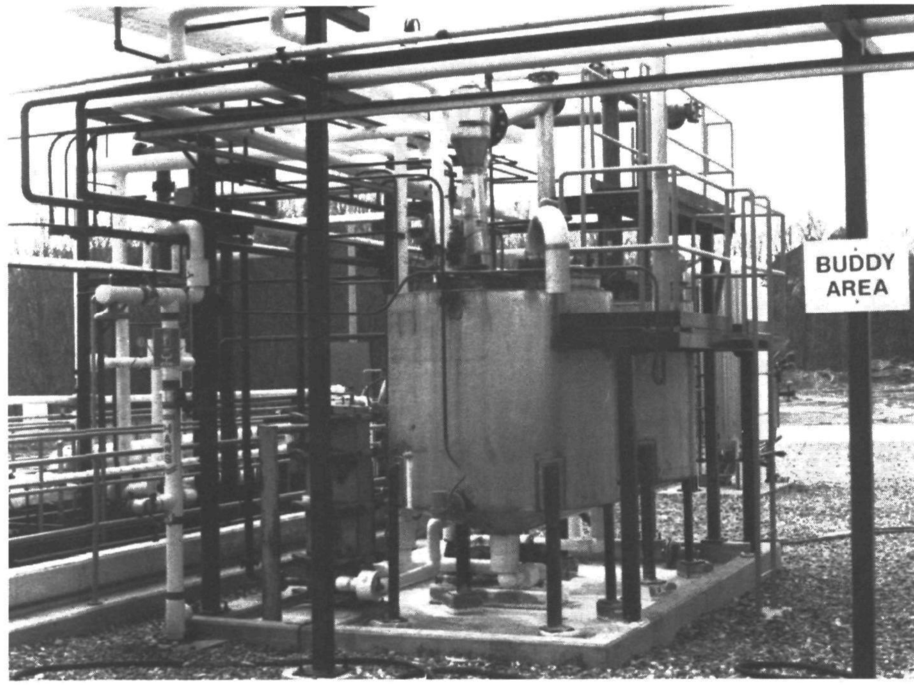
Date: April 12, 1989

Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
IDA - "B" Hydrocyanic acid
storage tank - sodium
hydroxide scrubber



Number 15 of 45

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ49
Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Date: April 12, 1989

Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
IDA - "B" Hydrocyanic acid
storage tank - sodium
hydroxide scrubber

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ49
Project: Audit, April 10-14, 1989
Number 16 of 45

Photographic Log

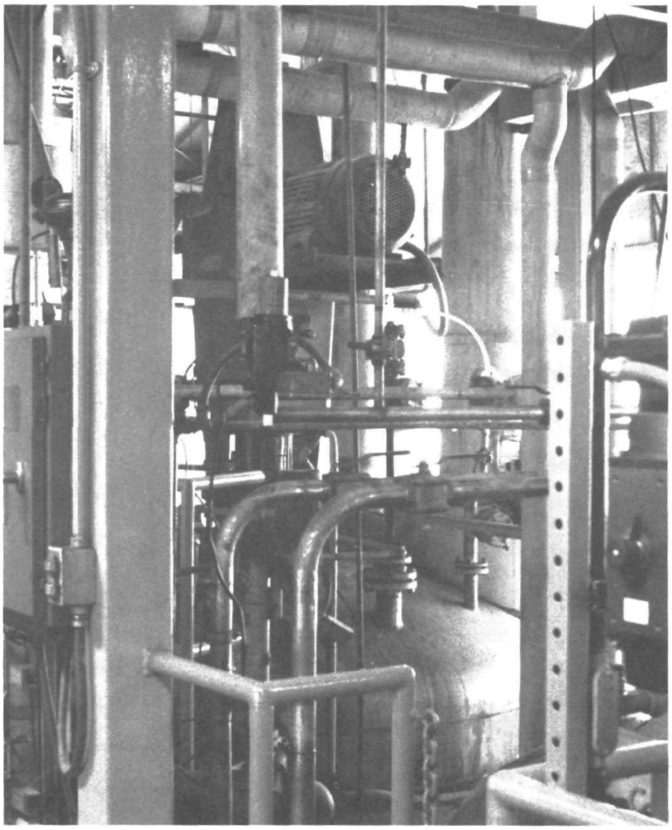
Date: April 12, 1989

Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
IDA B-Reactor (V-1506)



Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ 49
Project: Audit, April 10-14, 1989
Number 18 of 45

Photographic Log

Date: April 11, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

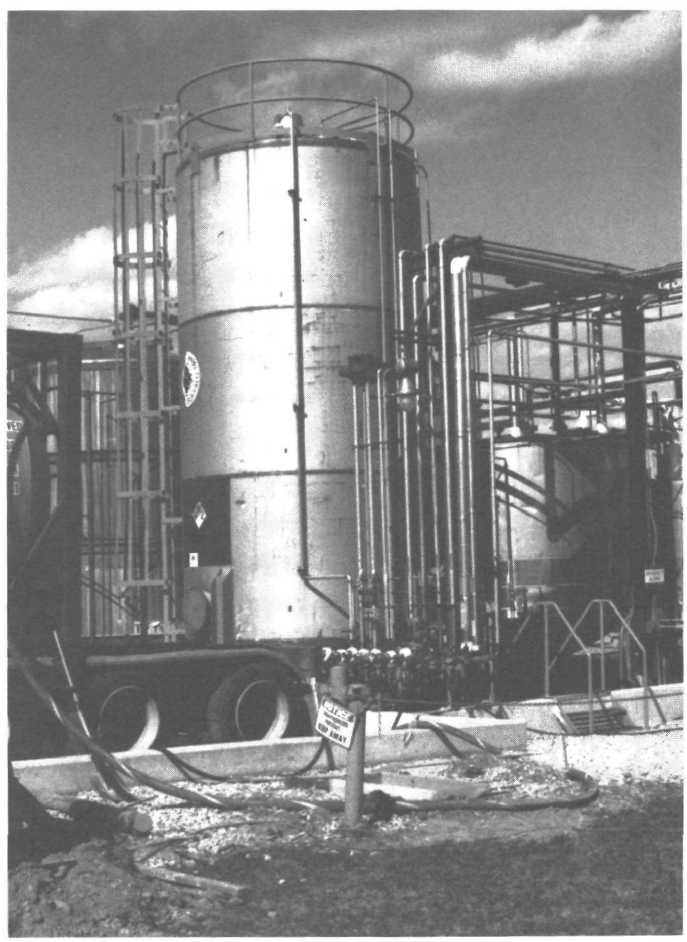
Brief Description:
Aminonitriles tank truck
loading

Number 11 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989



Date: April 11, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
Methyl-ethyl-Ketone (MEK)
storage tank

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ49
Project: Audit, April 10-14,1989
Number 10 of 45

Photographic Log

Date: April 13, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
Ammonia distillation column (left) and direct fired heater

Number 44 of 45

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ 49
Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Date: April 13, 1989

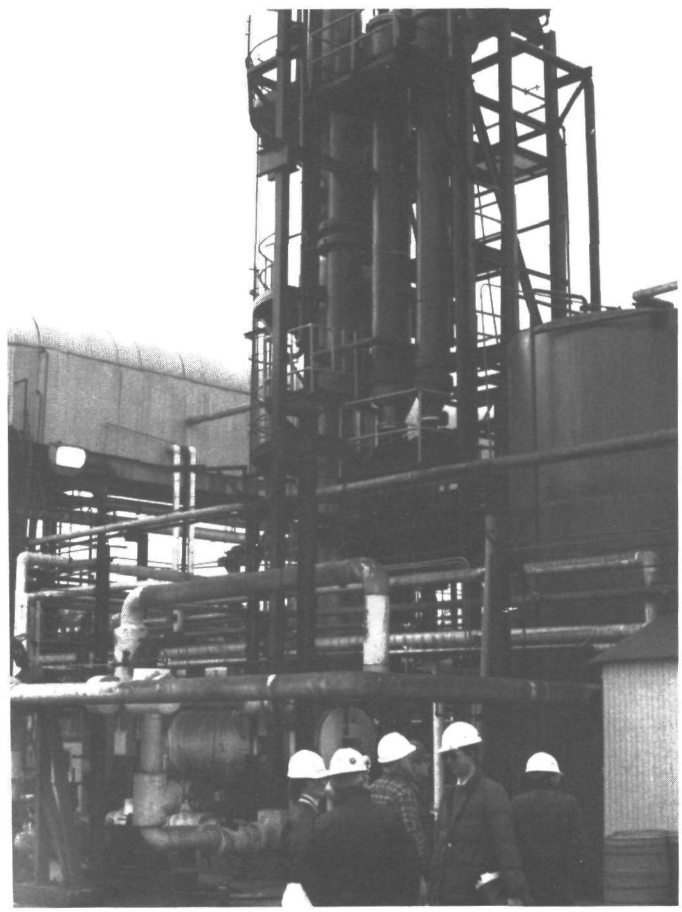
Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

