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MILITARY HANDBOOK

BEST MANAGEMENT PRACTICES FOR CONTROL OF TOXIC CHEMICAL DISCHARGES

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DEPARTMENT OF DEFENSE
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Best Management Practices for Control of Toxic Chemical Discharges
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1. This handbook was developed by the Department of Defense based on work performed under contract by the US Environmental Protection Agency.

2. This publication was approved on 25 September 1981 for inclusion in the military standardization handbook series.

3. This document provides information on Best Management Practices or BMPs for the control of toxic chemicals discharges. BMPs described in this handbook are intended primarily for water pollution control but may also result in ancillary benefits such as material conservation, cost savings and improved safety. The handbook is expected to be used by Commanders, managers and engineers in discharging their responsibility to protect the environment.

4. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, US Army Armament Research and Development Command, ATTN: DRDAR-TSC, Aberdeen Proving Ground, MD 21010 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

ABSTRACT

The purpose of this handbook is to provide information for the development of Best Management Practices or BMPs to control toxic chemical discharges. BMPs in the context of this handbook are practices or procedures to prevent or minimize the discharge of chemicals to surface waters; i.e. to prevent water pollution. Ancillary benefits of BMPs include material conservation, user safety and cost savings.

The handbook is intended primarily for engineers and other technical personnel responsible for environmental protection. Commanders and managers also will find the document useful in discharging their responsibility to protect the environment. Since BMPs emphasize procedures, especially human actions, training is an important element in an effective BMP program. BMPs currently are in use by many industrial facilities and Federal installations.

This handbook serves as a compilation or catalog of information on existing practices and is intended to be a reference document. Users are encouraged to use other innovative cost-effective techniques to achieve the basic objective of BMPs; i.e. to minimize water pollution from fugitive emissions (spills, leaks, runoff, etc.) associated with toxic chemicals usage.

FOREWORD

This handbook was prepared by the Specifications and Standards Branch, Chemical Systems Technical Support Division, Technical Support Directorate, US Army Armament Research and Development Command.

This document was written in October 1980 and is available to all elements of DOD, other Government agencies and other interested parties. Comments and suggestions on this publication are welcome and should be addressed to:

Commander
US Army Armament Research and Development Command
ATTN: DRDAR-TSC
Aberdeen Proving Ground, MD 21010

The information provided here should be considered advisory only. The procedures and techniques described herein have been successfully applied to numerous industrial operations and are believed to be applicable to Federal facilities. Many practices not mentioned in this document may be equally effective in achieving the goal of pollution control.

The mention of trade names or names of commercial suppliers in this document does not constitute endorsement of such products or suppliers by the US Government.

Information contained in this document is based on work performed by Hydroscience, Inc. during the period June 1978 to February 1979 under contract to the US Environmental Protection Agency, Contract No. 68-03-2568. The Hydroscience report has been adapted for DOD use. Permission has been granted by the US EPA project officer to use the information contained in the report "NPDES Best Management Practices Guidance Document", EPA-600/9-79-045, December 1979 for the purposes of this handbook.

Throughout this handbook, certain terms appear which normally are associated with the private sector such as "plant" or "employee". Wherever they appear, these terms should be considered synonymous with "facility" or "personnel", respectively.

ACKNOWLEDGEMENT

The author gratefully acknowledges the advice and assistance of the following persons in the preparation of this handbook:

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1. INTRODUCTION

1.1. Purpose

This handbook addresses practices and procedures to prevent or minimize the potential for releases of toxic chemicals to the environment.

Its purpose is to provide information for Commanders, managers, engineers and others to use in discharging their responsibility for environmental protection.

1.2. Scope

The practices described herein are primarily intended to minimize water pollution from activities ancillary to manufacturing operations. Activities and areas of particular concern include: material storage areas; loading and unloading operations; plant site runoff; in-plant transfer areas, process areas and material handling areas; and sludge or waste disposal areas. Many of the practices also are expected to be applicable to chemicals storage, use and ultimate disposition in non-manufacturing situations. Occupational health and safety as well as non-water pollution impacts or control methods are beyond the scope of this handbook.

1.3. Discussion

The best management practices or BMPs described in this handbook were developed to supplement a regulation published by the US Environmental Protection Agency (EPA) on June 7, 1979 in the Federal Register (44 FR 32954-5) as part of major revisions to its National Pollutant Discharge Elimination System (NPDES) program. The NPDES permit is the principal mechanism used by EPA to control point source water pollution. Any facility which discharges wastewater to waters of the United States must obtain an NPDES permit to comply with the Clean Water Act of 1977 (hereafter "the Act").

EPA expects to require many facilities which use, produce or discharge any toxic pollutant as specified in Section 307 of the Act or hazardous substance as specified in Section 311 of the Act to develop and implement a BMP plan. A BMP plan consists of general requirements and specific requirements. This handbook describes these requirements of BMP plans in some detail in the context of EPA's NPDES regulation. The user of this handbook is encouraged to tailor the elements of the BMP plan to meet the needs of his/her particular circumstances even though a BMP plan, per se, may not be required of the facility or operation in question.

DOD activities are directed to DOD Instruction 6050.5, 25 January 1978, for information on a DOD system to acquire, review, store and disseminate selected data on hazardous materials. DODI 6050.5 describes a Hazardous Material Information System (HMIS) to: 1) develop procedures to prevent mishaps in the handling, storage, use, transportation and disposal of hazardous materials;

2) apprise DOD personnel of the hazard of materials encountered in DOD workplaces; and 3) devise environmentally acceptable disposal procedures. The HMIS provides that Material Safety Data Sheets (MSDS) be accessible by National Stock Number (NSN), trade name, chemical name, hazardous ingredients, and manufacturer. MSDS information is to be provided to the Director, Defense Logistics Agency (DLA) by DOD Components' focal points and the General Services Administration (GSA). The DOD components focal points for hazardous materials information should provide guidance to activities using hazardous materials, including information on specific management practices.

2. BEST MANAGEMENT PRACTICES

2.1. Ancillary sources. The activities which are associated with or ancillary to the industrial manufacturing or treatment process are particularly suited for BMPs. For brevity, all such activities are referred to as "ancillary sources". The ancillary sources at the plant should be examined to determine if there is a reasonable potential for equipment failure (e.g., spillage or leakage), natural conditions (e.g., site runoff or drainage from raw material storage), or other circumstances (e.g., sludge or waste disposal) which could result in the discharge of a significant amount of toxic or hazardous pollutants to receiving waters. The ancillary sources are divided for discussion in this document into five categories: material storage areas; loading and unloading areas; plant site runoff; in-plant transfer, process, and material handling areas; and sludge and hazardous waste disposal areas.

Material storage areas include storage areas for toxic and hazardous chemicals as raw materials, intermediates, final products or by-products. Included are: liquid storage vessels that range in size from large tanks located at a tank farm to 55-gallon drums; dry storage in bags, piles, bins, silos, and boxes; and gas storage in tanks and vessels.

