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Technical Resource Document for Obtaining Variances from the Secondary Containment Requirement of Hazardous Waste Tank Systems

Volume 1: Technology-Based Variance

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EXECUTIVE SUMMARY

This document was developed to provide hazardous waste tank system owners and operators information for submitting technology-based and risk-based variances from the EPA requirement for secondary containment with release monitoring for these tank systems. It was written in two volumes; Volume 1 covers technology-based variances, and Volume 2 covers risk-based variances. This summary covers Volume 1.

On July 14, 1986, EPA promulgated revised standards for hazardous waste storage and treatment tank systems. These regulations require that all new hazardous waste tank systems be provided secondary containment with release monitoring. This requirement will also be phased in for existing tank systems.

EPA recognized that the goal of protecting human health and the environment might be achieved in ways other than secondary containment. For example, new tank system design, operating practices, or release detection technologies could substitute for traditional secondary containment approaches. Innovative risk management methods that would provide low probability of risk to the environment could also be used. A combination of any of the above approaches might be demonstrated to be protective of human health and the environment. Therefore, tank system owners or operators may apply for a variance from the secondary containment requirements of the hazardous waste tank system standards. Both risk-based and technology-based variances can be obtained.

Technology-based variances can be granted if the tank system owner/operator can show that by using new technology and/or alternative operating procedures together with location characteristics, a release will be contained, detected, and removed before it leaves the area under control of the owner/operator. Ultimately, the applicant must demonstrate that the release is prevented from reaching ground water or surface water at least as effectively as if a secondary containment technique were employed. New and existing tank systems may qualify for this type of variance. The demonstration to be conducted and submitted to EPA in order to support a request for this variance is discussed in detail in this volume.

A risk-based variance may be granted if the tank system owner/operator can show that if a release occurs there will be no substantial hazard (present or future) to the environment and human health. Details of the demonstration needed for risk-based variance are covered in Volume 2 of this report.

Technology-Based Variance Application Process

The tank system owner/operator provides the EPA Regional Administrator (or cognizant state authority) a written notice of his/her intent to conduct a demonstration of all requirements in §§ 264.193(g)(1) or 265.193(g)(1) needed to apply for this variance. Owners/operators of existing tank systems must send the Regional Administrator written notice of intent at least 24 months before secondary containment is required. Those owner/operators of new tank systems have 30 days prior to entering into a contract to send the Regional Administrator written notice of intent. This notice must have the following information: facility location, nature and quantity of waste, system age, description of the steps required to conduct the demonstration, and a timetable for completing each of these steps. The actual application must be submitted within 180 days after the written notice has been provided. Once the application is received, the Regional Administrator will notify the public and allow 30 days to comment upon it. For interim status tank systems, the variance must be approved or denied by the Regional Administrator within 90 days of his/her receipt of the demonstration.

Preliminary Screening Procedure

Guidelines are provided for the potential applicant to determine whether he/she should apply for a variance. The assumption that a release incident will be equivalent to a catastrophic release of waste material is used to determine whether granting of the variance is likely. The extent of a catastrophic release is affected by poor tank system conditions and vulnerable hydrogeologies. These will create a potential for denial of the variance. Sensitive hydrogeologies are evaluated with respect to tank system location (proximity to ground water or surface water), waste release movement through the unsaturated zone, and waste release movement above ground. Tank system integrity is evaluated via an examination for leaks, cracks, corrosion (or erosion) and potential for collapsing, rupturing, or failing.

Data Needed to Apply

The actual variance application should include the following items: general company information, executive summary, description of the alternative design/operating procedure justifying the variance, characterization of the tank/operating system, source characterization, site hydrogeology, determination of zone of engineering control, leak detection effectiveness demonstration, determi·ation of waste travel time, effectiveness of spill/leak response plan, and sufficiency of detection and remedial action. This information must be as complete as possible to prevent any unnecessary delay in the approval or disapproval process.

