# APPENDIX A
## TYPE B INVESTIGATION BOARD APPOINTMENT MEMORANDUM

This page intentionally left blank.

United States Government | Department of Energy

Oak Ridge Operations Office

# memorandum

DATE: August 23, 2000

REPLY TO
ATTN OF: SE-32:Mullins

SUBJECT: **TYPE B INVESTIGATION - SUBCONTRACTOR EMPLOYEE CHEMICAL BURN INJURIES - PORTSMOUTH GASEOUS DIFFUSION PLANT, PORTSMOUTH, OHIO**

TO: Robert D. Dempsey, Deputy Assistant Manager, Office of the Assistant Manager for Environment, Safety, Health and Emergency Management (AMESH), SE-30

You are hereby appointed Chairman of the Investigation Board to investigate the August 22, 2000, chemical burn to an employee of IT Corporation, subcontractor to UT-Battelle, LLC, at the Portsmouth Gaseous Diffusion Plant. I have determined that the accident meets the requirements for a Type B Accident Investigation as required by DOE Order 225.1A, "Accident Investigations."

You are to perform a Type B investigation of this incident and to prepare an investigation report. The report shall conform to requirements detailed in DOE Order 225.1A and DOE G 225.1A-1, Implementation Guide for Use with DOE 225.1A, Accident Investigations. The Board will be comprised of the following members:

Brenda Hawks, Nuclear Safety Programs Team Leader, Nuclear Safety Division, AMESH, ORO, Member
Joseph R. Enright, Occupational Safety and Health Manager, Weldon Spring Site-Remedial Action Project, ORO, Member
Jerry Robertson, Occupational Safety and Health Manager, Operations Division, AMESH, Trained Accident Investigator

The scope of the Board's investigation is to include, but is not limited to, identifying all relevant facts; analyzing the facts to determine the direct, contributing, and root causes of the incident; developing conclusions; and determining judgments of need that, when implemented, should prevent the recurrence of the incident. The Board will focus on and specifically address the role of DOE and contractor organizations and Integrated Safety Management Systems, including oversight of subcontractors, as they may have contributed to the overall accident. The scope will also include an analysis of the application of lessons learned from similar accidents within the Department.

If additional resources are required to assist you in completing this task, please let me know and it will be provided. Nancy Carnes has been appointed to serve as the Board's legal liaison. You and members of the Board are relieved of your other duties until this assignment is completed.

The Board will provide my office with weekly reports on the status of the investigation and not include any findings or arrive at any premature conclusions until an analysis of all the causal factors have been completed. Draft copies of the factual portion of the investigation report will be submitted to my office and the contractor for factual accuracy review prior to the report finalization.

The final investigation report should be provided to me by September 25, 2000. Any delay to this date shall be justified and forwarded to this office. Discussions of the investigation and copies of the draft report will be controlled until I authorize release of the final report. If you have any questions, please contact me or Robert Poe at 576-0891.

G. Leah Dever
Manager

cc:
D. Michaels, EH-1, 7A-097, HQ/FORS
C. Huntoon, EM-1, 5A-014, HQ/FORS
R. Berube, EH-4, 7A-075, HQ/FORS
T. Rollo, EH-21, HQ/270CC
M. Johnson, SC-3, 7B-084, HQ/FORS
E. Cumesty, M-2, ORO
R. Folker, M-2, ORO
S. Wyatt, M-4, ORO
G. Benedict, UE-50, ORO
R. W. Poe, SE-30, ORO
M. McBride, SE-33, ORO
R. Nelson, EM-90, ORO
G. Malosh, LM-10, ORO
S. McCracken, EM-95, ORO
N. Carnes, CC-10, ORO
J. Fowler, CC-10, ORO
V. Adams, UE-54, PORTS

# APPENDIX B
# ANALYSIS

This page intentionally left blank.