Loading and unloading operations involve the transfer of materials to and from trucks or railcars but not in-plant transfers. These operations include pumping of liquids or gases from truck or railcar to a storage facility or vice versa, pneumatic transfer of dry chemicals to or from the loading or unloading vehicle, transfer by mechanical conveyor systems, and transfer of bags, boxes, drums, or other containers from vehicles by fork-lift trucks or other materials handling equipment.

Runoff is generated principally from rainfall on a plant site. Runoff from material storage areas, in-plant transfer areas, loading and unloading areas, and sludge disposal sites potentially could become contaminated with toxic and hazardous substances. Heavy metal pollutants from sludge disposal sites are a special concern. Fallout, attributable to the plant air emissions which settle on the plant site, may also become a source of contaminated runoff. Contaminated runoff may reach a receiving body of water through overland flow, drainage ditches, storm or clean cooling water sewers, or overflows from combined sewer systems.

In-plant transfer areas, process areas, and material handling areas encompass all in-plant transfer operations from raw material to final product. Various operations could include transfer of liquids or gases by pipelines with appurtenances such as pumps, valves and fittings, movement of bulk materials by mechanical conveyor-belt systems, and fork-lift truck transport of bags, drums, and bins. All transfer operations within the process area with a potential for release of toxic and hazardous substances to other than the process waste water system are addressed in this grouping.

Sludge and hazardous waste disposal areas are sources of potential contamination of receiving waters. The operations include landfills, pits, ponds, lagoons, and deep-well injection sites. Depending on the construction and operation of these sites there may be a potential for leachate containing toxic or hazardous materials to seep into the ground water, eventually reaching surface waters, or for liquids to overflow to surface waters from these disposal operations. BMP requirements are not intended to duplicate the requirements of RCRA. Actions taken for compliance with RCRA or other environmental laws may be referenced in the BMP plan.

2.2. Minimum Requirements of a BMP Plan. BMPs may include some of the same practices used by industry for pollution control, for SPCC plans for oil and hazardous materials, for safety programs, for fire protection, for protection against loss of valuable raw materials or products, for insurance policy requirements or for public relations. The NPDES regulations provide instructions for development of BMP plans (see 40 CFR Part 125, Subpart K, "Criteria and Standards for BMPs Authorized Under Section 304(e) and 402(a)(1) of the Act"). The minimum requirements of a BMP Plan are prescribed by the BMP regulation and are listed in Table 1. They are divided into two categories: general requirements and specific requirements.

Table 2-1

Minimum Requirements of a BMP Plan

A. General Requirements

1. Name and location of facility
2. Statement of BMP policy and objectives
3. Review by facility manager

B. Specific Requirements

1. BMP Committee (Environmental Protection Committee)
2. Risk Identification and Assessment
3. Reporting of BMP Incidents
4. Materials Compatibility
5. Good Housekeeping
6. Preventive Maintenance
7. Inspections and Records
8. Security
9. Employee Training

2.2.1. General Requirements. The BMP plan shall be organized and described in an orderly narrative document format and shall be reviewed by the engineering staff and facility manager. A description of the facility, including the plant name, the type of plant, major processes used, and the products manufactured, shall be included in the BMP plan, and a map shall be provided showing the location of the facility and the adjacent receiving waters. The BMP plan will include specific objectives for the control of toxic or hazardous substances as part of the statement of facility policy.

2.2.2. Specific Requirements. Each of the 9 specific requirements listed in Table 2-1 must be addressed in the BMP plan. The size and complexity of the BMP plan will vary with the facility's environmental policy, size, complexity, and location of the facility, among other factors. It is anticipated that the length and detail of the BMP plan will be commensurate with the quantity of toxic and hazardous chemicals onsite and their opportunity for discharge. Therefore, a fundamental part of the BMP plan in determining the potential for toxic hazardous chemicals to reach receiving waters is "Risk Identification and Assessment".

Discussions of the specific requirements are presented on the following pages. Each specific requirement contains important elements that should be considered in developing a BMP plan. For convenience, the elements are listed below each discussion of the specific requirements. It is recognized that all elements may not be applicable to all facilities. Elements should be added, deleted or modified to fit the needs of a particular facility. Facilities are encouraged to use innovative techniques to achieve equivalent results.

2.2.2.1. BMP Committee. The BMP Committee is that group of individuals within the organization which is responsible for developing the BMP plan and assisting management in its implementation, maintenance and updating. Thus, the Committee's functions are similar to those of a fire prevention or safety committee.

The scope of activities and responsibilities of the "BMP Committee" should include all aspects of the facility's BMP plan, such as identification of toxic and hazardous materials handled; identification of potential spill sources; establishment of incident reporting procedures; development of BMP inspection and records procedures; review of environmental incidents to determine and implement necessary changes to the BMP plan; coordination of incident response, cleanup and notification of authorities; establishment of BMP training for personnel; and aiding interdepartmental coordination in carrying out the BMP plan. Initial response actions and assessment of environmental impact may also be performed by the Committee.

Other Committee duties could include review of new construction and changes in processes and procedures at the facility relative to spill prevention and control. The Committee can also periodically evaluate the effectiveness of the overall BMP plan and make recommendations to management in support of policy on BMP-related matters.

Management has overall responsibility for the BMP plan. The plan should contain a clear statement of the management's policies and responsibilities with respect to BMP-related matters. Authority and responsibility for immediate action in the event of a spill should be clearly established and documented in the BMP plan, with the Committee indirectly involved in that responsibility. The Committee should advise management on the technical aspects of environmental incident control, but should not impede the decision-making process for preventing or mitigating spills and incidents.

The size and makeup of the BMP Committee should be appropriate to the size and complexity of the facility and the specific toxic and hazardous chemicals handled. Facility personnel knowledgeable in spill control, waste treatment and occupational hygiene such as environmental specialists, production foreman, and treatment plant supervisor should be included. In some facilities, the Committee might consist of the one manager or engineer assigned responsibility for environmental control. For very small facilities, the Committee function might even have to be fulfilled by competent engineers or managers from the staff of the nearest large facility or headquarters.

A list of personnel on the BMP Committee should be included in the BMP plan. The list should have the office and home telephone numbers of the Committee members and the names and phone numbers of backup or alternate people. A chairperson of the Committee should be designated.

Elements of the "BMP Committee", listed below, should be considered in developing a BMP plan:

- Inclusion of facility personnel knowledgeable in spill control, waste treatment, occupational health and safety, such as environmental specialists, production foreman, treatment plant supervisor, or medical personnel. At Army installations, for example, the community environmental officer, plant safety manager and fire marshal should be considered for the Committee.

- Responsibility for

  providing assistance to management for developing a BMP plan,
  providing assistance to management in implementing, maintaining, and updating the BMP plan,
  identifying toxic and hazardous substances,
  identifying potential spill sources,
  establishing BMP incident reporting procedures,
  developing BMP inspections and records procedures,
  reviewing environmental incidents,
  coordinating incident response, cleanup and notification procedures,
  establishing BMP training for facility personnel,
  providing assistance for interdepartmental coordination in carrying out the BMP plan,
  reviewing new construction and changes in processes and procedures,
  evaluating the effectiveness of the BMP plan,
  making recommendations to management in support of policy on BMP-related matters.