A brief description of each data need is provided below:

- Overall description of system - this section describes the alternative system design or operating procedures that the tank system owner/operator believes will justify the variance;

- Tank system and operating system description - this section should provide information on the tank system's demonstrated ability to prevent releases. The Regional Administrator will evaluate this ability based on the actual tank system design, installation procedures, corrosion protection measures, operational history/problems encountered with existing tank systems, and the tank system's overfill and spill protection features;

- Source characterization - the physical and chemical properties of the stored waste must be provided to determine its potential for migration (in the event of a release) or contribution to tank system corrosion or incompatibility;

- Site hydrogeologic conditions - this information is necessary in order to determine the time of travel of the waste (in the event of a release) through the unsaturated zone of the soil. Such information should include, but not be limited to, site geology, climatic and meteorological data, and any subsurface investigative methods/results used;

- Zone of engineering control - this zone is the area under control of the owner/operator in which releases can be detected, contained, and ultimately removed prior to such releases reaching the ground water or surface water. The information provided will describe how this zone is defined, and consists of the site plan, water table maps, cross-sections (of the tank system location, highest seasonal water table, property boundaries, nearest surface water, locations of all surface and subsurface structures and utilities), accesses/obstructions to any remedial action, any cleanup equipment limitations, migration pathways (travel times), soil volume, legal agreements, and safety margins.

- Release detection - this section will demonstrate how effectively the owner/operator's system can detect a release. This entails a thorough description of the effectiveness, reliability, lower detection limit and response time of the release detection system;

- Determination of waste travel time - this section contains the calculations supporting projection of waste travel time during a release. These times must be provided for overland flow (horizontal movement) and/or unsaturated zone flow (vertical movement) depending on whether the tank system is aboveground or underground;

- Response contingency plan - this section must contain details of the applicant's response to any inadvertent waste release;

- Demonstration of adequacy for detection and remedial action - this section builds upon the previous data elements and uses them to demonstrate to the Regional Administrator whether remedial actions are sufficient to contain the waste releases within the zone of engineering control. In particular, the applicant must demonstrate that the time for detection, response, and completion of remedial action is less than the time for the release to migrate beyond the zone of engineering control.

Submittal and Review

After completing the preparation of the application, owner/operators then submit it to the Regional Administrator for review. (In a State that has received authorization from EPA to implement the RCRA program, demonstrations should be made to the appropriate State official.) The following review process applies for both the technology-based and risk-based application.

Upon review of the application, the EPA may take one of the following actions:

- Approval of Variance Request

  If the demonstration satisfies the Regional Administrator that migration is contained at least as effectively as it would be by a secondary containment system, a variance may be granted under 40 CFR 264(265).193(g) and (h).

- Request for More Information

  The Regional Administrator may deem the application incomplete if he or she feels that additional data are necessary to complete or more fully substantiate the premises of the demonstration. In such an instance, the Regional Administrator may request specific additional information. The decision for approval or disapproval may be suspended until such time as the application is deemed complete.

1. INTRODUCTION

1.1 Purpose and Scope of Technical Resource Document

1.1.1 Background

The hazardous waste storage and treatment tank system standards were developed and promulgated by EPA to respond to the Hazardous and Solid Waste Amendments of 1984 while modifying certain existing hazardous waste tank system regulations that had proved unworkable and/or ineffective. These standards were published in the Federal Register (51 FR 25422-486, July 14, 1986).

The rule essentially requires secondary containment with interstitial monitoring for all new hazardous waste tank systems. For existing tank systems, the requirement for secondary containment with interstitial monitoring will be phased in. Tank systems storing or treating listed dioxin-containing wastes must meet these requirements within two years of the effective date of this regulation. Other existing tank systems that are determined to be non-leaking on the basis of tank system integrity assessments or other means must meet these requirements by the time the tank system is 15 years old. Periodic tank system integrity assessments are required for all tank systems not fitted with secondary containment. The rule also contains procedures for use in the event that a leak is discovered.

1.1.2 Purpose of This Document

The purpose of this technical resource document is to provide technical assistance and information for owners/operators of hazardous waste tank systems applying for either a technology-based variance or a risk-based variance from the secondary containment requirements of the hazardous waste tank systems regulations. The document identifies the information requirements of the variance applications and prescribes a format for presenting this information. The document does not set standards or acceptable criteria for such variances. Further, the document does not prescribe specific techniques to obtain required information or to demonstrate the effectiveness of an alternative method. It is the responsibility of the applicant to devise and demonstrate the validity of techniques used, to gather required information, and to demonstrate the effectiveness of the proposed method.