## Table B-1: Barrier Analysis

| Barrier | Purpose | Analysis/Effect on Accident |
|---|---|---|
| PPE (Apron) | An apron covers the front of a person from the chest to below the knees and provides protection against splatters of hazardous substances. | The barrier failed because the proper PPE was not utilized. The apron would have reduced the severity or prevented the burns received by the victim. |
| PPE (Goggles and/or full face shield) | Goggles protect the eyes from splashing of chemical solutions. A face shield protects the face from splashing of chemical solutions. | The barrier failed because proper PPE was not utilized. Regular safety glasses with side shields were utilized, which protected the eyes. The use of goggles and full face shield would have prevented further burns on the face. |
| Hazard Analysis | A forward-looking identification and control of hazards throughout the life cycle of a project. | The barrier failed due to deficiencies in the USQD, HASP, and HASP Addendum, which did not properly analyze all of the hazards. Some of the controls identified in the MSDS, AHA, HASP, HASP Addendum, and USQD were not implemented. An adequate and fully implemented hazard analysis would have identified the necessary controls to prevent or mitigate the seriousness of the accident. |
| Procedures/Work Control Documents | Document control. | The barrier failed because documents were not formally approved and controlled. An adequate configuration control program would ensure documents were approved, maintained up to date, and controlled throughout the life of the project. This control would have increased the likelihood the documents would be updated to reflect actual field activities and potential hazards. |
| Training | To learn about the hazards related to their job, the means for protecting themselves, and how to perform particular tasks. | The barrier failed because the hazards and properties of the various chemicals were not understood. Personnel were not trained on the hazards associated with the tasks being performed. The lack of adequate training reduced personnel awareness to potential hazards, resulting in unsafe activities. |
| Oversight | To ensure worker protection by compliance with DOE directives and National Consensus Standards. | The barrier failed because DOE and contractor surveillance failed to identify problems at the work site. Adequate oversight would have identified HS deficiencies on the site. |

## Table B-1: Barrier Analysis

| Barrier | Purpose | Analysis/Effect on Accident |
|---|---|---|
| Certified Engineered Equipment | Credibility of equipment to operate as designed. | The barrier failed because all equipment supplied did not include certification for the activity. The HASP states that all custom modification to equipment is strictly prohibited unless authorized in writing by the original equipment manufacturer or certified as safe by a registered professional engineer. This was not completed. The numerous leaks in and around the rods, resulting in modification of the equipment, contributed to unnecessary exposure to permanganate. |
| Readiness Review | Ensure objectives are well established, procedures and personnel are ready to implement the scope of work, and programmatic objectives are accomplished prior to initiation of field activities. | The barrier failed because the BJC SORC readiness review team failed to ensure HS and programmatic objectives were implemented prior to initiation of field activities. An adequate readiness review would have ensured the controls to safely perform the work were fully implemented. |
| Roles and Responsibilities | Provide clear roles and responsibilities. | The barrier failed because no one took overall responsibility for HS. Clear roles and responsibilities provide for adequate accountability, assuring that proper assessments and oversight are performed. |
| Effective Equipment | Identify the hazards and appropriate engineered controls. | The barrier failed because modifications in the field to the equipment were not communicated, and they prevented engineering controls from being implemented. Proper engineering controls would have reduced the collection of permanganate solution. |
| Daily Tailgate Safety Meeting | To discuss significant changes in the scope of work on the site, potential hazards, and activities to be performed that day and to provide specific job assignments. | The barrier failed because daily tailgate meetings did not address specific job assignments for the day or adequately address the potential hazards of permanganate neutralization and appropriate PPE for work activities. Proper communication during tailgate sessions provides needed information to control work and implement protective measures for work activities. |
| Secondary containment for containers, hoses, and pipes containing or transporting permanganate | To prevent sprays, spills, and leaks. | The barrier failed because secondary containment was not provided. Secondary containment provides containment of spray, spills, and leaks, thereby reducing the potential for exposure. |

## Table B-2: Change Analysis

| Normal "Ideal" | Actual | Analysis |
|---|---|---|
| Workers are adequately trained to the hazards of the chemicals and OSHA hazard communication requirements. | Not all workers understood the hazards associated with the various chemicals on site and their reactions, and they allowed many OSHA noncompliant conditions to exist on site. | OSHA hazard communication requires employees be trained and understand the hazards of workplace chemicals and basic safety requirements. This training would have heightened personnel awareness to potential hazards and reduced acceptance of noncompliant conditions. |
| ES&H reviews are performed by DOE and contractor oversight groups to ensure HS of workers. | An adequate ES&H review was not conducted on site. | Adequate reviews would have identified HS deficiencies and the lack of hazard analysis for all activities. Proper oversight would have identified HS problems and achieved resolution. |
| Hazard analysis is performed on all work using up-to-date technical information. | Hazard analysis did not evaluate the different properties of the various chemicals located at the site with up-to-date technical information. | Understanding the neutralization reaction and chemical concentrations was necessary to safely perform the work. |
| Adequate turnover between changing staff to communicate changes in design, operations, and procedures. | Inadequate communication between changing staff occurred. | Hazards were introduced when changes in design, operations, and procedures were not effectively communicated. |
| The BJC HS Advocate assigned to project performed duties in accordance with EH-5614, *Safety Advocate Program*. | Procedure were not followed, and HS deficiencies remained. | Adherence to the procedure might have identified HS deficiencies. |
| Employees are encouraged to approach all work with a high degree of inquisitiveness (i.e., Stop Work Authority/Time Out for Evaluation). | Work continued after numerous problems with the equipment and leaks of permanganate. Employees became desensitized to the hazards that were present. | Failure to analyze and control hazards due to changing work conditions. |
| BJC STR assigned to project executed duties in accordance with BJC-FS-01, *STR Requirements for Subcontract Execution.* | The procedure for subcontract execution was not followed. | The STR did not follow requirements required by the procedure. Adherence to the procedure would have increased the formality and rigor of oversight. |