2.2.2.2. Risk Identification and Assessment. The areas of the facility subject to BMP requirements should be identified by the BMP Committee, plant engineering group, environmental engineer, or others in the facility. Each such area should be examined for the potential risks of discharges to receiving waters of significant amounts of toxic pollutants or hazardous substances from ancillary sources. Any existing physical means (dikes, diversion ditches, etc.) of controlling such discharges also should be identified.

The areas described above should be clearly indicated on a plant plot plan or drawing. A simplified materials flowsheet showing major process operations can be used to indicate the direction and quantity of flow of materials from one area to another. The direction of flow to navigable waters of potential major spills and surface runoff subject to BMP regulations could also be estimated based on site topography and indicated on the plant site drawings. Dry chemicals which are on the toxic or hazardous lists need to be evaluated if they have the potential to reach navigable waters in significant quantities via rainfall runoff, for example.

A hazardous substance and toxic chemical (materials) inventory should be developed as a part of the "Risk Identification and Assessment" process. The detail of the materials inventory should be proportionate to the quantity of toxic pollutants and hazardous substances on site and the potential for them to reach the receiving waters. For example:

(1) The facility has determined that materials stored in bulk quantities at a tank farm have a high potential for reaching the receiving waters in the event of structural failure or overfills. Therefore, the materials inventory for the tank farm should be detailed, and should provide the identity, quantities, and locations of each material.

(2) The facility has determined that materials stored in small quantities at the research laboratory have a low potential for reaching the receiving waters. Therefore, the materials inventory for the laboratory should be minimally detailed, and might not include the identity, quantity, or location of each material but may include an estimate of the total quantity of toxic and hazardous materials stored and would provide the location of the laboratory. The rationale for the "low risk" nature of the laboratory should be provided in this part of the BMP plan.

(3) The facility has determined that materials used in a batch operation in the manufacturing process have a high potential for reaching the receiving water. The facility supplies a variety of products through the batch operation process to accommodate fluctuations in public demand. Consequently, the materials used for the batch process vary from week to week, oftentimes unexpectedly. Therefore, the materials inventory for the batch operation should be detailed but remain flexible. The inventory might include the identification of each material expected for use, and the maximum quantity of material that the batch process can handle. The materials inventory could be updated to include any material substitutions unanticipated at the time of the original inventory.

The examples above illustrate the flexibility of the materials inventory. A materials inventory should be part of the "Risk Identification and Assessment" of every BMP plan but the detail of the inventory will vary with the size and complexity of the plant, the quantities of toxic and hazardous chemicals on site and the potential for those materials to reach surface waters. Determining the potential for incidents reaching receiving waters as well as the detail needed for the materials inventory requires sound engineering judgement.

The materials inventory and other useful technical information should be made available to the BMP Committee but may require separate filing from the BMP plan documents to protect confidentiality, trade secrets, or classified information. This data may include physical, chemical, toxicological and health information (e.g., technical bulletins or safety data sheets) on the toxic and hazardous substances handled; the quantities involved in various operations or ancillary sources; and the prevention, containment, mitigation, and cleanup techniques that are used or would be used in the event of a discharge.

Materials planned for future use in the plant should be evaluated for their potential to be discharged in the significant amounts to receiving waters. Where the potential is high, the same type of technical data described above should be obtained.

Elements of "Risk Identification and Assessment", listed below, should be considered in developing a BMP plan:

- Identification of areas of the facility subject to BMP requirements.
- Examination of identified areas for potential risks of BMP incidents reaching receiving waters.
- Establishment of an environmental monitoring plan (analysis of pathways, determination of sampling locations, methods of sampling, baseline surveys, etc.).
- Identification of existing site-specific or pollutant-specific containment measures.
- Plot plans or drawings that clearly label the identified areas.
- Simplified flowsheet(s) of the major process operations.
- Estimation of the direction of flow of potential discharges toward navigable waters.
- Evaluation of the potential for materials planned for future use to be discharged to receiving waters in significant amounts.
- Materials inventory system tailored to the need of the particular facility.
- Physical, chemical, toxicological, and health information on the toxic and hazardous chemicals on-site.

2.2.2.3. Reporting of BMP Incidents. An incident is a discharge of a significant amount of a toxic pollutant or hazardous substance from an ancillary source.

A BMP incident reporting system is used to keep records of incidents such as spills, leaks, runoff and other improper discharges for the purpose of minimizing recurrence, expediting mitigation or cleanup activities, and complying with legal requirements. Reporting procedures defined by the BMP Committee should include: notification of a discharge to appropriate personnel to initiate immediate action; formal written reports for review and evaluation of the BMP incident and revisions to the BMP plan; and notification as required by law to governmental and environmental agencies in the event that a spill or other reportable discharge reaches the surface waters.

The reporting system should designate the avenues of reporting and the responsible facility and government officials to whom the incidents would be reported. A list of names, office telephone extensions, and residence telephone numbers of key personnel in the order of responsibility should be utilized when necessary for immediate reporting of incidents to plant management for implementation of emergency response plans.

A communications system should be designated and available for notification of an impending or actual BMP incident. Reliable communications with the person or persons directly responsible would expedite immediate action and countermeasures to prevent incidents or to contain and mitigate discharged chemicals. Such a communication system could include telephone or radio contact between transfer operations, and alarm systems that would signal the location of an incident. Provisions to maintain communications in the event of a power failure should be addressed.

Written reports on all BMP incidents should be submitted to the facility BMP Committee and plant management for review. Reporting procedures should include notification of appropriate medical or occupational health personnel. Written reports should include the date and time of the discharge, weather conditions, nature of the materials involved, duration, volume, cause, environmental problems, countermeasures taken, people and agencies notified, and recommended revisions, as appropriate, to the BMP plan, operating procedures and/or equipment to prevent recurrence. Also, written reports should include any occupational injuries or illnesses resulting from the incident.

Procedures and key data should be outlined for necessary reporting of BMP incidents to federal, state, and local regulatory authorities. In some circumstances, voluntary reporting to authorities such as municipal sewage treatment works, drinking water treatment plants, and fish and wildlife commissions may be desirable. The individuals responsible for notification should be listed. Pertinent telephone numbers should be listed for those individuals at the facility and those in the agencies to be notified. The phone numbers should be reviewed periodically for accuracy and might actually be used in the course of a "spill drill".

Elements of "Reporting of BMP Incidents", listed below, should be considered in developing a BMP plan:

- Maintenance of records of incidents through formal reports for internal review.
- Notification as required by law to governmental and environmental agencies should an incident occur.
- Procedures for notifying the appropriate personnel, and taking preventive or mitigating actions.
- Identification of responsible facility and government officials.
- A list of names, office telephone extensions, and residence telephone numbers of key personnel.
- A communications system for reporting incidents in-plant (i.e., telephone, alarms, radio, etc.).