1.1.3 Who May Apply for Variances

This document provides information to aid the potential applicant in deciding whether to apply for a variance from the secondary containment provision in the hazardous waste storage and treatment tank system standards.

In some instances, applicants may not need to seek a variance from the secondary containment requirement because their design may actually satisfy the definition of secondary containment. To help applicants identify such situations, Chapter 1.1.6 below includes a discussion of the distinction between (a) an equivalent secondary containment device and (b) an alternative design and operating practice that prevents releases from reaching ground water or surface water at least as effectively as a secondary containment device.

The Agency recommends that the applicant become familiar with the intent and scope of the secondary containment and variance provisions before deciding whether to invest the resources necessary to prepare a comprehensive petition for a variance.

1.1.4 The Secondary Containment Requirement

Before publishing the hazardous waste tank system standards, the EPA conducted an analysis of the problems associated with these tank systems. The analysis concluded that many of these systems are now leaking or can be expected to release hazardous waste or hazardous constituents in the future. Such releases may pose a significant risk to the communities exposed to the released substances. The principal causes of tank system failure were identified as (1) external corrosion, (2) installation problems, (3) structural failure, (4) overfills due to operator error, and (5) ancillary equipment failure.

EPA considered the technical options available for addressing releases from tank systems. A variety of studies on tank system failure and the associated risk analyses supported EPA's conclusion that the only demonstrated method for ensuring against releases to the ground water and surface water is secondary containment with interstitial monitoring. The principal advantage of secondary containment with interstitial monitoring over other release detection and prevention methods considered is its ability to both detect and contain a release before contaminant migration into the environment occurs.

Secondary containment systems therefore act as a defense against releases reaching the environment. The Agency did not dismiss other alternative technologies to secondary containment such as tank system testing and corrosion protection; in fact, the Agency maintains that their use, especially in combination with secondary containment, can enhance the overall integrity of the tank system.

1.1.5 Rationale for Allowing Variances from the Secondary Containment Requirements

The hazardous waste tank system standards provide for two types of variances. The first can be obtained if the owner/operator can show that alternative design and operating practices, together with location characteristics, will prevent the migration of released materials to ground water or surface water at least as effectively as secondary containment with interstitial monitoring. This variance is referred to throughout this document as the technology-based variance.

The second type of variance, referred to as the risk-based variance, can be obtained if it can be demonstrated that there would be no substantial present or potential hazard to human health or the environment associated with a release that migrates to the ground water or surface water.

Both variances are available for permitted, interim status, and 90-day accumulation tank systems; however, the risk-based variance is not available for new underground hazardous waste tank systems.

The Agency concluded that secondary containment is not necessarily an end in itself but that other methods may achieve the regulation's goal when site-specific situations are taken into account. By allowing a technology-based variance from the secondary containment requirements, the Agency is encouraging the refinement and further development of existing technologies as well as the development of new technologies. The Agency concluded that it was not reasonable to pass judgment on the viability of innovative technologies that have not yet been developed. The technology-based variance thus becomes a vehicle for assessing new approaches to the problems related to hazardous waste tank system management.

The Agency recognizes that there may be certain limited situations in which secondary containment devices are not needed and for which a variance is therefore appropriate. One example may be the storage of non-flowing hazardous waste materials, such as dry residues, ash, and spent catalysts. Since there are a variety of properties associated with these materials (e.g., solubility in water, size of particles), and site specific factors that could affect the potential release of hazardous constituents into the environment, the Agency concluded that it was inappropriate to allow a class exemption for non-flowing hazardous wastes. Thus, the regulation provides a means by which an owner/operator can obtain a variance from all or part of the secondary containment requirements of the regulation by demonstrating that the design of his system meets the established goal of preventing the migration of any hazardous waste or hazardous constituent into the ground water or surface water during the life of the facility.