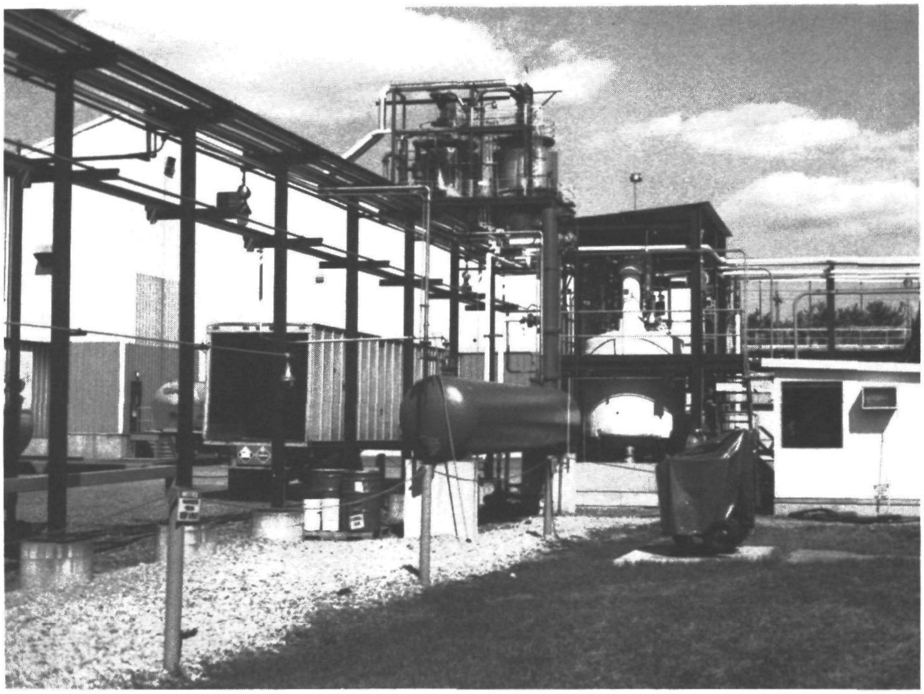
Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
Ammonia distillation column

Camera Model: Minolta SRT 100b
Lens Used: 28 mm 1:2.8 MC ϕ49
Project: Audit, April 10-14,1989
Number 45 of 45



Photographic Log



Date: April 11, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

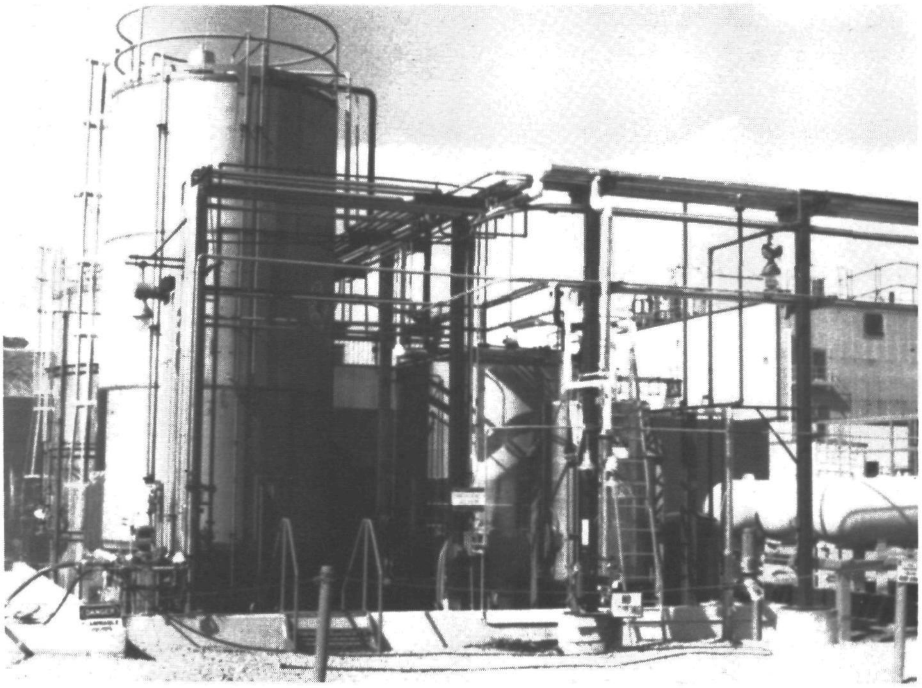
Brief Description: Ammonia Scrubber and aminonitriles (KAN) plant

Number 8 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989



Date: April 11, 1989

Time: early afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
Aminonitriles (KAN) tank farm

Number 9 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R Grace, Hampshire Chemicals Co., April 10-14, 1989

Photographic Log

Date: April 12, 1989

Time: afternoon

Location: W.R. Grace Facility Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT EPA Site Audit Team Member

Brief Description: Waste water treatment clarifier

Number 33 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ø 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

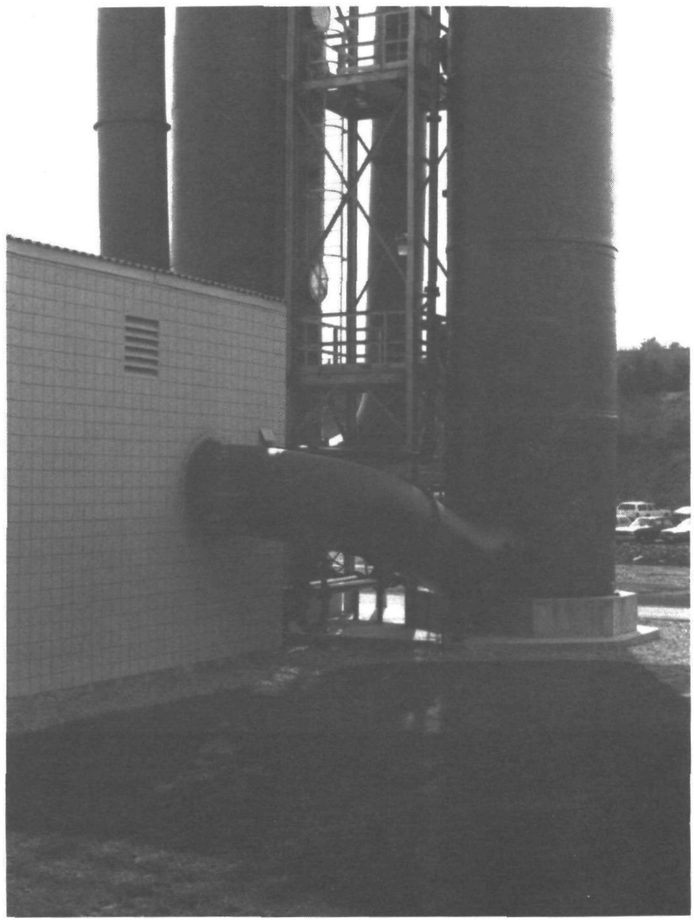
Date: April 12, 1989

Time: afternoon

Location: W.R Grace Facility Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT EPA Site Audit Team Member

Brief Description: Waste water treatment end-of-pipe ammonia scrubber/absorber



Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ø 49

Project: Audit, April 10-14, 1989

Number 32 of 45

Photographic Log

Date: April 12, 1989

Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
Waste water treatment
equalization basin
1,000,000 gals/3 days

Number 30 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Date: April 12, 1989

Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
Waste water treatment
aeration basins

Number 31 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Photographic Log

Date: April 13, 1989

Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
Hazardous waste drum
storage area

Number 35 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

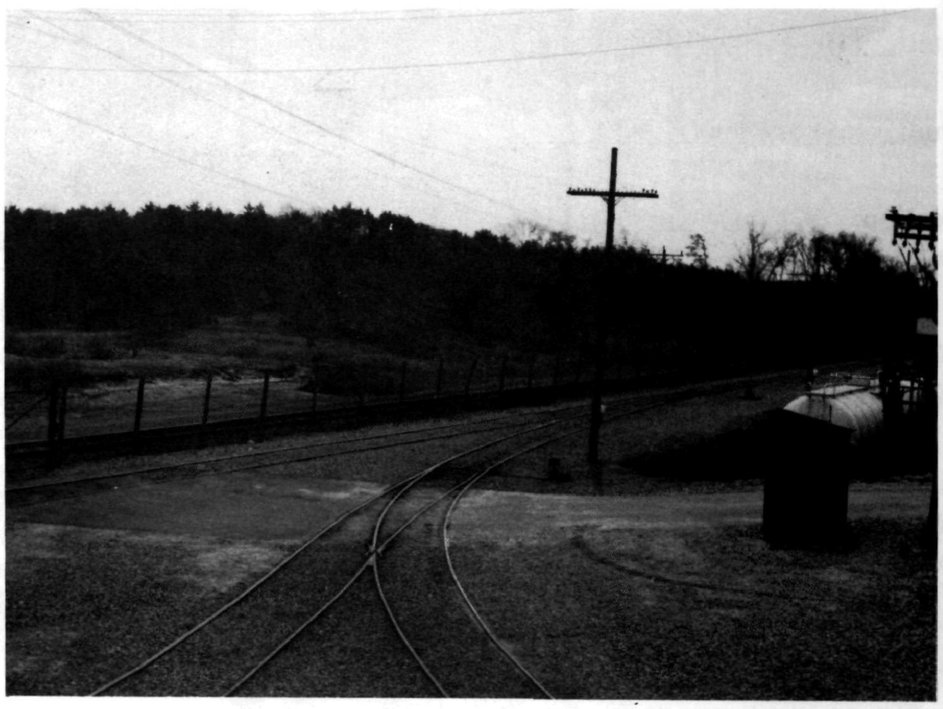
Date: April 13, 1989

Time: afternoon

Location: W.R. Grace Facility
Nashua, New Hampshire

Photo By: Nermin Ahmad - TAT
EPA Site Audit Team Member

Brief Description:
Grace Rail siding looking
south from "A"
Hydrocyanic Acid storage tank



Number 39 of 45

Camera Model: Minolta SRT 100b

Lens Used: 28 mm 1:2.8 MC ϕ 49

Project: Accidental Release Audit - W.R. Grace, Hampshire Chemicals Co., April 10-14, 1989

Appendix C

Accidental Release Information Questionnaire

Answers to EPA Attachment I

1. **Identify the person(s) answering these Questions on behalf of the addressee of this reporting requirement. Further, identify a person that EPA may contact in case it wants to discuss the answers to these Questions and a lead contact to accompany an audit team throughout your facility.**

   Persons answering these Questions:

   Lauchlin V. Hines
   Assistant Plant Manager

   William J. Pasko
   Technical Manager

   David J. Laferriere
   Process Engineering Manager

   Eileen E. Conley
   Environmental Engineer

   Lead Contact:

   Jeremiah B. McCarthy
   Plant Manager

2. **Identify all environmental permits issued by federal or state authorities that apply to the Facility. Describe all activities at the Facility that are covered by such permits.**

   Permit to Manage Hazardous Waste
   Permit No. 048724173
   Issued by N.H. Waste Management Division
   Permitted activities: Storage only of hazardous waste.