2.2.2.4. Materials compatibility. Incompatibility of materials can cause equipment failure resulting from corrosion, fire or explosion. Equipment failure can be prevented by ensuring that the materials of construction for containers handling hazardous substances and toxic pollutants are compatible with the containers' contents and surrounding environment. It should be noted that mixing of incompatible chemicals may result in detrimental physical effects to exposed personnel in addition to corrosion, fire or explosion.

Materials compatibility encompasses three aspects: compatibility of the chemicals being handled with the materials of construction of the container, compatibility of different chemicals upon mixing in a container, and compatibility of the container with its environment. The specific requirements of "Materials Compatibility" in the BMP plan should provide procedures to address these three aspects in the design and operation of the equipment on site handling toxic and hazardous materials.

The BMP documentation on materials compatibility should recognize the engineering practices already used at the facility, and should summarize these existing practices with regard to corrosion and other aspects of material compatibility. Specific consideration should be given to procedures and practices delineating the mixing of chemicals and the prohibition of mixing of incompatible chemicals which might result in fire, explosion or unusual corrosion. Thorough cleaning of storage vessels and equipment before being used for another chemical should be standard practice to ensure that there is no residual of a chemical that is incompatible with the second, or later, chemical to be used. Coatings or cathodic protection should be considered for protecting a buried pipeline or storage tank from corrosion.

Where applicable, material testing procedures should be described. Proposed substitutions for currently used toxic or hazardous chemicals should be studied to determine whether the construction materials of the existing containers are compatible with the proposed new conditions. The procedures

utilized by the plant or an outside contractor to perform the materials compatibility study should be documented. Materials compatibility aspects of waste disposal which are covered by the RCRA hazardous waste regulations should be referenced in the BMP plan.

Elements of "Materials Compatibility", listed below, should be considered in developing a BMP plan:

- Evaluation of process changes or revisions for materials compatibility.
- Incorporation of existing engineering practices with regard to materials of construction, corrosion, and other aspects of materials compatibility.
- Evaluation of procedures for mixing of chemicals and of possible incompatibility with other chemicals present.
- Cleansing of vessels and transfer lines before they are used for another chemical.
- Use of proper coatings and cathodic protection on buried pipelines if required to prevent failure due to external corrosion.

2.2.2.5. Good housekeeping. Good housekeeping is essentially the maintenance of a clean, orderly work environment and contributes to the overall facility pollution control effort and safety and health program. Periodic training of personnel on housekeeping techniques for those areas where the potential exists for BMP incidents reduces the possibility of incidents caused by mishandling of chemicals or equipment.

Examples of good housekeeping include neat and orderly storage of bags, drums and piles of chemicals; prompt cleanup of spilled liquids to prevent significant run-off to navigable waters; sweeping, vacuuming or other cleanup of accumulations of dry chemicals as necessary to prevent them from reaching receiving waters; and provisions for storage of containers or drums to keep them from protruding into open walkways or pathways.

Maintaining personnel interest in good housekeeping is a vital part of the BMP plan. Methods for maintaining good housekeeping goals could include regular housekeeping inspections by supervisors and higher management; discussions of housekeeping at meetings; and publicity through posters, suggestion boxes, bulletin boards, slogans, incentive programs and employee publications.

Elements of "Good Housekeeping", listed below, should be considered in developing a BMP plan:

- Neat and orderly storage of chemicals.
- Prompt removal of spillage.

- Maintenance of dry and clean floors by use of brooms, vacuum cleaners, etc.

- Proper pathways and walkways and no containers and drums that protrude onto walkways.

- Minimum accumulation of liquid and solid chemicals on the ground or floor.

- Strategically located sorbents, or other clean-up materials for spills.

- Stimulation of employee interest in good housekeeping.

2.2.2.6. Preventive maintenance. An effective preventive maintenance (PM) program is important to prevent BMP incidents. A PM program involves inspection and testing of equipment and systems to uncover conditions which could cause breakdowns or failures with resultant significant discharges of chemicals to receiving waters. The program should prevent breakdowns and failures by adjustment, repair or replacement of items. A PM program should include a suitable records system for scheduling tests and inspections, recording test results, and facilitating corrective action. Most facilities have existing PM programs which provide a degree of environmental protection. It is not the intent of the BMP plan to require development of a redundant PM program. Instead, the objective is to have qualified personnel (e.g., BMP Committee, maintenance foreman, environmental engineer) evaluate the existing plant PM program and recommend to management those changes, if any, needed to address BMP requirements.

A good PM program should include the following: (1) identification of equipment or systems to which the PM program should apply; (2) periodic inspections or tests of identified equipment and systems; (3) appropriate adjustment, repair, or replacement of items; and (4) maintenance of complete PM records on the applicable equipment and systems.

The BMP plan documentation on PM may include a list of procedures, examples of recordkeeping, a list of the principal systems to which the PM program is applicable, and directions for obtaining the records for any particular system included or referenced in the BMP plan. In general, it will be adequate to reference in the BMP plan the scope and location of existing PM procedures and records applicable to the PM specific requirement.

Elements of "Preventive Maintenance", listed below, should be considered in developing a BMP plan:

- Identification of equipment and systems to which the PM program should apply.

- Periodic inspections of identified equipment and systems.

- Periodic testing of such equipment and systems.

- Appropriate adjustment, repair, or replacement of parts.

- Maintenance of complete PM records on the applicable equipment and systems.

2.2.2.7. Inspections and records. The purpose of the inspection and records system is to detect actual or potential BMP incidents. The BMP plan should include written inspection procedures and optimum time intervals between inspections. Records to show the completion date and results of each inspection should be signed by the appropriate personnel and maintained for a period of three years. A tracking (follow-up) procedure should be instituted to assure that adequate response and corrective action have been taken. The record-keeping portion of this system can be combined with the existing spill reporting system at the facility.

While security and other personnel may frequently and routinely inspect the facility for BMP incidents, these people are not necessarily capable of assessing the potential for such incidents. Thus certain inspections should be assigned to designated qualified individuals, such as maintenance personnel or environmental engineering staff.

The inspection and records system should include those equipment and plant areas identified in the "Risk Identification and Assessment" portion of the BMP plan as having the potential for significant discharges. To determine the inspection frequency and inspection procedures, competent environmental personnel should evaluate the causes of previous incidents, and assess the probable risks for incident occurrence. Furthermore, the nature of chemicals handled, materials of construction, and site-specific factors including age, inspection techniques and cost effectiveness should be considered.

Qualified personnel should be identified to inspect designated equipment and plant areas. Typical inspections should include examination of pipes, pumps, tanks, supports, foundations, dikes, and drainage ditches. Records should be kept to determine if changes in preventive maintenance or good housekeeping procedures are necessary. Each of the ancillary sources should have "Inspection and Records" programs designed to meet the needs of the particular facility.