## Table B-2: Change Analysis

| Normal "Ideal" | Actual | Analysis |
|---|---|---|
| Documenting all HS-related data in the logbooks per the HASP. | The documentation on deficiencies and hazards was not documented in the logbook. | Personnel were not aware of all safety deficiencies, and decisions on control were not communicated to everyone on site. Making personnel aware of safety deficiencies reduces the likelihood of accidents. |
| Conduct effective daily tailgate safety meetings discussing significant changes in the scope of work, specific job assignments, and potential hazards on site. | Tailgate safety meetings were conducted, but they were not effective. | Discussions on the changes to the scope of work, changes to specific work assignments, and implementation of appropriate PPE related to the hazards were not effective. Proper daily tailgate meetings would have reduced the likelihood of personnel performing work outside that assigned and without proper PPE protection. |
| Neutralize sodium permanganate safely. | Bisulfite and thiosulfate were used interchangeably to neutralize permanganate. | Concentrated permanganate reacts violently with thiosulfate. Knowledge of neutralization reaction would have decreased the likelihood of the accident. |
| Always assume the permanganate solution is concentrated until actual measurements are performed to verify the dilution. | Assumed permanganate solution was dilute without taking measurements to verify concentration. | If a measurement to determine permanganate concentration was performed, neutralization of concentrated permanganate utilizing the dilute process would not have occurred. |

# APPENDIX C
# HEALTH AND SAFETY PLAN

This page intentionally left blank.

**Table C-1: HASP - Key Project Personnel and Responsibilities**

- BJC PM - responsible for the day-to-day operation and activities for the project.
- BJC STR - coordinates all field activities with the UT-Battelle PM and BJC PM. Ensures that all work is done in compliance with BJC requirements.
- BJC Health Physics Manager - responsible for the day-to-day health physics operations and activities at PORTS. The BJC Health Physics Manager will coordinate and assign Radiation Control Technicians and related project support as needed.
- BJC HS Manager - is responsible for the day-to-day HS operations and activities at PORTS. The BJC HS Manager coordinates and assigns related project support as needed.
- BJC HS Advocate - with the STR, coordinates all HS needs between the BJC HS organization and project personnel.
- UT-Battelle PM - coordinates field activities with the UT-Battelle field team and subcontractors and is responsible for all operations and activities pertaining to the project.
- UT-Battelle Project HSO - reports all activities to the UT-Battelle PM. The HASP states that an experienced HSO, who is acceptable as qualified by UT-Battelle and BJC, will be present at an active job site at all times. The specific responsibilities include the following:
  (1) implementing the HASP on the work site, ensuring that each person at the site understands and signs off on the HASP prior to working, and noting any deviations to the BJC HS Advocate;
  (2) conducting project safety meetings, pre-entry briefings, and daily tailgate safety meetings, documenting all subjects and personnel attendance prior to initiation of work each day and when there are significant changes in the scope of work on the site; and documenting all HS-related data in the HS logbook;
  (3) conducting any required monitoring as designated by the HASP and performing periodic inspections to evaluate the HASP's effectiveness;
  (4) conducting audits to ensure compliance with all HS procedures and providing documentation in the HSO's logbook;
  (5) performing a functional check at least once per day (more often if ambient weather conditions change or other conditions necessitate the need as perceived by the HSO) of any monitoring equipment and recording the results on the daily instrument calibration log;
  (6) ensuring that all nonradiological monitoring equipment is calibrated and operating correctly according to the UT-Battelle HS procedures manual (ORNL 1992) and/or the manufacturer's instructions;
  (7) assisting personnel with completion of action-level incident response or accident forms if needed;
  (8) ensuring that an HS work permit has been issued by BJC through the STR prior to the start of on-site activities;
  (9) ensuring that no equipment will be operated any closer than 20 feet from electrical transmission lines;
  (10) notifying the STR of personnel at the work site at the beginning of the day and the location of work activities; and
  (11) ensuring that sanitation requirements of OSHA 1926.51 are adhered to on the project.