   National Pollutant Discharge Elimination System
   Permit No. NH0000591
   Issued by Water Management Division
   U.S. Environmental Protection Agency
   and
   N.H. Water Supply and Pollution Control Division
   Permitted activities: Discharge of wastewater from the facility to the Merrimack River.

   Permit to Operate Cleaver Brooks 500 Hp Boiler A
   Permit No. PO-B-193
   Issued by N.H. Air Resources Division
   Permitted activities: Operation of 500 Hp Boiler A.

Permit to Operate Cleaver Brooks 500 Hp Boiler B
Permit No. PO-B-1541
Issued by N.H. Air Resources Division
Permitted activities: Operation of 500 Hp Boiler B.

Permit to Operate Cleaver Brooks 600 Hp Boiler
Permit No. PO-B-1542
Issued by N.H. Air Resources Division
Permitted activities: Operation of 600 Hp Boiler.

Temporary Permit Cleaver Brooks 800 Hp Boiler
Permit No. TP-B-172
Issued by N.H. Air Resources Division
Permitted activities: Operation of 800 Hp Boiler.

Permit to Operate New Hot Oil Heater
Permit No. PO-B-1045
Issued by N.H. Air Resources Division
Permitted activities: Operation of Ammonia Tower Hot Oil Heater.

Permit to Operate Lime Waste Treatment Incinerator
Permit No. PO-BP-2412
Issued by N.H. Air Resources Division
Permitted activities: Operation of Lime Waste Treatment Incinerator for the incineration of process waste streams.

Permit to Operate NTA Production Equipment
Permit No. PO-BP-193
Issued by N.H. Air Resources Division
Permitted activities: Operation of production equipment for the production of nitrilotriacetic acid.

Permit to Operate IDA Production Equipment
Permit No. PO-BP-2411
Issued by N.H. Air Resources Division
Permitted activities: Operation of production equipment for the production of iminodiacetic acid.

3. **Briefly describe the Facility and its operations. Include in this description a simple process flow chart labeling process steps, vents, blowers, stacks, control equipment, waste treatment systems, and safety instrumentation. (Submit flow diagrams on eight and one-half by eleven-inch paper if they are readily available in this format.) List the major raw materials used and end products produced at the Facility.**

Founded in 1958 and acquired by W. R. Grace & Co. in 1965, the Nashua Facility is one of four major chemical facilities operated and managed by the Organic Chemicals

Division. Most of the products manufactured at this location are based on Hydrocyanic Acid chemistry and cannot be produced elsewhere by Grace in the United States or Canada. The facility consists of four manufacturing plants, a research lab, office and effluent treatment facilities.

There are currently 325 full-time employees, including approximately 200 factory and about 125 office and research personnel employed at the Nashua location. Except for a scheduled two week shut-down each summer for maintenance, replacement and reconditioning of equipment, the plant normally operates 24 hours/day, 7 days/week.

The Nashua Facility is a batch specialty chemical plant. We produce 133 products; some products are produced continually and some are produced seasonally.

Since the Facility does produce so many products, an interpretation of the desired process information was requested from Raymond DiNardo, Manager, Region 1 Chemical Emergency Preparedness Program. As per an August 25, 1988 conversation with him, we are providing process flowsheets by the major product line groups rather than providing a flowsheet for each product. The major product line groups covered by these flow sheets represent ≈70% of plant production. The remaining products are, for the most part, simple variations of one of these major product lines. (For example, EDTA is made as a sodium salt solution by either of two processes, both shown on the flowsheets. These sodium salts are sold at various pH ranges and converted to other crystalline or solution forms totalling more than 30 variations.)

Attachments 1 through 9 depict the flowsheets for the major product line groups for the Nashua Facility. If any additional information is required, it will be provided upon request.

Major raw materials used at the facility:

1,3-diaminopropane
acetone
aminoethylethanolamine
ammonia, anhydrous
ammonia, aqueous solution
calcium magnesium oxide
calcium oxide
coconut acid
copper oxide
cyclohexanone
diethanolamine

diethylenetriamine
ethylenediamine
ferric chloride
ferrous sulfate
formaldehyde
hydrocyanic acid
hydrogen peroxide
isopropanol
lauric acid
manganese oxide
magnesium oxide
methyl ethyl ketone
monomethanolamine
monomethylamine
nitric acid
oleic acid
phosphorous trichloride
potassium hydroxide, solution
sodium cyanide, solution
sodium hydroxide, solution
sponge iron
sulfuric acid
zinc oxide

Major products produced at the facility:

acetone aminonitrile (AAN)
ammonia, anhydrous
cyclohexanone aminonitrile (CHAN)
diethylene triaminepentaacetic acid (HAMP-EX Acid)
disodium iminodiacetate (DSIDA)
ethylenediamine tetraacetic acid, 2.5% magnesium
(HAMP-ENE 2.5% Magnesium)
ethylenediamine tetraacetic acid, 6% manganese
(HAMP-ENE 6% Manganese)
ethylenediamine tetraacetic acid, 6.5% zinc
(HAMP-ENE 6.5% Zinc)
ethylenediamine tetraacetic acid, 7.5% copper
(HAMP-ENE 7.5% Copper)
ethylenediamine tetraacetic acid, 3% calcium
(HAMP-ENE 3% Calcium)
ethylenediamine tetraacetic acid (HAMP-ENE Acid)
hexamethlyenetriamine
iminodiacetic acid (IDA)
methyl ethyl ketone aminonitrile (MEKAN)
methyl isobutyl ketone aminonitrile (MIBKAN)
nitrilotriacetic acid, zinc (HAMPSHIRE NTA Zinc)
N-cocoyl sarcosine (HAMPOSYL C)
N-hydroxyethylethylenediaminetriacetic acid, 5% iron
(HAMP-OL 5% Iron)
N-hydroxyethylethylenediaminetriacetic acid
(HAMP-OL Acid)
N-lauroyl sarcosine (HAMPOSYL L)
N-oleoyl sarcosine (HAMPOSYL O)

pentasodium diethylenetriaminepentaacetate, solution (HAMP-EX 80)
sodium cocoyl sarcosinate (HAMPOSYL C-30)
sodium cyanide, solution
sodium lauroyl sarcosinate (HAMPOSYL L-30)
sodium sulfate
tetrasodium ethylenediamine tetraacetate, solution (HAMP-ENE 100)
tetrasodium ethylenediamine tetraacetate (HAMP-ENE Na_4)
tetrasodium ethylenediamine tetrahydrate (HAMP-ENE 220)
trisodium ethylenediamine tetraacetate, solution (HAMP-ENE Na_3)
trisodium nitrilotriacetate monohydrate (NTA)
trisodium nitrilotriacetate, solution (NTA-150)
trisodium N-hydroxyethylethylenediaminetriacetate, solution (HAMP-OL 120)
trisodium N-hydroxyethylethylenediaminetriacetate hydrate (HAMP-OL Crystals)

4. **How large is the average buffer zone around your facility? Provide a map showing your building location and surrounding area.**

Average buffer zone: 387 ft.
Site plan enclosed: Grace Dwg. 04-25 (Attachment 10)

The average buffer zone of 387 feet refers to the literal Agency definition of a buffer zone as "any unpopulated spaced owned by your company between your process and storage areas and populated areas". Since this definition refers specifically to areas owned by the company, it does not include the effective unpopulated area, both company owned and otherwise owned, between the plant process and storage areas and adjacent populated areas.

Although the populated area to the west of the facility is adjacent to the facility boundary, to the south there is a 1125 foot zone, to the north a 2300 foot zone and to the east a 4800 foot zone between the facility process and storage areas and populated areas.

5. **Generally describe the area surrounding the Facility, including but not limited to, business, residences, schools, or other population centers. Identify the approximate number of people within a five-mile radius of the Facility.**

The W. R. Grace & Co.-Conn.'s Organic Chemicals Division facility in Nashua, New Hampshire, is located on Poisson

Avenue, adjacent to the Merrimack River, at 42°43'2.5" latitude and 71°26'19.6" longitude. Land in the area is used primarily for commercial strips, with some residential areas and multifamily residential developments. The facility is separated from the river to its east by the tracks of the Guilford Transportation Industries, Inc. railroad. It is bound on the west by commercial development (including a motel, a day care center and several restaurants) and three private residences; on the north by commercial property; and on the south by a manufacturing plant. A golf course and residential area lie across the river from the plant. A five mile radius from the plant includes substantially all of the towns of Nashua and Hudson, New Hampshire and Tyngsboro and Dunstable, Massachusetts. The total population of these four towns is 108,000.

6. **How many people are employed at the Facility?**

   There are currently 325 people employed at the Facility.

7. **Generally describe the terrain surrounding the Facility. (e.g., geology, large bodies of water, man-made features, etc.)**

   The terrain surrounding the facility is best described by the attached United States, Department of the Interior, Geological Survey Map. (See Attachment 11) The land slopes steeply downgrade west to east. Spit Brook crosses the western boundary of the plant site, flows northeasterly for approximately 200 feet in an open channel, and then is conveyed under the plant via a 6-foot conduit to the Merrimack River. The Merrimack River lies to the east of the plant and flows from north to south.