Material storage areas for dry chemicals should be inspected for evidence of, or the potential for, windblowing which might result in significant discharges. Liquid storage areas should be inspected for leaks in tanks, for corrosion of tanks, for deterioration of foundations or support, and for closure of drain valves in containment facilities. Inspections could include the examination of seams, rivets, nozzle connections, valves, and connecting pipelines. Storage tanks should be inspected for evidence of corrosion, pitting, cracks, abnormalities, and deformation and such evidence should then be evaluated.

For in-plant transfer and materials handling of liquids, inspections should include visual examination for evidence of deterioration of pipelines, pumps,

valves, seals and fittings. The general condition of items such as flange and expansion joints, pipeline supports, locking valves, catch or drip pans, and metal surfaces also should be assessed.

For loading and unloading operations, inspections during transfer of materials would permit immediate response if an incident occurred. The conditions of pipelines, pumps, valves, and fittings for liquid transfer systems and pneumatic conveying systems used for transferring dry chemicals should be inspected. Inspections (together with monitoring) should be used to ensure that the transfer of material is complete before flexible or fixed transfer lines are disconnected prior to vehicular departure. Before any tank car or tank truck is filled, the lower-most drain valve and all outlets of such vehicles should be closely examined for evidence of leakage and, if necessary, tightened, adjusted or replaced. Before departure, all tank cars or tank trucks should be closely examined to ensure that all transfer lines are disconnected and that there is no evidence of leakage from any outlet.

For runoff, inspections should be used for examining the integrity of the stormwater collection system and the overflow diversion structures, and for ensuring the drain valves and pumps for diked areas are properly closed. The plant sewer and storm sewer system should be periodically surveyed to ensure that toxic and hazardous pollutants are not discharged in significant amounts. Additionally, inspections should include diked areas to ensure that hazardous and toxic chemicals are not discharged from inside diked areas to waterways. Any liquid, including rainwater, should be examined, and where necessary, analyzed, before being released from the diked areas to a receiving water.

For sludge and hazardous waste disposal sites, visual inspections should include examinations for leaks, seepage, and overflows from land disposal sites such as pits, ponds, lagoons, and landfills. Other procedures and inspection techniques should be considered on a site-specific basis. Any inspections made or records kept to comply with RCRA may be included in the BMP plan by reference.

Elements of "Inspection and Records", listed below, should be considered in developing a BMP plan:

- Inspection of:

  storage facilities,

  transfer pipelines,

  loading and unloading areas,

  pipes, pumps, valves, and fittings,

  tank corrosion (internal and external),

  windblowing of dry chemicals,

tank support or foundation deterioration,

seams along drainage ditches and old tanks,

deterioration of primary or secondary containment,

housekeeping,

drain valves on tanks,

damage to shipping containers,

conveying systems for dry chemicals,

integrity of stormwater collection system,

leaks, seepage, and overflows from sludge and various waste disposal sites.

- Records of all inspections.
- Tracking procedures to assure adequate response and corrective action have been taken when inspections reveal deficiencies.

2.2.2.8. Security. A security system is needed to prevent accidental or intentional entry to a facility which might result in vandalism, theft, sabotage or other improper or illegal use of plant facilities that could possibly cause a BMP incident. Most facilities have security systems to prevent unauthorized entry leading to theft, vandalism, sabotage and the like. The BMP plan should describe those portions of the existing security system which ensure that the pertinent chemicals are not discharged to receiving waters in significant quantities. Documentation of the security system may require separate filing from the BMP plan documents to prevent undesirables from gaining access to confidential business information or classified information.

The BMP Committee, plant security manager, plant engineer or other qualified installation personnel should evaluate the coverage of the existing security system for those areas of the plant and the equipment identified by the "Risk Identification and Assessment" specific requirement as having the potential for significant discharges. They should recommend to management any changes necessary to improve the security system.

Examples of security measures include: routine patrol of the plant by security guards in vehicles or on foot; fencing to prevent intruders from entering the site; good lighting; vehicular traffic control; a guardhouse or main entrance gate, where all visitors are required to sign in and obtain a visitor's pass; secure or locked entrances to the facility; locks on certain valves or pump starters; and television surveillance of appropriate sites, such as facility entrance, and loading and unloading areas.

Whenever possible, security personnel should be instructed to observe leaks from tanks, valves, or pipelines while patrolling the facility and also be informed of the procedures to follow when a spill or other discharge is detected. Many plants use contractor or plant security personnel who may not be qualified or may not have time to carry out such surveillance. In such cases, the surveillance can be incorporated in the "Inspection and Records" specific requirement and should be conducted by production or environmental staff.

Elements of "Security", listed below, should be considered in developing a BMP plan:

- Routine patrols by security personnel.
- Fencing.
- Good lighting.
- Vehicular traffic control.
- Controlled access at guardhouse or main entrance gate.
- Visitor passes.
- Locked entrances.
- Locks on certain drain valves and pump starters.
- Television monitoring.

2.2.2.9. Employee training. Training programs should instill in personnel, at all levels of responsibility, a complete understanding of the BMP plan, the processes and materials with which they are working, the safety hazards, the practices for preventing discharges, and the procedures for responding properly and rapidly to toxic and hazardous materials incidents. Employee training meetings should be carried out at least annually to assure adequate understanding of the objectives of the BMP plan and the individual responsibilities of each employee. Typically, these meetings could be a part of routine employee meetings for safety or fire protection. Such meetings should highlight previous spill events or failures, malfunctioning equipment components, and recently developed BMP precautionary measures. Training sessions should review the BMP plan and associated procedures. Just as fire drills are used to improve an employee's reaction to a fire emergency, spill or environmental incident drills may serve to improve the employee's reactions to BMP incidents. Facilities are encouraged to conduct spill drills on a quarterly or semi-annual basis. Spill drills serve to evaluate the employees' knowledge of BMP-related procedures and are a fundamental part of employee training.

Of particular importance is the strong commitment and periodic input from commanders and top management to the employee training program to create the

necessary climate of concern for a successful program. The commander or manager might accomplish more in a brief, face-to-face, appearance than an elaborate, impersonal training program would accomplish.

Adequate training in a particular job and process operation is essential for understanding potential discharge problems. Knowledge of specific manufacturing operations and how discharges could occur, or have occurred in the past, is important in reducing human error that can lead to BMP incidents.

The training program should also be aimed at making personnel aware of the protocol used to report discharges and notifying the people responsible for response so that countermeasures can be initiated. In addition, personnel involved in BMP-incident response would be trained to use cleanup materials such as sorbents, gelling agents, foams, and neutralizing agents. As appropriate, they should be educated in safety precautions, in the side effects of the chemicals they are working with, and in possible chemical reactions. Operating manuals and standard procedures for process operations should include appropriate sections on the BMP plan and the spill control program and would be readily available for reference. Spill response drills, suggestion boxes, posters, and incentive programs can be used to motivate personnel to be alert to the potential for discharges and to their prevention.