  The HASP goes on to state the HSO will have first aid and cardiopulmonary resuscitation certification and will take all necessary measures required by law when providing medical assistance to injured personnel. A physician-approved and portable first aid kit will be kept immediately available and regularly inspected. A UT-Battelle HSO will be provided for the lance permeation and ISCOR deployment.

## Table C-2: HASP Addendum - IT Personnel Responsibilities

- Technical Advisor - provides technical input into design and implementation; advises on potential for worker exposure to project hazards along with appropriate methods and/or controls to eliminate site hazards; facilitates reporting of injuries, reviews injury reports, and provides the appropriate level of guidance in accident prevention.
- PM - reports to upper-level management and has overall responsibility for safety in preventing and protecting against all hazards during site activities. Ten specific responsibilities of the IT PM, in conjunction with the UT-Battelle and BJC PMs, are stated.
- SSHS or Designee - has the ultimate responsibility to stop operations when a hazard exists that may threaten the safety and health of the field team or surrounding population or that causes adverse impact to the environment. Thirteen specific responsibilities are stated, which include maintaining effective site-specific HASP procedures for the project; implementing all safety procedures and operations on site; upgrading or downgrading the levels of PPE based upon site observations; having responsibility for HS monitoring equipment on site; and maintaining a daily safety log of all site activities.
- Field Team Leader - is the subcontractor site supervisor. Nine specific responsibilities are stated, which include assuring and enforcing compliance with the site-specific HASP and enforcing the "buddy system" on site.
- SHSO - assigned on a full-time basis to each site during site activities. Assists and represents the HS Representative. The SHSO has the responsibility and authority to implement and enforce the approved site-specific HASP, including modifying/halting work and removing personnel from the site if work conditions change and impact on-site/off-site HS matters. The SHSO serves as the main contact for any on-site emergency situation. The SHSO advises the PM on all aspects of HS on the site.

## Table C-3: HASP Requirement Compliance

A HASP is required by EPA and OSHA, 29 CFR 1926.65, for all hazardous waste operations. The Lance Permeation Project at X-701B is characterized as a hazardous waste operation. On July 19, 2000, the BJC SORC Chairperson gave permission to proceed for the X-701B Lance Permeation Phase of the UT-Battelle project based on the readiness review performed on June 29, 2000.

| 29 CFR 1926.65 Requirement | Project Compliance |
|---|---|
| Organization Structure (Must establish the specific chain of command and specify the overall responsibilities of supervisors and employees. The organizational structure shall be reviewed and updated as necessary to reflect the current status of waste site operations.) | • The July 1999 HASP does not contain an organizational structure; however, Section 2 provides a list of key project personnel and responsibilities. The information provided is satisfactory to meet the requirements for oversight on the stated project. However, the Board determined that BJC personnel did not execute the responsibilities assigned in accordance with site procedures. The UT-Battelle Project HSO on site at the time of the accident did not execute his responsibilities as stated in this HASP. Changes to key personnel were not documented in the HASP to ensure that the current status was reflected. The key personnel list was not even correct at the start of the project. This is a noncompliance with requirements.<br>• The June 2000 HASP Addendum provides IT's project personnel and responsibilities. In general, the text meets the requirement for a documented organization structure. However, the "Site Health and Safety Organization Chart" was not completed with the actual names of the individuals assigned to the stated responsibilities. Additionally, the HASP Addendum was not updated to reflect changes in assignments during the project. This is a noncompliance with requirements. |