8. **List all extremely hazardous substances present at your facility in excess of the threshold planning quantity listed in Appendices A and B of the Wednesday, April 22, 1987, Federal Register, pages 13397 through 13410, and all CERCLA hazardous materials generated, treated, produced, used, stored, disposed of, or otherwise handled at or by the Facility in excess of 10,000 pounds in any calendar year. (See Table 302.4 of 40 CFR Part 302 for listed CERCLA hazardous materials.) For each hazardous material and extremely hazardous substance, identified, further identify:**

   a. **The Chemical Abstracts Service (CAS) registry numbers.**

b. The quantity generated, treated, produced, used, stored, disposed of, or otherwise handled each year over the past two years.

c. A brief description of how and the location where it was used, treated, stored, disposed of, or otherwise handled.

8-1a Ammonia (CAS #7664-41-7)

8-2a Sodium Cyanide (CAS #143-33-9)

8-3a Ethylenediamine (CAS #107-15-3)

8-4a Hydrocyanic Acid (CAS #74-90-8)

8-5a Sulfuric Acid (CAS #7664-93-9)

8-6a Nitric Acid (CAS #7697-37-2)

8-7a Formaldehyde (CAS #50-00-0)

8-8a Phosphorus Trichloride (CAS #7719-12-2)

8-9a Hydrogen Peroxide (CAS #7722-84-1)

8-10a Ethylenediaminetetraacetic Acid (CAS #60-00-4)

8-11a Sodium Hydroxide (CAS #1310-73-2)

8-12a Potassium Hydroxide (CAS #1310-58-3)

8-13a Ferrous Sulfate (CAS #7720-78-7)

8-14a Ferric Chloride (CAS #7705-08-0)

8-15a Cyclohexanone (CAS 108-94-1)

8-16a Methyl Ethyl Ketone (CAS #78-93-3)

8-17a Methyl Isobutyl Ketone (CAS #108-10-1)

8-18a Acetone (CAS #67-64-1)

8-19a Phosphoric Acid (CAS #7664-38-2)

9. **Identify the hazardous material release prevention plans and procedures you use or have used at the Facility. Provide copies of such plans or procedures to EPA.**

Hazardous material release prevention plans and procedures consist of two components: prevention and response.

Prevention

All operating procedures using hazardous materials are designed to minimize the risk of a hazardous material release. These procedures include Standard Operation Procedures (SOPs) and Standard Raw Material Handling Procedures (SRHPs). Attached are copies of SOP 0730 (Attachment 13) for the fatty acid chloride reaction, and SRHPs 1200 (Attachment 14) and 1725 (Attachment 15) for hydrocyanic acid and phosphorus trichloride as examples of these procedures. Exact quantities have been blanked out of SOP 0730 due to the proprietary nature of this information.

Other procedures include maintenance and inspection procedures. Some of these procedures are part of SRHPs while others are done on a routine basis, ranging from daily to annually. Daily inspections include:

1. Morning tank farm readings by the Yard Crew which includes inspections for leaks.

2. Inspection of plant areas by the Production Supervisor at the start of each shift.

3. Inspection of the hazardous waste storage areas by the Pollution Control Operators.

4. Handling of hazardous materials by dedicated work crews. For example, hydrocyanic acid is unloaded by a dedicated crew that does not unload or load any other material. Likewise, the crew that unloads the other raw materials never unloads hydrocyanic acid.

A copy of our Hazardous Waste Handling Permit (Attachment 16) is attached as it outlines in detail our procedures for handling hazardous wastes and some of these inspection procedures.

Some examples of annual maintenance procedures include cleaning, internal inspection and replacement of all valves in the two hydrocyanic acid storage tanks and all the hydrocyanic acid railcars. The maintenance department recently purchased a new computer system to improve documentation of all maintenance inspections.

Other procedures used to minimize risk of an accidental release include (copies attached):

1. Contractor area permit (Attachment 17)

2. Contractor safety rules and procedures (Attachment 18)

3. Equipment procedures
   a. Equipment lock-out (Attachment 19)
   b. Line or pump repair (Attachment 20)
   c. Hot work permit (Attachment 21)
   d. Vessel Entry permit (Attachment 22)
   e. Defective equipment tag (Attachment 23)

Emergency Response

In the event of an upset or a release of a hazardous material, we have an extensive emergency response procedure to minimize the extent of the release. A copy of this "Contingency Plan" is attached (Attachment 24).

In summary, the Contingency Plan works as follows:

There are over 100 emergency alarm pull stations throughout the plant site. When a pull station is activated, a plant wide emergency alarm sounds and the pull station location is indicated on one of two central alarm panels. The emergency alarm can be used for any emergency requiring immediate assistance including an accident, chemical release, injured employee, fire, etc.

Several things happen when an emergency alarm sounds.

1. One of two trained Emergency Service Teams (EST) responds to the pull station location while the other waits as backup.

2. All plant radios are turned to channel 2.

3. All material transfers in the plant are stopped.

4. The pollution control operator switches plant effluent to a spill holding basin.

5. Office area paging systems are turned on.

The plant maintains two ESTs on site 24 hours a day, seven days a week. In addition, the alarm system and emergency equipment is tested and/or inspected on a weekly basis. This includes emergency alarms, fire prevention equipment, escape respirator checklist and emergency locker checklist.

Each Emergency Service Team consists of a Production Supervisor, three men from either the Production Department or the Maintenance Department, and one communications person from the Quality Control Laboratory. The Production Supervisor and the three team members suit up in personal protection equipment for the response effort. The communications person mans the central radio and telephone communication station.

Additional procedures are outlined in the plant "Safety Rules and Regulations" (Attachment 25).

10. **Identify the training activities at the facility related to safety and loss prevention.**

Training activities regarding safety and loss prevention begin the day a new employee is hired and is given a New Employee Safety Indoctrination.

This indoctrination includes familiarization with the plant's Safety Rules and Regulations, Right-to-Know and

Hazard Communication information.

Production employees are given further training in safe handling procedures for hazardous chemicals when they are assigned to a particular work area. This on-the-job training normally consist of a 60 to 90 day period during which the employee is trained by a qualified operator and by the production supervisor. Employees become familiar with emergency alarm locations by participating in the weekly testing procedures.

In addition to on the job training, other safety and loss prevention training is outlined below.

A. Safety Meetings

A-1 Safety Coordinator-Plant Wide Safety Meetings
Once a month, the Safety Coordinator has plant wide safety meetings which are mandatory for all plant operation and maintenance personnel. These meetings cover a variety of subjects such as:

Personal protective equipment
Right-to-Know, hazard communication
Hazards of specific chemicals
Respiratory protection program
Material handling procedures
Pollution control and spill procedures

A-2 Shift Supervisor Monthly Shift Safety Talks
These are similar to the plant wide safety meetings, but on a smaller scale. Once each month, every production and maintenance supervisor holds a safety talk for his employees. Subjects are similar to the plant wide meetings but are more detailed and more specific to the hazards associated with that group's work and work areas.

A-3 Contractor Safety Talks
All contractors entering the plant site are given an orientation and instructed on Contractor Safety Rules and Procedures (See Attachment 18). This orientation also includes information on the types of chemicals and the hazards that the contractor may be working near.

In addition, daily Contractor Area Permits and daily Hot Work Permits are required so that production supervisors are aware of what work is being performed in what areas by contractors.

B. Emergency Service Team Training (EST)

B-1 Monthly Practice Alerts
Each of the eight ESTs has a practice alert once every month. These practice sessions are unannounced and simulate a real emergency ranging from employee injury to chemical release. An evaluation session follows each practice session.

B-2 Fire Department Training
ESTs have received special training at the Nashua Fire Department training grounds including proper hose handling, the use of different nozzles, practice using fire fighting foam on oil fires, etc.

B-3 EST Leader Training
All EST Leaders (as well as other management personnel) have attended a week long hazardous materials response training course at the Association of American Railways training facility in Pueblo, Colorado. The plant Safety Coordinator and other personnel have also attended additional training programs such as Tank Truck Emergency courses at Texas A&M University.

C. Fire Extinguisher Training
Office and laboratory personnel have attended fire safety training sessions at the Nashua Fire Department training grounds that included practice using fire extinguishers to put out actual fires.

D. Fire Department Seminar and Tour
All Nashua Fire Department personnel have received two hours of classroom instruction on the chemicals we handle as well as a complete tour of the plant site.

We have also sponsored Nashua Fire Department personnel to attend above mentioned hazardous materials courses.

E. Hazardous Waste
All personnel handling hazardous waste receive training that includes the program outlined in the Hazardous Waste Permit (See Attachment 16).

11. **Briefly describe the methodologies by which the Facility identifies safety hazards and the systems, procedures or equipment used to prevent hazardous substance releases from occurring.**

In the early 1980's, a committee of key operating, technical and engineering personnel was formed to evaluate our storage and handling of hazardous raw materials. The Materials Use and Storage Team (MUST) evaluated the use and handling of hazardous materials as compared to applicable industry standards and practices. The result was a major capital projects program to improve the handling and storage of several materials including: phosphorus trichloride, hydrocyanic acid, monomethylamine, and anhydrous ammonia.

In designing changes to these systems, applicable industry standards both voluntary and regulatory, were used as the basis for design.

The most significant applicable voluntary standards which were developed with substantial input from the hydrocarbon industry are:

1. National Fire Protection Association NFPA-30, Flammable and Combustible Liquids Code.

2. NFPA-497, Classification of Class 1 Hazardous Location for Electrical Installation in Chemical Plants.

3. NFPA-497M, Classification of Gases, Vapors and Dusts for Electrical Equipment in Hazardous Locations.

4. American National Standards Institute ANSI B 31.3, Petroleum Refinery Piping

5. API Recommended Practice (RP) 520, Parts I and II, Design and Installation of Pressure-Relieving Systems in Refineries.