The training program should include records of the frequency, and names and positions of the personnel trained as well as the lesson plans, subject material covered, and instructors' names and positions. BMP-related training may be combined with other forms of training, such as safety and fire prevention at the discretion of commanders or managers.

In addition to permanent personnel, contractors or temporary personnel should be trained in procedures for preventing BMP incidents since these individuals may be unfamiliar with the normal operating procedures or location of equipment (pipelines, tanks, etc.) at the facility. Adequate supervision of contractor maintenance personnel should be provided to minimize the possibility of BMP incidents resulting from damaging equipment such as buried pipelines.

Elements of "Employee Training", listed below, should be considered in developing the BMP plan:

- Meetings held at least annually to assure adequate understanding of program goals and objectives.
- Environmental Incident (Spill) drills used at least semiannually.
- Periodic input from management.
- Adequate training in particular job and process operation and the effect on other operations.
- Transmission of knowledge of past incidents and causes.

- Making personnel aware of BMP plan and incident reporting procedures.
- Training in the use of sorbents, gelling agents, foams, and neutralizing agents for cleanup or mitigation of incidents.
- Operating manuals and standard procedures.
- Making personnel aware of health risks of chemicals handled through both the facility's BMP plan and safety program.
- Motivating personnel concerning incident prevention and control.
- Records of the personnel who were trained, and of the dates, instructors, subject matter, and lesson plans of the training sessions.
- Training and supervision of contractors and temporary personnel.

3. GLOSSARY OF TERMS

"the ACT"	-	Clean Water Act of 1977
Ancillary Sources	-	Activities associated with the manufacturing or treatment process which are particularly suited for BMPs, such as material storage areas, loading areas, etc.
Applicant	-	An applicant for an NPDES permit
BMP	-	Best Management Practice
BMP Plan	-	A plan describing the BMPs for a particular facility required by the NPDES regulations implementing section 402 of the Act.
NPDES	-	National Pollutant Discharge Elimination System
OSHA	-	Occupational Safety and Health Administration
Permittee	-	A facility, corporation, etc. which has an NPDES permit to discharge wastewater.
RCRA	-	Resource Conservation and Recovery Act
SPCC Plans	-	Spill Prevention Control and Countermeasure Plan required by section 311 of the Act.
TSCA	-	Toxic Substances Control Act

4. LITERATURE CITED

1. "NPDES Best Management Practices Guidance Document", Hydroscience, Inc. under contract to US Environmental Protection Agency, EPA-600/9-79-045, December 1979.

2. "Criteria and Standards for Best Management Practices under Sections 304(e) and 402(a)(1) of the Act", 40 CFR Part 125, Subpart K (44FR 32954-5), June 7, 1979.

3. "Hazardous Material Information System", DODI 6050.5, January 25, 1978.

Assignee Activity: GS

Custodians:

Army - EA
Navy - SH
Air Force - 68

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Appendix A

TECHNICAL BULLETINS/MATERIAL SAFETY DATA SHEETS

Technical bulletins and material safety data sheets for specific toxic and hazardous compounds were reviewed to obtain information on BMPs for specific chemicals. Technical bulletins referred to as Material Safety Data Sheets, Technical Data Sheets or Chemical Safety Data Sheets were obtained from several companies and a major trade association. A list of the chemicals addressed by the technical bulletins or data sheets appears below.

Typical contents of these technical bulletins include information on specific chemicals relative to physical and chemical properties, hazardous ingredients, fire and explosive hazards, health hazards, reactivity, spill or leak procedures, special safety precautions, and loading and unloading precautions. Information obtained from these technical bulletins relative to BMPs for specific chemicals is summarized in Appendix C.

Reference Numbers	Chemical
T1	Dursban
T2	Methylenechloride
T3	Chlorobenzene
	Dichlorobenzene
	Trichlorobenzene
T4	Trichloroethylenes
T5	Methylchloride
T6	Pentachlorophenol
T7	Chlorine
T8	Acetic anhydride
T9	Butyl acetate
T10	Ethylenediamine
T11	Formic acid, glacial
T12	Formic acid, 90%
T13	Phenol
T14	Propionic acid
T15	Toluene
T16	Triethylamine
T17	Carbaryl
T18	Carbaryl 50%
T19	Carbaryl 85%
T20	Carbaryl 95%
T21	Carbaryl 97.5%
T22	Acetic acid
T23	Acrolein
T24	Benzene
T25	Butyric acid
T26	Diethylamine
T27	Ethylbenzene

Technical Bulletins/Material Safety Data Sheets (Continued)

Reference Numbers	Chemical
T28	Methyl chloride
T29	Vinyl acetate
T30	Amyl acetate
T31	Xylene
T32	Styrene
T33	Hydrochloric acid
T34	Acrolein
T35	Allyl alcohol
T36	Epichlorohydrin
T37	Allyl chloride
T38	Vinyl chloride
T39	Para-Xylene
T40	Ortho-Xylene
T41	Xylene
T42	Toluene
T43	Cyclohexane
T44	Sulfuric acid
T45	Tetrachloroethane
T46	Maleic anhydride
T47	Nitrobenzene
T48	Nitric acid
T49	Paraformaldehyde
T50	Caustic potash (potassium hydroxide)
T51	Phosphorus
T52	Hydrofluoric acid
T53	Phosphorus oxychloride
T54	Phosphorus trichloride
T55	Chlorosulfonic acid
T56	Methyl bromide
T57	Hydrochloric acid
T58	Acetic acid
T59	Ammonium dichromate
T60	Sodium
T61	Benzyl chloride
T62	Allyl chloride
T63	Vinyl acetate
T64	Diethylamine
T65	Acetic anhydride
T66	Acetic acid
T67	Benzene
T68	Chlorine
T69	Phosgene

INDUSTRIAL CONTACTS

The following is a list of the industrial contacts made during this project.

Industrial Contacts

Reference Numbers	Description
S1	Site visit - Procter and Gamble, Cincinnati, Ohio
S2	Site visit - Hooker Chemical Company, Niagara Falls, New York
S3	Site visit - Allied Chemical Company, Hopewell, Virginia
P1	Phone contact - Allied Chemical Company
P2	Phone contact - Union Carbide Corporation
P3	Phone contact - Shell Chemical Company
P4	Phone contact - Stauffer Chemical Company
P5	Phone contact - Celanese Chemical Company
P6	Phone contact - E. I. du Pont de Nemours & Co., Inc.
R1	Questionnaire Response - Celanese Chemical Company
R2	Questionnaire Response - Shell Chemical Compnay
R3	Questionnaire Response - Union Carbide Corporation