## Table C-3: HASP Requirement Compliance

| 29 CFR 1926.65 Requirement | Project Compliance |
|---|---|
| Comprehensive Work Plan (Shall address the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives.) | • The HASP, combined with the HASP Addendum, contains satisfactory information regarding the objectives of the project. The HASP and HASP Addendum do NOT contain satisfactory information concerning the objectives and methods for accomplishing those tasks. The task of handling the permanganate returning up the drill rig is not identified; therefore, no method for handling is stated. The only process described for neutralization of permanganate is in Section 11.3, "Spill Response." The documents did not address permanganate neutralization from either ground fissures during injection process or permanganate solution collected from rod return and/or previous bore holes.<br>• The AHA was prepared to address the potential hazards for the operation. This document was attached to the HASP Addendum as required information. The AHA did not identify all the potential hazards present at the job site, nor were all the tasks identified. The only neutralization process stated in documentation is for a concentrated spill.<br>• The above statements demonstrate inadequate Comprehensive Work Plan requirements in the areas of specific task definition and methods for accomplishment. Satisfactory compliance with project objectives is not demonstrated in these documents. |
| Site-Specific HASP (The site HASP must be kept on site. The plan shall address the each phase of site operation and include the requirements and procedures for employee protection.) | • The HASP, HASP Addendum, and AHA were on site. However, the HASP Addendum on site was dated May 2000, whereas the HASP Addendum reviewed by the BJC SORC readiness review team for permission to proceed was dated June 2000. It was noted by the Board that pages 8 and 11 were dated "Final June 15, 2000," and all other pages were dated "May 2000."<br>• General personnel HS hazards are addressed in these documents.<br>• As stated above, all phases of site operations are not contained in the documents. |
| HS Training Program (All personnel on site shall receive training prior to engaging in hazardous waste operations. Personnel must be trained to the level required by their job function and responsibility.) | • Based on a cursory review of training records and interviews, the Board did not find any deficiencies in formal training requirements for personnel on site.<br>• Daily tailgate meetings were conducted and discussed general HS requirements.<br>• The Board concludes the specific hazards associated with ability of sodium permanganate to be concentrated above 10% was not adequately understood and communicated to personnel on site. Personnel on site were familiar with potassium |

## Table C-3: HASP Requirement Compliance

| 29 CFR 1926.65 Requirement | Project Compliance |
|---|---|
| | permanganate, which at ambient temperature does not exist in solution form at or above 8%. The Board concludes that adequate training/knowledge of the potential hazards associated with concentrated sodium permanganate was not provided.<br>• BJC HS Advocate performed a safety briefing to all individuals on site July 18, 2000. The briefing was satisfactory to provide basic safety requirements and emergency response for the site. However, personnel reporting to the site for changeover of personnel did not receive this safety briefing. The Board concludes the lack of a safety briefing for later reporting personnel demonstrates a weakness in ISM core function 5, Feedback and Continuous Improvement. |
| Medical Surveillance Program (A medical surveillance program is required by the employer.) | • All employers reviewed have a medical monitoring program. Based on the cursory review of medical monitoring records and interviews, the Board concludes that a medical surveillance program(s) was in place for personnel performing operations. |
| Standard Operating Procedures for Safety and Health. | • The HASP and HASP Addendum state that safety precautions to be followed are outlined in the *ORNL Health and Safety Procedures Manual*, Sections 8.6 and Section 13 (ORNL 1992). The *ORNL Health and Safety Procedures Manual* was not on site.<br>• No training or instruction on the *ORNL Health and Safety Procedures Manual* was provided to the subcontractors for the project.<br>• The Board concludes the requirement for standard operating procedures for HS was not satisfactory implemented on site. |
| Any Necessary Interface Between General Program and Site-Specific Activities | • General program personnel include the UT-Battelle PM; BJC HS Manager; BJC PM; UT-Battelle Technical Director; BJC STR; IT Technical Advisor; IT PM; and IT HS Representative. The necessary interfaces between these organizations was not clearly defined in either the HASP or the HASP Addendum.<br>• The HASP Addendum provides an organizational chart; however, the chart neither contains all the needed positions nor provides names for all of the identified positions.<br>• Neither the HASP nor the HASP Addendum adequately discusses the interface between organizations. Roles and responsibilities were not clearly defined. |

This page intentionally left blank.

# APPENDIX D
# SODIUM PERMANGANATE, SODIUM THIOSULFATE, AND SODIUM METABISULFITE PROPERTIES, HAZARDS, AND HANDLING

This page intentionally left blank.