6. API STD 650, Welded Steel Tanks for Oil Storage Tanks.

7. API STD 2000, Venting Atmospheric and Low-Pressure Storage Tanks.

8. API 510, Pressure Vessel Inspection Code

9. API RP 2001, Fire Protection in Refineries

Another group which has played a major role in chemical plant safety was the Manufacturing Chemists' Association, Inc. (MCA), now the Chemical Manufacturer's Association (CMA). The Chemical Safety Data Sheets produced by that group contained "Properties and Essential Information for Safe Handling and Use of ..." various chemicals. MCA also produced manuals for standard and recommended practices. This information was superseded by manufacturers Material Safety Data Sheets (MSDS) and storage and handling booklets. All products which are considered to be hazardous materials, whether or not stored in permanent outside storage, require MSDSs.

In addition to these voluntary standards, certain applicable codes and standards are part of the laws of the State of New Hampshire, or local fire laws. These include:

1. Building Code Officials and Code Administrators International BOCA Basic Fire Prevention code and NFPA 101, Life Safety Code; recommendations based on these codes were made by the Nashua Fire Department.

2. American Society of Mechanical Engineers (ASME) Unfired Pressure Vessel Code, Section VIII, Division 1 and Power Boiler Code, Section I.

3. Referenced voluntary standards such as:
   a. NFPA 70, National Electrical Code; especially Article 500, Hazardous (Classified) Locations
   b. NFPA 30, Described earlier
   c. API STD 650, Described earlier
   d. NFPA, Liquified Petroleum Gases.

Other mandatory laws at the federal level applicable to plant operations include those under the jurisdiction of OSHA, EPA and DOT. These laws have been incorporated into state law in many instances.

Once a preliminary design is completed, process review meetings are held to evaluate possible problems. In most cases "what if" type scenarios are explored similar to a HAZOPS. These review meetings include input from hourly maintenance and production employees, supervisors, plant technical and process engineers, project engineers and, in many cases, Grace Corporate Risk Assessment Group and independent consultants. Design reviews are continued until everyone is satisfied with the design.

In addition to design meetings and applicable standards and regulations, there are other basic principals used as a design basis, including:

Minimizing the total volume and number of storage containers.
Minimizing the quantity of hazardous materials inside process areas.
Operation of systems at lowest possible pressures.

Use of passive rather than active safety controls, where possible.
Provision of redundancy on critical equipment

In addition to the major project efforts instituted by the MUST program, a number of other methods are used to identify potential safety hazards. These include:

Inspections by Grace Corporate Risk Assessment Group
Inspections by Grace Specialty Chemicals Environmental, Health and Safety Department
Inspections by CNA Insurance Co.
Inspections by Marsh & McClennan Protection Consultants
Annual inspections by Hartford Steam Boiler (A complete inspection of all ASME code vessels was completed within the last year)
Monthly inspections by plant Safety Committee members
Plant maintenance Safety Work Order System

As a final step in evaluating potential releases, air modeling studies are being prepared for several "realistic worst case" scenarios involving the most hazardous materials. The cases chosen were selected with the help of Grace's Corporate Risk Assessment Group and Marsh & McClennan Protection Consultants. The results of this study will be made available for use by the Local Emergency Planning Committee when the study is completed.

12. For the August 5, 1988, Phosphorus Trichloride release, provide answers to the following questions:

a. What was the cause of the accident?

b. How could the accident have been avoided?

c. What steps have you taken to avoid future accidents of this nature?

d. Once the accident occurred, what steps were taken to evacuate the immediate area and control the situation? How can this process be improved?

e. What are the potential health risks to workers and persons in the immediate area of the release? How many people were exposed at the time of the accident and how were they treated?

f. What is the likelihood of a future accident at the plant and what is being done to diminish this risk?

a. The cause of the August 5, 1988 Hydrochloric Acid Release was the failure of a butterfly valve on the atmospheric vent line on the reactor. This valve is installed on the atmospheric vent line on the tank. Normally this valve is closed during processing, closing off the atmospheric vent, and all vapors are vented through a water scrubber system. This valve is opened when the reactor is being cleaned. The failure of this valve to properly seat allowed the vapors to escape through the atmospheric vent rather than to the scrubber system.

b. The cause of the incident is described in 12a above. The steps taken to avoid future incidents are described in 12c below and have been implemented as a result of our analysis of the event.

c. The failed valve has been replaced with a valve that is specified for a more severe service. Additionally, modifications have been made to the scrubber system and to the process operation to carry out future reactions under negative pressure which gives indication ahead of time that all valves are properly sealed. A secondary scrubber has also been added to this system.

d. Once the venting of the vapors to atmosphere was detected, the ongoing process was shut down and our on-site emergency response team was activated. They donned personal protective gear and breathing apparatus, cleared the process area, and set up water hoses to deluge the area with water to scrub the escaping vapors out of the air. An improvement to this response effort would be to provide fog nozzles for the fire hoses. Deluging the area with a fog spray would be more efficient for scrubbing the vapors than deluging the area with a fire hose spray.

e. "High concentrations of hydrochloric acid vapors are highly corrosive to eyes, skin, and mucous membranes. The acid may produce burns, ulceration, scarring on skin and mucous membranes, and it may produce dermatitis on repeated exposure." (Ref.: Sittig, Handbook of Toxic and Hazardous Chemicals, p. 375)

There were no on-site personnel exposed to the acid vapors who were not protected by personal protective gear and self contained breathing apparatus. There were no on-site personnel treated for exposure.

EPA representatives were unable to detect any concentrations of hydrochloric acid vapors in the area surrounding the plant site. This fact, in conjunction with air release modeling data, indicate that off-site exposure above the TLV concentration was unlikely. Incident reports indicate that 51 off-site people were examined for possible exposure. Of these, one was kept overnight for observation and was released the next day.

The remaining 50 were released immediately.

f. As was described in the answer to Question 12-c, the failed valve has been replaced. Additionally, modifications have been made to the scrubber system and to the process operation to carry our future reactions under negative pressure.

Process operations with the modifications are being closely monitored by the Process Engineering Group to assure that these process modifications are not only operating properly but are resulting in the desired process modifications.

A copy of the incident summary report that was submitted to the responding Agencies is enclosed (Attachment 26).

Appendix D

HCN Release Profile

EPA ATTACHMENT II
03/15/88 HCN RELEASE

OMB #: 2050-0065

U.S. ENVIRONMENTAL PROTECTION AGENCY
RELEASE PREVENTION QUESTIONNAIRE

INITIAL REPORT

SECTION 1. FACILITY PROFILE

1. FACILITY NAME: W. R. GRACE & CO.-CONN.
ORGANIC CHEMICALS DIVISION

2. FACILITY ADDRESS: POISSON AVENUE
Street
NASHUA
City
N. H.
State
03061
Zip Code

3. NAME OF OWNER: W. R. GRACE & CO.-CONN.

4. ADDRESS OF OWNER: GRACE PLAZA, 1114 AVENUE OF THE AMERICAS
Street
NEW YORK
City
N. Y.
State
10036
Zip Code

5. RESPONDENT: JEREMIAH B. MC CARTHY
Name
PLANT MANAGER
Title
POISSON AVENUE
Street
NASHUA
City
N. H.
State
03061
Zip Code
(603) 888-2320
Telephone

6. Please indicate the year facility operations began.

[1] [9] [5] [8]

7. Identify the four-digit Standard Industrial Classification (SIC) that best describes your facility operations and the primary product or service of this facility.

[2] [8] [6] [9]

a. SIC code
b. Primary product or service: SPECIALTY CHEMICALS

8a. Check the item below that best describes the status of facility operations at the time of release.

a. [X] In operation
b. [ ] Temporarily inactive
c. [ ] Permanently closed

8b. Check the item below that best describes the current status of facility operations.

a. [X] In operation
b. [ ] Temporarily inactive
c. [ ] Permanently closed

If Item a is marked, go to Section II Hazardous Substance Release Profile. If Item b or c is marked, answer Question 8.c. below.

8c. Is the shut down of operations at your facility related to the accidental release of hazardous substances?

[ ] Yes
[ ] No

EPA ATTACHMENT II
03/15/88 HCN RELEASE

SECTION II. HAZARDOUS SUBSTANCE RELEASE PROFILE

The following section asks several questions concerning the accidental release of hazardous substances. If exact responses cannot be provided, please provide estimates using your best professional judgment.

9. Indicate the date release occurred.

[0] [3] - [1] [5] - [8] [8]
(month) (day) (year)

10. Indicate the time of day release occurred.

[0] [1] : [3] [5]
[ ] A.M.
[X] P.M.

11. Indicate date release ceased.

[0] [3] - [1] [5] - [8] [8]
(month) (day) (year)

12. Indicate time of day release ceased.

[0] [1] : [4] [5] estimated
[ ] A.M.
[X] P.M.

NOTE: In identifying parties notified of the release, we have included all officials known to Grace to have been notified. Notification to some of the listed parties may have been made by other officials originally notified by Grace.

EPA ATTACHMENT II
03/15/88 HCN RELEASE

13. Were federal authorities notified?

[x] Yes [ ] No

a. If yes, identify all federal authorities notified regarding the release.
(If more than one, please attach list on separate page) PLEASE SEE PAGE 9A

RANDY RICE
US EPA
(Name)

BOSTON, MA
(City)

MA 02203
(State)

(617) 565-3273
(Telephone)

b. Indicate the date and time of day federal authorities were notified.

[0] [3] - [1] [5] - [8] [8] (Date)
(month) (day) (year)

[0] [2] : [3] [5] (Time)
[ ] A.M.
[x] P.M.