Because the risk-based variance is based on the potential effects on human health or the environment, a petition for a risk-based variance need not include information on leak detection and prevention technologies. Rather, the petition can be based solely on the risks associated with a potential release into the environment. The distinction between these two variance procedures is important for a potential applicant to understand before making a decision on whether (and which type of) a variance is appropriate for his or her situation.

The Agency discourages the submission of technology-based variance applications in those situations where secondary containment is obviously provided. For example, for tank systems located inside buildings, the building floor (if impervious and if appropriate berms are constructed and drains are not a pathway for releases), could function as the secondary containment system. The Agency also discourages the submission of unpersuasive applications without a sound technical and scientific rationale that supports the variance request, and may deny a variance petition if the application is incomplete.

1.1.6 Equivalency Versus Effective Containment

It is important to understand the distinction between an equivalent secondary containment device and alternative design/operating practices that protect the ground water and surface water at least as effectively as secondary containment. Sections 264.193(d) and 265.193(d) of the hazardous waste tank system standards stipulate that secondary containment for tanks include one or more of the following devices: (1) external liner, (2) vault, (3) double-walled tank, or (4) an equivalent device as approved by the Regional Administrator.

An equivalent device is actually a secondary containment design -- other than a liner, vault, or double-walled tank -- that is capable of containing and detecting a release from the primary vessel. Such a device would need to satisfy all of the performance criteria established in Section 264.193 or Section 265.193 for a secondary containment system. To help illustrate the distinction, a tank design, whereby an aboveground tank is provided with a double bottom with interstitial monitoring installed between the bottoms, and is situated on a concrete base extending from the tank wall to a peripheral dike, would be considered an equivalent device. Alternatively, an earthen berm would be a poor candidate as an equivalent device because of the performance criterion that states that the secondary containment system must be "designed, installed and operated to prevent any migration of wastes or accumulated liquid out of the system to the soil, groundwater, or surface water at any time during the use of the tank system." [40 CFR 264(265).193(b)(1) - emphasis added.] Earthen materials are not considered impermeable, and the owner/operator would have to provide data that would support the contention that such a system would prevent any migration.

To summarize, equivalent secondary containment devices are allowed, contingent on the approval of the Regional Administrator. A technology-based variance would apply only to alternative designs or practices for systems that do not have secondary containment.

1.1.7 Organization of Document

Chapter 2 of this volume discusses procedures for submitting variance applications, with advice on form and content. Chapter 3 is the main part of this volume, describing information and data needs for the demonstration of the technology-based variance. The different sections of a variance application are described in the subsections of Chapter 3 as follows.

- Characterization of tank systems and operating procedures (Chapter 3.2). Factors considered include tank system design, corrosion protection, information on existing tank system (age, location), overfill and spill protection features, and operation and maintenance procedures.
- Source characterization, including physical and chemical characteristics of stored materials and potential worst-case release volumes (Chapter 3.3).
- Characterization of site hydrogeologic conditions, including climatic and meteorological data (e.g., precipitation, runoff, evapotranspiration, and infiltration rate) as well as data on the physical, chemical, and geological characteristics of the unsaturated zone of the soil, and the depth of water table (Chapter 3.4).
- Determination of the zone of engineering control (Chapter 3.5). This is based on depth to ground water, distance to surface water, and distance to neighboring property, and depends on such factors

as accessibility and obstructions, equipment limitations, migration pathways and travel times, soil volume, and legal agreements.

- Demonstration of the effectiveness of leak detection devices that will be used (Chapter 3.6). This is based on a description of the detection method; identification of the variables that may affect system operation; calibration, testing, and maintenance procedures; the lower limit of leak detection; and response time.

- Determination of waste travel time (Chapter 3.7). This is based on the results of computation of waste travel time in the overland scenario (for aboveground tank systems) and unsaturated zone scenario (for both aboveground and underground tank systems).

- Demonstration of the effectiveness of the spill/leak response plan, including time required to respond to a release (Chapter 3.8). The description of the plan for responding to and containing spills and leaks must include discussions of company responsibilities, alarm mechanisms, response actions, safety, disposal, training, and financial responsibility; and

- Demonstration of the sufficiency of the overall detection and remedial action plan (Chapter 3.9). The final analysis must demonstrate that the time to detect and contain a leak is sufficient to prevent migration of releases to ground water or surface water. The computation is based upon data presented in Chapter 3.5 through 3.8.