**Table D-1: Sodium Permanganate (Permanganate), Sodium Thiosulfate (Thiosulfate), and Sodium Metabisulfite (Bisulfite) Properties, Hazards, and Handling**

Forty percent sodium permanganate ($NaMnO_4$), referred to as permanganate, is a powerful oxidizing material used to oxidize hallogenated organic compounds (i.e., TCE). Under normal conditions, the material is stable. However, it may decompose spontaneously if exposed to intense heat ($135^0C/275^0F$) and may be explosive in contact with certain incompatible chemicals. It may react violently with divided and readily oxidizable substances. As an oxidant, permanganate is noncombustible, but it will accelerate the burning of combustible materials (including but not limited to wood, cloth, organic chemicals, and charcoal). Therefore, contact with all combustible materials and/or chemicals must be avoided. The product should be stored in a cool, dry area in closed containers, and storing on wooden decks should be avoided. Permanganate is incompatible with acids, peroxides, and all combustible organic or readily oxidizable materials, including inorganic oxidizable materials and metal powders. Mixture with hydrochloric acid liberates chlorine gas. Also, in a fire situation, permanganate may form corrosive fumes. Acute overexposure can be irritating to body tissue if contact occurs. Permanganate solution will cause further irritation of tissue, open wounds, burns, or mucous membranes.

Spills of permanganate should be collected and diluted to approximately 6% with water. After dilution, reduce with sodium thiosulfate, bisulfite, or ferrous salt. The bisulfite or ferrous salt may require some dilute sulfuric acid (10 wt percent) to promote reduction. If an acid is utilized, the solution should be neutralized with sodium bicarbonate to neutral pH. Sludge should be decanted/filtered and disposed of at an approved landfill. Where permitted, the solution may be drained into a sewer with large quantities of water. The PPE recommended in the manufacturer's chemical fact sheet during handling includes face shields and/or goggles, rubber or plastic gloves, and a rubber or plastic apron. An eyewash station should be provided in the work area, and engineering or administrative controls should be implemented to control mist. If clothing becomes contaminated, it should be washed off immediately. In addition, spontaneous ignition may occur in contact with cloth or paper.

Sodium thiosulfate ($Na_2S_2O_3$), referred to as thiosulfate, is used to neutralize permanganate. Under normal conditions, the material is stable. This material is to be stored in a tightly closed container in a cool, dry, ventilated area. Burning may produce sulfur oxides. Thiosulfate is incompatible with metal nitrates, sodium nitrates, iodine, acids, lead, mercury, and silver salts. If this material is swallowed or inhaled, it may cause irritation to skin, eyes, and the respiratory tract. Low level of toxicity is possible with ingestion. In addition, irritation may occur from skin contact and contact with the eyes. The manufacturer's MSDS recommendations for PPE are protective gloves , body-covering clothing, and safety glasses. It is also recommended that an eyewash fountain and quick-drench facilities be maintained in the work area. In case of a spill, the material should be swept up and containerized for reclamation or disposal. Vacuuming or wet sweeping may be used to avoid dust dispersal.

Sodium metabisulfite anhydrous 97% ($Na_2S_2O_5$), referred to as bisulfite, is used to neutralize permanganate. Under normal conditions the material is stable, but it may decompose if heated.

This material is to be stored in a tightly closed container in a cool, dry, well-ventilated area away from incompatible substances. Incompatible materials include strong oxidizers and acids. This material may produce sulfur dioxide gas when in contact with acids and/or water (ice). Conditions to avoid are dust generation, moisture, exposure to air, excess heat, and oxidizers. Hazardous decomposition products include oxides of sulfur and toxic fumes of sodium oxide. Potential health effects are as follows: (1) eye - irritation; (2) skin - irritation, may cause skin sensitization, an allergic reaction, which becomes evident upon re-exposure; (3) ingestion - gastrointestinal irritation, exposure may cause central nervous system depression, gastrointestinal and cardiac abnormalities, and violent colic; and (4) chronic exposure - prolonged or repeated skin contact may cause dermatitis, reproductive effects have been reported in animals, and repeated and prolonged exposure may cause allergic reactions in sensitive individuals. The manufacturer's MSDS recommendations for PPE are protective eyeglasses or chemical safety goggles, appropriate protective gloves to prevent skin exposure, and protective clothing to prevent skin exposure. The MSDS states storage facilities should be equipped with an eyewash facility and a safety shower. The manufacturer's MSDS states to flush eyes with plenty of water for at least 15 minutes and to immediately flush skin with plenty of soap and water for at least 15 minutes while removing contaminated clothing and shoes. It further goes on to state to get medical aid immediately. In the case of a spill, sweep up the material and place it in a suitable container for disposal, avoiding dust generation and ensuring that proper ventilation is provided. There is a caution to make sure that no water gets inside the container.