Appendix B

BMP KEYWORD SUMMARY

BMP	References
Spill committee	1, 2, 5, 12, 18, 57, 78, 83, 100
Spill reporting	1, 2, 3, 8, 9, 12, 15, 22, 44, 49, 54, 78, 83, 100
Materials compatibility	6, 43, 44, 50, 64, 85, 111, 112, 138, P4, P1, T44, T48, T58
Materials inventory	12, 78, 83, 100
Visual inspection	2, 4, 5, 7, 9, 12, 13, 21, 24, 27, 29, 40, 44, 45, 57, 83, 100, 104, 106, 108, 123, 124, 125, 143, 144, 145, 146, P4, R1, T5, T43, T44, T46, T47, T48, T50, T52, T53, T54, T55, T56, T57, T61, T64, R3
Security	2, 26, 45, 50, 61, 83, 100
Employee training	1, 2, 5, 8, 12, 44, 78, 83, 84, 100, 104, 105, T43-T64, R3
Preventive maintenance	1, 4, 5, 12, 13, 21, 42, 43, 53, 106
Good housekeeping	1, 4, 5, 12, 13, 21, 42, 43, 53, 122, P2, R3
Prevention	
Monitoring/instrumentation	3, 4, 5, 7, 8, 9, 12, 13, 21, 25, 26, 28, 29, 40, 41, 42, 44, 45, 53, 54, 57, 60, 68, 78, 83, 100, 105, 106, 107, 125, 130, 138, T3, T4, T43, T45, T46, T47, T48, T49, T50, T52, T53, T54, T56, T57, T62, R3
Nondestructive testing	4, 40, 44, 46, 100, 106, 112, R1, R3
Labeling	5, 21, 50, 61, 111, 125, T35, T6, T37, P4, T43-64
Covering	7, 11, 61, 67, 68, 103, R1, R3
Pneumatic/vacuum conveying	50, 103, 124, 140, 142, 143, 144, 145, 146, T44, T48, T52, T53, T54, T55, T57, T60, R3
Vehicle positioning	123, 124, T5, T48, T53, T54, T55, T57, T61-T64
Dry cleanup	5, 50, T49, T50, T59, R3

BMP	References
Containment	
Secondary containment	1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 17, 21, 24, 29, 32, 44, 46, 47 49, 50, 52, 53, 54, 57, 61, 62, 68, 78, 83, 100, 112, 125, T11, T14, T16, T22, T26, T29, T35, T36, T37, T38, T41, T42, T66, T67, P1, P2, P4, S2, S3, R1, T63, R3
Flow diversion	5, 7, 10, 11, 12, 13, 17, 26, 57, 66, 78, T43, R3
Vapor control	35, 36, 57, S3, T2, T3, T38, T44, T45, T46, T52, T54, T55, T56, T57, T58, T61-T63, R3
Dust control	50, 103, 110, 142, 144, 145, 146, T17, R3
Sealing	6, 7, 30, 31, 60, 150, 151
Mitigation	
Cleanup	
Gelling agents	2, 9, 24, 31, 33, 34, 47, 49, 60, 101
Foams	36, 49, 59, 60, 101, 141, P1, T23, T34, R3
Sorbents	2, 9, 24, 33, 34, 36, 47, 49, 60, 100, 101, 114, T13, T35, T37, T41, T42, T67, T45, T48, T53, T54, T55, T63
Physical methods	S3, T17, P1, P2, T13, P4
Mechanical methods	9, 47, 60, 78, T34, T35, R3
Treatment	
General	49, 89, 90, 91, 92, 94, 98, 109, 126
Carbon adsorption	49, 61, 109, 126
Volatilization	109, 126
Liquids-solids separation	9, 12, 22, 24, 49, 61, 62, 109, 126, 134
Ion exchange	49, 61, 101, 114, 134
Neutralization	9, 12, 22, 23, 32, 52, 53, 57, 101, 114, 126, 134, S2, R1, T65, T44, T46, T48, T50, T52, T53, T55, T58, T60, T61, R3
Coagulation/precipitation	9, 12, 22, 24, 49, 61, 62, 101, T59
Incineration	12, 54, 61, 63, 101, 126, 134, 139, T4, T6, T7, T8, T9, T10, T13, T14, T15, T22, T23, T24, T25, T26, T27, T28, T34, T35, T36, T37, T41, T42, T65, T66, T67, S2, T43, T46, T47, T49, T57, T60, T61, T62, T63, T64
Biological	48, 49, 61, 109, 126, 134, T55, T58
Chemical oxidation	32, 126, 134

BMP	References
Ultimate Disposition	
General	58, 61, 65, 69, 89, 90, 126, 128, 139, 155
Deep-well injection	7, 54, 61, 63, 126, 138
Landfill	18, 54, 61, 63, 64, 125, 126, 133, 134, T4, T17, T41, T42, T67, T46, T47, T49, R3
Surface impoundments	6, 7, 12, 30, 61, 63, 120, P2, 144
Ocean disposal	44, 61, 126, T44, T6, R3
Direct discharge	10, 11, 12, 100, 126, T44, T63, R3
Reclamation	12, 52, 61, 63, 126, P1, P2, S2, S3, P4, T4, T41, R3
Municipal system	11, T47
Contract disposal	65, 68, 128, 137, S2, T51

Appendix C

BMPs FOR SPECIFIC TOXIC AND HAZARDOUS CHEMICALS

Specific Compound or Group	BMPs Identified	Reference Number
Acetaldehyde	Diversion, drainage control, holding ponds, waste treatment	7
	Incineration	T7
Acetic anhydride	Incineration	T8
	Incineration, neutralization	T65
Acetic acid	Containment, incineration	T22
	Dikes, incineration	T66
	Diversion, drainage control, holding ponds, waste treatment	7
	Vapor control, employee training, labeling, biological treatment, neutralization	T58
Acid	Containment, curbs, dikes, catchment basins	10
	Neutralization	23
	Dead-end sumps, ditches, curbing, good housekeeping, preventive maintenance	1
	Crushed lime, bicarbonate, soda ash	23
	Dikes, high-level alarms	57
Acrolein	Dikes, neutralization, water spray, foam, treatment	57
	Foams, sodium sulfite, incineration	T23
	Foams, vacuum trucks, controlled burning	T34
Acrylonitrile	Sorbents	34
	Concrete diked areas	57
Adipic acid	Dry cleanup	53

Specific Compound or Group	BMPs Identified	Reference Number
Allyl alcohol	Sorbents, dikes, vacuum trucks, labeling, controlled burning	T35
Allyl chloride	Sorbents, containment, labeling, controlled burning	T37
	Vapor control, monitoring (vapor), employee training, labeling, vehicle positioning, incineration	T62
Ammonium dichromate	Labeling, dry cleanup, employee training, chemical precipitation	T59
Benzene	Sorbents	34
	Foam, vapor control	59
	Incineration	T24
	Sorbents, dikes, incineration, landfill	T67
Benzyl chloride	Employee training, labeling, visual inspection, vehicle positioning, vapor control, neutralization, incineration	T61
Butyl acetate	Incineration	T9
	Foam, vapor control	59
Butyric acid	Incineration	T25
Calcium hydroxide	Flow diversion	57
Carbaryl	Dust control, drip pans, good housekeeping, dry cleanup, vacuum cleanup devices, visual inspection, sand bag containment, reclamation, landfill, pneumatic conveying, employee training	R3
	Dust control, dry cleanup, landfill with lime or caustic	T17
Chlorinated organics	Dead-end sumps, diking, curbing, good housekeeping, preventive maintenance	1