1.1.8 Information Sources

Appendix A lists sources of environmental and hydrogeologic information, including EPA offices and Regions, the U.S. Geological Survey and U.S. Department of Agriculture, and various other Federal and State agencies.

1.2 Overview of Variances

The standards that apply to owners and operators of hazardous waste tank systems are contained in Title 40 of the Code of Federal Regulations, Parts 264 and 265, Subpart J. Sections 264.193 and 265.193, "Containment and Detection of Releases," require that tank systems be provided with secondary containment with release detection to prevent the release of hazardous waste or hazardous constituents to the environment. The owner or operator of a tank system may obtain a variance from this requirement, however, by demonstrating to the EPA Regional Administrator* either that (1) alternative design and operating practices, together with location characteristics, will prevent the migration of the hazardous waste or hazardous constituents into ground or surface water at least as effectively as secondary containment during the active life of the tank system, or that (2) in the event of a release that does migrate to ground or surface water, no present or potential hazard will be posed to human health or the environment (40 CFR 264(265).193(g)).

A variance granted upon demonstration of the first of these alternatives is known as a technology-based variance; the second type is a risk-based variance. Both new and existing tank systems can qualify for a technology-based variance. New underground tank** systems are not eligible for risk-based variances.

1.2.1 Technology-Based Variances

To request a variance from secondary containment, the tank owner or operator must first notify the Regional Administrator in writing of his intention to conduct and submit a demonstration. For existing tank systems, notification must be submitted at least 24 months prior to the date that secondary containment must be provided. (For most existing tank systems, secondary containment must be provided within two years after January 12, 1987, or when the tank system has reached 15 years of age, whichever comes later; consult 40 CFR 264(265).193(a)(3) to (5).) For new systems, notification must take place at least 30 days prior to entry into a contract for installation. Figure 1-1 provides a schematic on the secondary containment requirement and when it takes effect.

As part of the written notification, the owner or operator must submit a description of the steps necessary to conduct the demonstration, along with a time table for completion of each step. The demonstration itself must be completed within 180 days after notification.

All applicants for a technology-based variance must provide detailed plans and engineering and hydrologic reports describing alternative design and operating practices that will, in conjunction with location

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* In States that have received authorization from EPA to implement the RCRA program, demonstrations should be made to the appropriate State officials. Hereinafter, the term Regional Administrator refers to either the EPA or the State official, as appropriate.

** "Underground tank" means a device meeting the definition of "tank" in §260.10 whose entire surface area is totally below the surface of and covered by the ground.

aspects, prevent the migration of any hazardous waste or hazardous constituent into the ground water or surface water during the life of the facility. In addition, a description of controls and operating practices to prevent spills and overflows must be supplied. Owners and operators of tank systems in which ignitable, reactive, or incompatible wastes are to be stored or treated must describe how operating procedures, tank systems, and facility design will achieve compliance with the requirements for these types of waste.