14. Were state authorities notified?

[x] Yes [ ] No

a. If yes, identify all state authorities notified concerning the release.
(If more than one, please attach list on separate page) PLEASE SEE PAGE 1

MR. RICHARD STROME
N.H. OFFICE OF EMERGENCY MANAGEMENT
(Name)

CONCORD
(City)

N.H. 03301
(State)

(603) 271-2231
(Telephone)

EPA ATTACHMENT II
03/15/88 HCN RELEASE

13. (a) Mr. O'Brien
National Response Center
Washington, CD 02003
1-800-424-8802

(b) Notification on: 03/15/88
Notification at: 02:20 p.m.

EPA ATTACHMENT II
03/15/88 HCN RELEASE

b. Indicate the date and time of day state authorities were notified.

[0] [3] - [1] [5] - [8] [8] (Date)
(month) (day) (year)

[0] [2] : [0] [0] (Time)
[ ] A.M.
[X] P.M.

15. Were local authorities notified?

[x] Yes [ ] No

a. If yes, identify all local authorities notified concerning the release. (If more than one, please attach list on separate page)

MR. RICHARD MC CANN
NASHUA OFFICE OF EMERGENCY PREPREDNESS
(Name)

NASHUA
(City)

N. H. 03060
(State)

(603) 881-4300
(Telephone)

b. Indicate the date and time of day local authorities were notified.

[0] [3] - [1] [5] - [8] [8] (Date)
(month) (day) (year)

[0] [1] : [5] [5] [ ] [ ] (Time)
[ ] A.M.
[X] P.M.

EPA ATTACHMENT II
03/15/88 HCN RELEASE

14. (a) Mr. Richard Andrews
N. H. Air Resources Division
Concord, NH 03302
(603) 271-1370

(b) Notification on: 03/15/88
Notification at: 02:15 p.m.

(a) Ms. Roberta Cirie
N. H. Waste Management Division
Concord, NH 03301
(603) 271-2943

(b) Notification on: 03/15/88
Notification at: 02:55 p.m.

EPA ATTACHMENT II
03/15/88 HCN RELEASE

16. Was the general public notified?

[ ] Yes [X] No

a. If yes, indicate the person that notified the general public of release.
(If more than one, please attach list on separate page)

____
(Name)

____
(Title)

____
(Company or Government Office)

( ) ______________________________
(Telephone)

b. Indicate the date and time of day the general public was notified.

[ ] [ ] - [ ] [ ] - [ ] [ ] (Date)
(month) (day) (year)

[ ] [ ] : [ ] [ ] (Time)
[ ] A.M.
[ ] P.M.

17. Were members of the general public evacuated?

[ ] Yes [X] No

a. If yes, please indicate number evacuated.

[ ] [ ] [ ] [ ] [ ] [ ]

b. Please indicate date and time of day evacuation began.

[ ] [ ] - [ ] [ ] - [ ] [ ] (Date)
(month) (day) (year)

[ ] [ ] : [ ] [ ] (Time)
[ ] A.M.
[ ] P.M.

EPA ATTACHMENT II
03/15/88 HCN RELEASE

18. To the best of your ability, indicate the weather conditions at the time of release for each item below. Approximations are acceptable.

a. Wind Speed (miles per hour) [0] [0] [9]

b. Wind Direction (N) [N] [W]

DEW POINT

c. ~~Humidity (percent)~~ [ ] [ ] UNKNOWN

d. Temperature (Fahrenheit) [0] [3] [5]

e. Precipitation? [ ] Yes [x] No

19. Please check the one item below that best describes the location of the release within your facility.

(please check one item only)

[x] Process vessel
[ ] Storage vessel
[ ] Valves
[ ] Piping
[ ] Unknown
[ ] Other (please describe)

____
____
____
____

20. Please check the one item below that best describes the operational condition of releasing equipment at the time of the release.

(please check one item only)

[ ] Process startup
[ ] Process shutdown
[ ] Loading
[ ] Unloading
[x] Batch operation
[ ] Maintenance
[ ] Continuing operations
[ ] Unknown
[ ] Other (please describe)

____
____
____
____

EPA ATTACHMENT II
03/15/88 HCN RELEASE

21. Please check the one item below that best describes the primary cause of the release event.

(please check one item only)

[x] Equipment failure
[ ] Operator error
[ ] Bypass condition
[ ] Upset condition
[ ] Fire
[ ] Unknown
[ ] Other (Please describe)

____
____
____
____

22. Please check any items below that describe additional causes of the release event.

(check as many items as apply)

[ ] Equipment failure
[ ] Operator error
[ ] Bypass condition
[ ] Upset condition
[ ] Fire
[ ] Unknown
[X] Other (Please describe)

NONE
____
____
____

23. Check the items below that describe the end effects of the release event.

(check as many items as apply)

[X] Spill
[X] Vapor release
[ ] Explosion
[ ] Fire
[ ] Other (Please describe)

____
____
____
____

EPA ATTACHMENT II
03/15/88 HCN RELEASE

24.a. Identify in the table below the name of each hazardous substance released, the quantity released, and the concentration and physical state at the time of release.

	NAME	QUANTITY	UNIT	PHYSICAL STATE	CONCENTRATION
1.	HYDROCYANIC ACID	30	LBS	VAPOR	100%
2.	HYDROCYANIC ACID	5	GALS	LIQUID	100%
3.					
4.					

b. Please check the items below that describe your methods or source of information for your responses in Question 24.a.

[ ] on-line instrument
[ ] process records
[ ] engineering calculation
[x] estimate
[x] other (please describe)

(1) METEOROLOGICAL DATA
(1) COMPUTER AIR MODELING

EPA ATTACHMENT II
03/15/88 HCN RELEASE

25.a. In the table below, please estimate the quantity of substances listed in Question 24.a released to each media. Be sure to specify the measurement unit.

NAME	MEDIA	QUANTITY	UNIT
	Air	30	LBS
1. HYDROCYANIC ACID VAPOR	Surface Water	-0-	LBS
	Land	-0-	LBS
	Ground Water	-0-	LBS
	Air	-0-	LBS
2. HYDROCYANIC ACID LIQUID	Surface Water	-0-	LBS
	Land	-0-	LBS
	Ground Water	-0-	LBS
	Air		
3.	Surface Water		
	Land		
	Ground Water		
	Air		
4.	Surface Water		
	Land		
	Ground Water		

b. Please check the items below that describe your methods or source of information for your responses in Question 25.a.

[ ] physical properties
(1,2) [X] observation
[ ] on-line instrument
[ ] engineering estimate
[X] other (please describe)

(1) METEOROLOGICAL DATA
(1) COMPUTER AIR MODELING

EPA ATTACHMENT II
03/15/88 HCN RELEASE

26.a. Did any substances identified in Questions 24 and 25, migrate beyond the legal boundaries of your facility (for example, a vapor release was carried by prevailing wind beyond the fence line of your facility)?

(1) [X] Yes (If yes, please answer Question 26.b)
(2) [X] No (If no, skip Question 26.b and answer Question 27)

b. In the table below specify the quantities of substances that migrated past your facility boundaries.

NAME	MEDIA	QUANTITY	UNIT
1. HYDROCYANIC ACID VAPOR	Air	MAXIMUM OF 30	LBS
	Surface Water	-0-	LBS
	Land	-0-	LBS
	Ground Water	-0-	LBS
2. HYDROCYANIC ACID LIQUID	Air	-0-	LBS
	Surface Water	-0-	LBS
	Land	-0-	LBS
	Ground Water	-0-	LBS
3.	Air		
	Surface Water		
	Land		
	Ground Water		
4.	Air		
	Surface Water		
	Land		
	Ground Water		

c. Please check the items below that describe your methods or source of information for your responses in Question 26.b.

[X] physical properties and ambient conditions
[ ] observation
[ ] on-line instrument
[ ] engineering estimate
[X] other (please describe)

METEOROLOGICAL DATA
COMPUTER AIR MODELING

27. Did injuries occur among facility employees as a result of the event?

[ ] Yes
[X] No
[ ] Don't know

a. If yes, please indicate number of injuries.

[ ] [ ] [ ] [ ] [ ] [ ]

[ ] Number of injuries unknown

28. Did injuries occur among the general public as a result of the event?

[ ] Yes
[X] No
[ ] Don't know

a. If yes, please indicate number of injuries.

[ ] [ ] [ ] [ ] [ ] [ ]

[ ] Number of injuries unknown

29. Did deaths occur among facility employees as a result of the event?

[ ] Yes
[X] No
[ ] Don't know

a. If yes, please indicate number of deaths.

[ ] [ ] [ ] [ ] [ ] [ ]

[ ] Number of deaths unknown

30. Did deaths occur among the general public as a result of the event?

[ ] Yes
[X] No
[ ] Don't Know

a. If yes, please indicate number of deaths.

[ ] [ ] [ ] [ ] [ ] [ ]

[ ] Number of deaths unknown

31. Did environmental effects occur as a result of the event?

[ ] Yes
[X] No
[ ] Don't Know

a. If yes, please describe the impact.

____

____

____

EPA ATTACHMENT II
03/15/88 HCN RELEASE

SECTION III. CLEANUP AND PREVENTION PROFILE

32. Did your facility undertake cleanup of the release?

[x] Yes (If yes, please answer Question 32)
[ ] No (If no, please answer Question 33)

33. Has cleanup of the release been completed?
[x] Yes (If yes, please answer Questions 32.a and 32.b)
[ ] No (If no, please answer Questions 32.a and 32.c)

a. Please supply the name and address of the party responsible for cleanup.

William Pasko
(Name)

Technical Manager
(Title)

W. R. Grace & Co., Poisson Avenue
(Address)

Nashua, NH 03061
(City, State)

(603) 888-2320
(Telephone)

b. Indicate the date cleanup activity ceased.