Specific Compound or Group	BMPs Identified	Reference Number
Chlorine	Alkaline absorption monitoring, liquid-level alarm, water spraying, foam, neutralization, nondestructive testing	R3
	Dovering (roof)	R1
	Dead-end sumps, diking, curbing, good housekeeping, preventive maintenance	1
	Increased inspections, redundant instrumentation, labeling	P4
Chlorobenzenes	Level alarms, vapor control, pump transfer (no air transfer)	T3
Chlorosulfonic acid	Employee training, labeling, pneumatic-conveying, vehicle positioning, visual inspection, vapor control, sorbent, neutralization, biological treatment	T55
Corrosive liquids	Dikes, flow diversion, waste treatment, direct discharge	R3
	Visual inspection, nondestructive testing	R1
	Dikes	P1
	Separate dikes	P2
	Containment, materials compatibility	P4
Cyclohexane	Monitoring (vapor), labeling, visual inspection, drains, curbs, incineration, employee training	T43
	Employee training, labeling, vehicle positioning, visual inspection, incineration	T64
Diethylamine	Containment to treatment plant incineration	T26
Diethylether	Foam, vapor control	59
Dry chemicals	Dry cleanup, good housekeeping, reclamation	P2
Dry chemicals	Dry cleanup, reclamation	P1

Specific Compound or Group	BMPs Identified	Reference Number
Epichlorohydrin	Dikes	T36
Ethyl benzene	Foams, vapor control	59
	Incineration	T27
Ethyl ether	Foam, vapor control	59
Ethylenediamine	Incineration	T10
Ferric chloride	Sorbents	34
Flammables	Foams	P1
Formaldehyde	Sorbents	34
Formic acid	Containment, incineration	T11
Hydrochloric acid	Vapor control, monitoring (vapor), employee training, labeling, neutralization, visual inspection, vehicle positioning, pneumatic conveying	T57
Hydrofluoric acid	Containment, neutralization	52
	Deap-end sumps, diking, curbing, good housekeeping, preventive maintenance	
	Neutralization, employee training, labeling, vapor control, pneumatic conveying, visual inspection, monitoring, alkaline absorption (vapors)	T52
Human poisons	Dust control, drip pan, good housekeeping, dry cleanup, vacuum cleanup deices, visual inspection, sand bags, reclamation, landfill, pneumatic conveying, employee training, dikes, flow diversion, waste treatment	R3
Maleic acid	Dikes, materials compatability	P1
Maleic anhydride	Employee training, labeling, monitoring (vapor) visual inspection, vapor control, neutralization, landfill, incineration	T46

Specific Compound or Group	BMPs Identified	Reference Number
Methyl bromide	Employee training, vapor control, labeling, visual inspection, monitoring (vapors)	T56
Methyl chloride	Stop source of leak, incineration	T28
	Vehicle positioning, inspection	T5
Methylene chloride	Vapor control	T2
Nitric acid	Employee training, monitoring (vapors), labeling, sand sorbents, pneumatic conveying, materials compatibility, visual inspection, vehicle positioning, neutralization	T48
	Sorbents	34
Nitrobenzene	Monitoring (vapors), employee training, labeling, visual inspection, incineration, landfill, municipal sewage system	T47
Paraformaldehyde	Monitoring (vapors), employee training, explosion relief devices, labeling, dry cleanup, incineration, landfill	T49
PCBs	Covering, curbing, visual inspection, labeling	R3
	Surface impoundment	P2
	Contract disposal	52
	Dead-end sumps, diking, curing, good housekeeping, preventive maintenance	1
Pesticides	Dead-end sumps, incineration	52
Phenol	Sorbents	34
	Sorbents, dry cleanup, incineration	T13
	Sorbents, nondestructive testing, monitoring, containment, security, drip pans, depressed areas, inspections	100
	Dikes, sumps, paving, reclamation	53

Specific Compound or Group	BMPs Identified	Reference Number
Phosgene	Alkaline absorption, monitoring, doubled-walled tanks, cathodic protection, alarms (pressure, temperature, and liquid level)	R3
	Increased inspections, redundant instrumentation, labeling	P4
Phosphoric acid	Containment, dikes, holding ponds, storage	6
	Sorbents	34
Phosphorus	Employee training, labeling, contract disposal, incineration	T51
Phosphorus oxychloride	Employee training, labeling, monitoring, visual inspection, pneumatic conveying, vehicle positioning sorbents, neutralization, vapor control	T53
Phosphorus trichloride	Monitoring, employee training, labeling, sand sorbent, vapor control, visual inspection, vehicle positioning, neutralization, pneumatic conveying	T54
Potassium hydroxide	Employee training, monitoring (vapors), labeling, dry cleanup, neutralization, materials compatability, visual inspection	T48
Propionic acid	Containment, incineration	T14
Sodium	Employee training, labeling, vacuum conveying, incineration, neutralization	T60
Sodium hydroxide	Sorbents	34
	Dead-end sumps, curbing, good housekeeping, preventive maintenance	1
	Containment, neutralization, reclamation	52
	Dikes, sumps, paving, reclamation	53
	Curbing	57
Sodium hypochloride	Containment, chemical treatment, neutralization, chemical oxidation	32

Specific Compound or Group	BMPs Identified	Reference Number
Solids	Dry cleanup, reclamation	P4
Solvents	Containment, sumps, neutralization	R1
Styrene	Containment, chemical treatment neutralization, chemical oxidation	32
Sulfuric acid	Labeling, employee training, materials compatibility, visual inspection, pneumatic conveying, vapor control, neutralization, surface impoundments, direct discharge	T44
	Containment, sumps, neutralization	R1
	Containment, treatment	32
	Dikes, sumps, paving, reclamation	53
	Sorbents	34
Tetrachloroethane	Monitoring (vapors), vapor control, sorbents, employee training, labeling	T45
Trichloroethylene	Reclamation, incineration, landfill	T4
	Dead end sumps, diking, curbing, good housekeeping, preventive maintenance	1
Triethylamine	Containment, incineration	T16
	Foam, vapor control	59
Toluene	Incineration	T15
	Dikes, sorbents, incineration, land burial	T42
	Sorbents	34
	Foam, vapor control	59
Vinyl acetate	Containment, treatment	T29
	Waste treatment	7
	Vapor control, monitoring, employee training, labeling, vehicle positioning, dikes, incineration, direct discharge, sorbent (paper)	T63

Specific Compound or Group	BMPs Identified	Reference Number
Vinyl chloride	TV inspection	45
	Dikes, water spraying	T38
Volatiles	Forced dispersal, heating, burning, water spraying	35
Xylene	Dikes, sorbents, reclamation, incineration landfill	T41

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