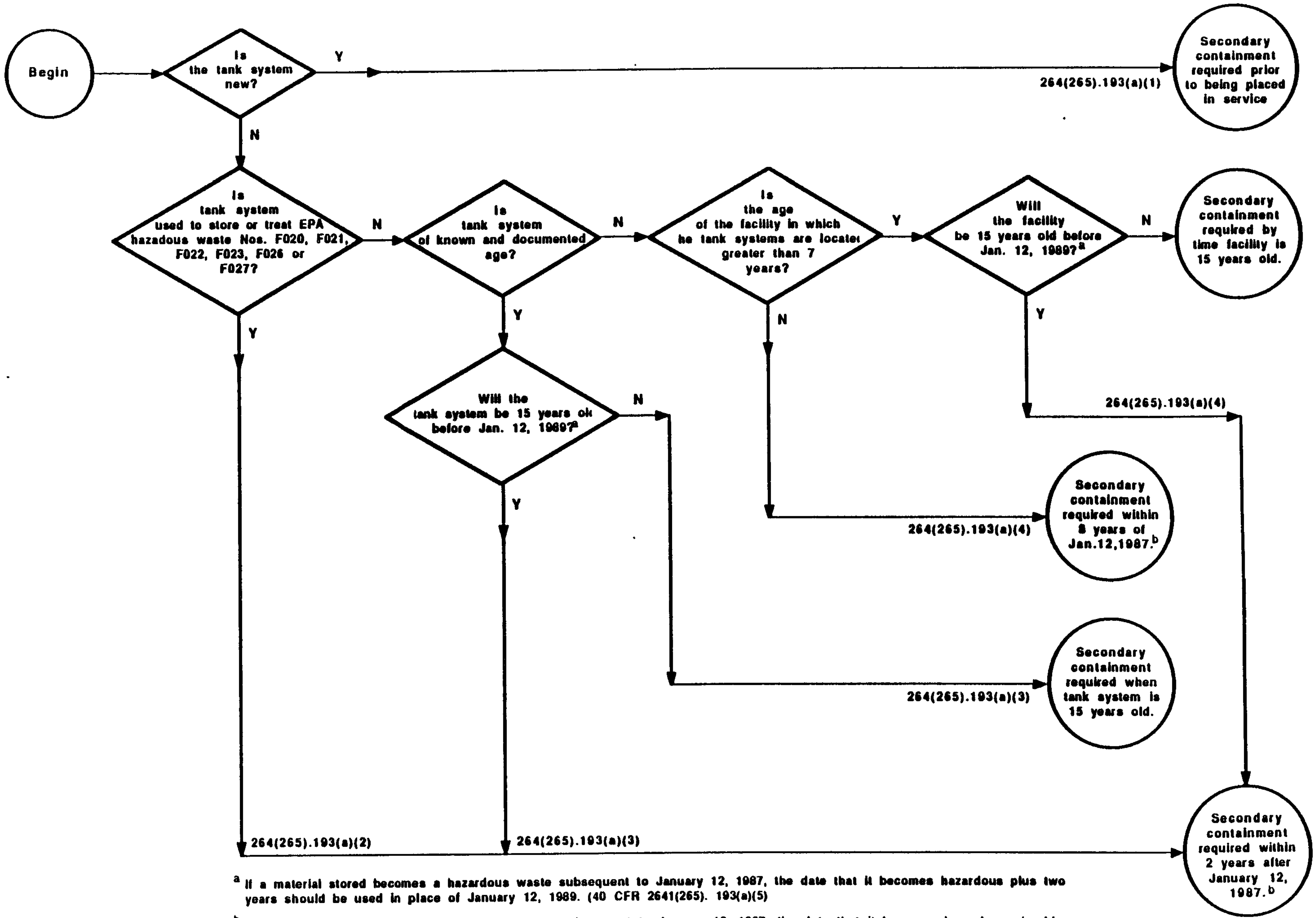
Meanwhile, all existing tank systems that do not have secondary containment must be assessed to determine that the tank system is not leaking or unfit for use. The operator must obtain and keep on file a written assessment reviewed and certified by an independent, qualified registered professional engineer by January 12, 1988. In some instances, tank systems may be storing materials that are not defined as hazardous. If these materials are subsequently listed by EPA as hazardous in its regulations (i.e., in 40 CFR 261.30, 31, 32, and 33), specific procedures apply to the tank systems storing these materials. Integrity assessments for tank systems storing materials that become hazardous wastes subsequent to July 14, 1986, must be conducted within 12 months after the date that the waste becomes a hazardous waste.

Tank systems subject to Interim Status standards are eligible for variances from secondary containment subject to the requirements of 40 CFR Part 265. These requirements are the same as for 40 CFR Part 264 tank systems except for the following provisions (Section 265.193(h)):

- The Regional Administrator will inform the public, through a newspaper notice, of the availability of the demonstration for a variance. The notice will be placed in a daily or weekly major local newspaper and will provide at least 30 days for the public to review and comment on the demonstration for a variance.