[0] [3] - [1] [5] - [8] [8]
(month) (day) (year)

c. Please indicate the approximate date completion of cleanup activity is expected.

[ ] [ ] - [ ] [ ] - [ ] [ ]
(month) (day) (year)

EPA ATTACHMENT II
03/15/88 HCN RELEASE

34. Please describe the immediate response activities taken to contain or minimize the release.

Please see Page 20A

35. As simply as possible, describe release prevention practices and policies (backup systems, containment system, training programs) utilized at the facility when the release occurred.

See response to Attachment 1, Questions 9, 10, 11.

36. Please indicate which of the prevention practices and policies listed in Question 35, if any, were ineffective in preventing the release from reaching the environment.

NONE

37. Describe equipment repairs and/or replacements (management practices, operational changes, etc.) made as a result of the release.

A new gasket was installed in the flange connection and the vessel was then washed out with water. This was done so that all gaskets on the vessel could be inspected and replaced as necessary.

34. The operator suspected there was a leak in the process vessel because the instrument reading indicated a lesser quantity of hydrocyanic acid in the vessel than there should have been. He informed the supervisor and the two donned personal protective equipment to investigate.

When it was confirmed that there was a hydrocyanic acid leak, the on-site emergency response teams were activated. A maintenance team was suited up to assess and abate the leak.

The puddle of hydrocyanic acid crystallized upon exposure to the air and evaporated.

38. What additional preventative measure(s) will be taken to minimize the possibility of recurrence?

The process equipment design for this system has been modified to eliminate the need for this process vessel.

Appendix E

HCl Release Profile

EPA ATTACHMENT II
08/05/88 HCl RELEASE

OMB #: 2050-0065

U.S. ENVIRONMENTAL PROTECTION AGENCY RELEASE PREVENTION QUESTIONNAIRE

INITIAL REPORT

SECTION 1. FACILITY PROFILE

1. FACILITY NAME: W. R. GRACE & CO-CONN
ORGANIC CHEMICAL DIVISION

2. FACILITY ADDRESS: POISSON AVE
Street
NASHUA
City
N. H.
State
03061
Zip Code

3. NAME OF OWNER: W. R. GRACE & CO-CONN

4. ADDRESS OF OWNER: GRACE PLAZA, 1114 AVENUE OF THE AMERICAS
Street
NEW YORK
City
N. Y.
State
10036
Zip Code

5. RESPONDENT: JEREMIAH B. McCARTHY
Name
PLANT MANAGER
Title
POISSON AVE
Street
NASHUA
City
N. H.
State
03061
Zip Code
(603) 888-2320
Telephone

6. Please indicate the year facility operations began.

[1] [9] [5] [8]

7. Identify the four-digit Standard Industrial Classification (SIC) that best describes your facility operations and the primary product or service of this facility.

[2] [8] [6] [9]

a. SIC code
b. Primary product or service: SPECIALTY CHEMICALS

8a. Check the item below that best describes the status of facility operations at the time of release.

a. [X] In operation
b. [ ] Temporarily inactive
c. [ ] Permanently closed

8b. Check the item below that best describes the current status of facility operations.

a. [X] In operation
b. [ ] Temporarily inactive
c. [ ] Permanently closed

If Item a is marked, go to Section II Hazardous Substance Release Profile.
If Item b or c is marked, answer Question 8.c. below.

8c. Is the shut down of operations at your facility related to the accidental release of hazardous substances?

[ ] Yes
[ ] No

EPA ATTACHMENT II
08/05/88 HCl RELEASE

SECTION II. HAZARDOUS SUBSTANCE RELEASE PROFILE

The following section asks several questions concerning the accidental release of hazardous substances. If exact responses cannot be provided, please provide estimates using your best professional judgment.

9. Indicate the date release occurred.

[0] [8] - [0] [5] - [8] [8]
(month) (day) (year)

10. Indicate the time of day release occurred.

[0] [4] : [0] [0]
[X] A.M.
[ ] P.M.

11. Indicate date release ceased.

[0] [8] - [0] [5] - [8] [8]
(month) (day) (year)

12. Indicate time of day release ceased.

[0] [1]: [3] [0]
[ ] A.M.
[X] P.M.

NOTE: In identifying parties notified of the release, we have included all officials known to Grace to have been notified. Notification to some of the listed parties may have been made by other officials originally notified by Grace.

EPA ATTACHMENT II
08/05/88 HCl RELEASE

13. Were federal authorities notified?

[X] Yes [ ] No

a. If yes, identify all federal authorities notified regarding the release.
(If more than one, please attach list on separate page)

PAUL GROULX
(Name) US EPA
ENVIRONMENTAL SERVICES DIVISION
LEXINGTON
(City)

MA. 02173
(State)

(617) 860-4300
(Telephone)

ADDITIONAL AGENCY NOTIFICATIONS: SEE ATTACHED

b. Indicate the date and time of day federal authorities were notified.

[0] [8] - [0] [5] - [8] [8] (Date)
(month) (day) (year)

[0] [7] : [4] [5] (Time)
[X] A.M.
[ ] P.M.

14. Were state authorities notified?

[X] Yes [ ] No

a. If yes, identify all state authorities notified concerning the release.
(If more than one, please attach list on separate page)

JOHN GIFFORD
(Name) N. H. OFFICE OF EMERGENCY MANAGEMENT

CONCORD
(City)

N. H. 03301
(State)

(603) 271-2231
(Telephone)

ADDITIONAL AGENCY NOTIFICATIONS: SEE ATTACHED

ADDITIONAL AGENCY NOTIFICATIONS: PAGE 9A (SEE #13a) - HCl RELEASE - 08/05/88

FEDERAL

MS. KATHERINE DALY
US EPA
EMERGENCY RESPONSE TEAM
LEXINGTON MA 02173
617-860-4300
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 7:45 AM

MR TROUSDELL
NATIONAL RESPONSE CENTER
WASHINGTON DC 02003
1-800-424-8802
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 4:35 PM

PAUL O'CONNELL
US DEPARTMENT OF LABOR
CONCORD NH 03301
603-225-1629

NOTIFICATION ON 08/05/88
NOTIFICATION AT: Approx. 10:00 AM

ADDITIONAL AGENCY NOTIFICATIONS: PAGE 9 B (SEE #14a) - HCl RELEASE - 08/05/88

STATE

MS KIM TAYLOR
NH AIR RESOURCES DIVISION
CONCORD NH 03302
603-271-1370
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 8:30 AM

MICHAEL GALUSKA
NH WASTE MANAGEMENT DIVISION
CONCORD NH 03301
603-271-2942
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 7:40 AM

NANCY KURSEWITZ
NH WATER SUPPLY AND POLLUTION CONTROL
CONCORD NH 03301
603-271-2457
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 11:35 AM

JOHN GREGOIRE
NH FIRE MARSHAL
CONCORD NH 03301
603-271-3294
NOTIFICATION ON: 08/05/88
NOTIFICATION AT 6:45 AM

DISPATCH
NH DEPARTMENT OF SAFETY
CONCORD NH 03301
1-800-852-3792
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 5:25 AM

b. Indicate the date and time of day state authorities were notified.

[0] [8] - [0] [5] - [8] [8] (Date)
(month) (day) (year)

[0] [8] : [3] [4] (Time)
[x] A.M.
[ ] P.M.

15. Were local authorities notified?

[x] Yes [ ] No

a. If yes, identify all local authorities notified concerning the release.
(If more than one, please attach list on separate page)

RICHARD McCANN
(Name) NASHUA OFFICE OF EMERGENCY PREPAREDNESS

NASHUA
(City)

N. H. 03060
(State)

(603) 881-4300
(Telephone)

ADDITIONAL AGENCY NOTIFICATIONS: SEE ATTACHED

b. Indicate the date and time of day local authorities were notified.

[0] [8] - [0] [5] - [8] [8] (Date)
(month) (day) (year)

[0] [5] : [1] [2] [ ] [ ] (Time)
[x] A.M.
[ ] P.M.

ADDITIONAL AGENCY NOTIFICATIONS: PAGE 10 (SEE 15a) - HCl RELEASE - 08/05/88

LOCAL

DISPATCH
NASHUA FIRE DEPARTMENT
NASHUA NH 03060
911
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 4:59 AM

DISPATCH
NASHUA POLICE DEPARTMENT
NASHUA NH 03060
911
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 4:59 AM

DISPATCH
HUDSON FIRE DEPARTMENT
HUDSON NH 03051
603-883-7707
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 5:00 AM

DISPATCH
HUDSON POLICE DEPARTMENT
HUDSON NH 03051
603-889-9090
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 5:00 AM

ROY WILLEY
HUDSON LEPC
HUDSON NH 03051
603-886-6000
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 8:40 AM

PAUL LARKAM
TYNGSBORO LEPC
TYNGSBORO MA 01879
617-649-7504
NOTIFICATION ON: 08/05/88
NOTIFICATION AT: 8:41 AM

EPA ATTACHMENT II
08/05/88 HCl RELEASE

16. Was the general public notified?

[x] Yes [ ] No

a. If yes, indicate the person that notified the general public of release.
(If more than one, please attach list on separate page)

ASST. FIRE CHIEF WILLIAM LYNCH
(Name)

(Title)

NASHUA FIRE DEPARTMENT
(Company or Government Office)

(603) 883-3353
(Telephone)

b. Indicate the date and time of day the general public was notified.

[0] [8] - [0] [5] - [8] [8] (Date)
(month) (day) (year)

[0] [7] : [3] [5] (Time)
[X] A.M.
[ ] P.M.

17. Were members of the general public evacuated?

[x] Yes [ ] No

a. If yes, please indicate number evacuated.

[0] [0] [0] [2] [0] [0]

b. Please indicate date and time of day evacuation began.

[0] [8] - [0] [5] - [8] [8] (Date)
(month) (day) (year)

[0] [7] : [3] [5] (Time)
[x] A.M.
[ ] P.M.

HUDSON NH EVACUATED

0 8 - 0 5 8 8 (Date)
0 7 4 5 AM (Time) (Approximately)
3500 PERSONS

EPA ATTACHMENT II
08/05/88 HCl RELEASE

18. To the best of your ability, indicate the weather conditions at the time of release for each item below. Approximations are acceptable.

a. Wind Speed (miles per hour) [ ] [0] [5]

b. Wind Direction SOUTH [S] [W]

DEWPOINT
c. ~~XXXXXXXX~~ (percent) [6] [9] °F

d. Temperature (Fahrenheit) [7] [9] [°]

e. Precipitation? [ ] Yes [X] No

19. Please check the one item below that best describes the location of the release within your facility.

(please check one item only)

[X] Process vessel
[ ] Storage vessel
[ ] Valves
[ ] Piping
[ ] Unknown
[ ] Other (please describe)

____
____
____
____

20. Please check the one item below that best describes the operational condition of releasing equipment at the time of the release.

(please check one item only)

[ ] Process startup
[ ] Process shutdown
[ ] Loading
[ ] Unloading
[X] Batch operation
[ ] Maintenance
[ ] Continuing operations
[ ] Unknown
[ ] Other (please describe)

____
____
____
____

21. Please check the one item below that best describes the primary cause of the release event.

(please check one item only)

[X] Equipment failure
[ ] Operator error
[ ] Bypass condition
[ ] Upset condition
[ ] Fire
[ ] Unknown
[ ] Other (Please describe)

____
____
____
____

22. Please check any items below that describe additional causes of the release event.

(check as many items as apply)

[ ] Equipment failure
[ ] Operator error
[ ] Bypass condition
[ ] Upset condition
[ ] Fire
[ ] Unknown
[ ] Other (Please describe)

NONE
____
____
____

23. Check the items below that describe the end effects of the release event.

(check as many items as apply)

[ ] Spill
[X] Vapor release
[ ] Explosion
[ ] Fire
[ ] Other (Please describe)

____
____
____
____

24.a. Identify in the table below the name of each hazardous substance released, the quantity released, and the concentration and physical state at the time of release.

	NAME	QUANTITY	UNIT	PHYSICAL STATE	CONCENTRATION
1.	HYDROCHLORIC ACID	108 lbs.		VAPOR	100%
2.					
3.					
4.					

b. Please check the items below that describe your methods or source of information for your responses in Question 24.a.

[ ] on-line instrument
[X] process records
[X] engineering calculation
[ ] estimate
[X] other (please describe)

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25.a. In the table below, please estimate the quantity of substances listed in Question 24.a released to each media. Be sure to specify the measurement unit.

NAME	MEDIA	QUANTITY	UNIT
1. HYDROCHLORIC ACID	Air	108 lbs.	
	Surface Water	0 lbs.	
	Land	0 lbs.	
	Ground Water	0 lbs.	
2.	Air		
	Surface Water		
	Land		
	Ground Water		
3.	Air		
	Surface Water		
	Land		
	Ground Water		
4.	Air		
	Surface Water		
	Land		
	Ground Water		

b. Please check the items below that describe your methods or source of information for your responses in Question 25.a.

[ ] physical properties
[x] observation
[ ] on-line instrument
[X] engineering estimate
[x] other (please describe)

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26.a. Did any substances identified in Questions 24 and 25, migrate beyond the legal boundaries of your facility (for example, a vapor release was carried by prevailing wind beyond the fence line of your facility)?

[x] Yes (If yes, please answer Question 26.b)
[ ] No (If no, skip Question 26.b and answer Question 27)

b. In the table below specify the quantities of substances that migrated past your facility boundaries.

NAME	MEDIA	QUANTITY	UNIT
1. HYDROCHLORIC ACID	Air	108 lbs. MAXIMUM	___
	Surface Water	0 lbs.	___
	Land	0 lbs.	___
	Ground Water	0 lbs.	___
2. ___	Air	___	___
	Surface Water	___	___
	Land	___	___
	Ground Water	___	___
3. ___	Air	___	___
	Surface Water	___	___
	Land	___	___
	Ground Water	___	___
4. ___	Air	___	___
	Surface Water	___	___
	Land	___	___
	Ground Water	___	___

c. Please check the items below that describe your methods or source of information for your responses in Question 26.b.

[x] physical properties and ambient conditions
[ ] observation
[ ] on-line instrument
[x] engineering estimate
[x] other (please describe)

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27. Did injuries occur among facility employees as a result of the event?

[ ] Yes
[X] No
[ ] Don't know

a. If yes, please indicate number of injuries.

[ ] [ ] [ ] [ ] [ ] [ ]

[ ] Number of injuries unknown

28. Did injuries occur among the general public as a result of the event?

[ ] Yes
[ ] No
[ ] Don't know

ADDITIONAL INFORMATION ATTACHED

a. If yes, please indicate number of injuries.

[ ] [ ] [ ] [ ] [ ] [ ]

[ ] Number of injuries unknown

29. Did deaths occur among facility employees as a result of the event?

[ ] Yes
[X] No
[ ] Don't know

a. If yes, please indicate number of deaths.

[ ] [ ] [ ] [ ] [ ] [ ]

[ ] Number of deaths unknown

ADDITIONAL INFORMATION: PAGE 17 (SEE #28) - HCl RELEASE - 08/05/88

ALTHOUGH WE HAVE READ THE NEWSPAPER ACCOUNTS THAT PERSONS WERE TREATED AT AREA HOSPITALS FOR THE POSSIBLE EFFECTS OF EXPOSURE TO THE VAPORS, WE ARE UNABLE TO OBTAIN SPECIFIC INFORMATION ABOUT THESE POSSIBLE EXPOSURES, TO CONTACT THESE PERSONS. PATIENT CONFIDENTIALITY REQUIREMENTS PREVENT THE AREA HOSPITALS FROM DISCLOSING PATIENT NAMES.

INCIDENT REPORTS INDICATE THAT 51 PEOPLE WERE SEEN AT AREA HOSPITALS. OF THESE, 50 PEOPLE WERE RELEASED IMMEDIATELY; ONE PERSON WAS KEPT OVERNIGHT FOR OBSERVATION.

30. Did deaths occur among the general public as a result of the event?

[ ] Yes
[x] No
[ ] Don't Know

a. If yes, please indicate number of deaths.

[ ] [ ] [ ] [ ] [ ] [ ]

[ ] Number of deaths unknown

31. Did environmental effects occur as a result of the event?

[ ] Yes
[x] No
[ ] Don't Know

a. If yes, please describe the impact.

____

____

____

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SECTION III. CLEANUP AND PREVENTION PROFILE

32. Did your facility undertake cleanup of the release?

[x] Yes (If yes, please answer Question 32)
[ ] No (If no, please answer Question 33)

33. Has cleanup of the release been completed?
[x] Yes (If yes, please answer Questions 32.a and 32.b)
[ ] No (If no, please answer Questions 32.a and 32.c)

a. Please supply the name and address of the party responsible for cleanup.

William Pasko
(Name)

Technical Manager
(Title)

W. R. Grace & Company
(Address)

Poisson Avenue, Nashua, NH 03061
(City, State)

(603) 888-2320
(Telephone)

b. Indicate the date cleanup activity ceased.

[0] [8] - [0] [6] - [8] [8]
(month) (day) (year)

c. Please indicate the approximate date completion of cleanup activity is expected.

[ ] [ ] - [ ] [ ] - [ ] [ ]
(month) (day) (year)

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34. Please describe the immediate response activities taken to contain or minimize the release.

See Page 20A, Section 34

35. As simply as possible, describe release prevention practices and policies (backup systems, containment system, training programs) utilized at the facility when the release occurred.

See reponse to Attachment I, Questions 9, 10, 11.

36. Please indicate which of the prevention practices and policies listed in Question 35, if any, were ineffective in preventing the release from reaching the environment.

See Page 20A, Section 36.

37. Describe equipment repairs and/or replacements (management practices, operational changes, etc.) made as a result of the release.

See Page 20A, Section 37.

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34. When the operator detected a problem with the batch, he immediately shut down the addition of raw material to the reactor vessel. The operator notified the Production Supervisor who ordered the operator to begin to cool the reactor. The on-site emergency response teams were activated. Using the plant fire hose system, the two teams set up water sprays to knock down the vapors.

36. The cooling of the reactor was effective in slowing down the release of the escaping vapors; because of the volume of the batch, it is impossible to immediately cool the batch to totally prevent the release of the vapors.

The water deluge of the area with facility fire hoses would have been more successful if the fog nozzles were used instead of fire hose nozzles.

The emergency team was unable to properly seat the butterfly valve in the atmospheric vent line on the reactor. The failure of this valve has been identified as the cause of the incident.

37. The first step implemented was the replacement of the 8" butterfly valve with a new valve using Teflon as the material of construction for the valve seat.

38. As a further precaution, we will implement changes which will allow the scrubber to pull a vacuum on this reactor. Any slight vapor leaks, therefore, will be into the reactor, rather than out to the atmosphere. Finally, as part of this system, a vacuum gauge will be installed which will indicate proper operation of the scrubber system and proper closure and sealing of all valves in the reactor vent system.

We have begun a review of this and all other valves that vent to the atmosphere to insure that all such valves are of the most suitable materials of construction.

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38. What additional preventative measure(s) will be taken to minimize the possibility of recurrence?

See Page 20A Number 38.