- The Regional Administrator also may hold a public hearing, in response to a request or at his or her own discretion, to clarify issues concerning the demonstration for a variance. Public notice of the hearing will be given at the same time as notice of the opportunity for the public to review and comment on the demonstration. These two notices may be combined.

- The Regional Administrator has 90 days to approve or deny the request for a variance after receipt of the demonstration from the owner or operator. The Regional Administrator will notify the owner or operator and each person who submitted written comments or requested notice of the variance decision in writing.



[a] If a material stored becomes a hazardous waste subsequent to January 12, 1987, the date that it becomes hazardous plus two years should be used in place of January 12, 1989. (40 CFR 2641(265). 193(a)(5)

[b] If a material stored becomes a hazardous waste subsequent to January 12, 1987, the date that it becomes hazardous should be used in place of January 12, 1987.

Figure 1-1 Flow Diagram For Secondary Containment For Existing and New Tank Systems

- If the demonstration for a variance is incomplete or does not include sufficient information, the 90-day time period will begin when the Regional Administrator receives a complete demonstration, including all information necessary to make a final determination.

- If the public comment period is extended, the 90-day time period will be similarly extended.

Granting of the variance by EPA entitles the owner/operator to construct and/or operate the proposed tank system without secondary containment. In the event of a leak or spill of the tank contents, specific procedures must be followed. These procedures may differ depending on whether the release (1) is contained within an area known as the "zone of engineering control" or (2) migrates beyond this zone. In either case, §264.193(g)(3) and (4) and §265.193(g)(3) and (4) require the owner/operator to cease operation of the tank system, remove sufficient waste from the tank system to allow inspection and repair, and remove wastes from the environment to prevent migration to the ground water or surface water.

If the release is within the "zone of engineering control," the owner must make the necessary repairs before the tank system can be returned to service. If the variance was based upon leak detection and response, contaminated soils must be removed or decontaminated to allow the tank system to resume operation with the same efficiency of leak detection it had prior to the release. The tank system can be returned to operation provided the above conditions are met. If, however, the soil cannot be decontaminated or removed, the system must be closed and put under post-closure care. In such cases, if the tank system is repaired, replaced, or reinstalled, the owner must either provide secondary containment or reapply for a variance in order to operate that tank system.

If the release migrates beyond the zone of engineering control, post-closure care must be initiated if (1) the soils cannot be decontaminated or removed or (2) contamination of ground water or surface water occurs. The above conditions of secondary containment, or reapplication for a variance, however, would apply regardless of whether the soils were decontaminated or removed. This is because such migration itself signifies a failure of the technology for which the technology- based variance was originally granted.

A tank system that has started to leak or that is unfit for use must immediately be removed from service. Wastes must be removed within 24 hours or, if this is not possible, as quickly as possible. The tank system must be inspected to determine the cause of the release, and a visual inspection should be performed to determine the extent of environmental contamination. Measures should then be taken to prevent further migration of contaminants to soils or surface water and to remove and properly dispose of any visible contamination that has already taken place (40 CFR 264(265).196(a), (b), and (c)).

All leaks larger than one pound that are not immediately contained and cleaned up must be reported to the Regional Administrator within 24 hours, and a report must be submitted to the Regional Administrator within 30 days. This report must contain the following information (40 CFR 264(265).196(d)(3)):

- Likely route of migration.
- Characteristics of the surrounding soil (soil composition, geology, hydrogeology, climate).
- Sampling or monitoring data (if not available within 30 days, the data should be submitted as soon as possible).
- Distance to downgradient drinking water, surface water, and population areas.
- Description of response actions taken or planned.

For major repairs (e.g., installation of an internal liner; repair of a ruptured primary or secondary containment vessel; etc.), the tank system cannot be returned to service unless an independent, qualified, registered professional engineer has certified that the repaired system is capable of handling hazardous wastes without release for the intended life of the system. The certification must be submitted to the Regional Administrator within seven days of the system being returned to service (40 CFR 264(265).196(f)).

1.2.2 Risk-Based Variances

The general procedures for obtaining a risk-based variance are similar to the above, except that the demonstration must consist of a detailed assessment of the substantial present or potential hazards to human health or the environment from a release to the environment. Volume 2 provides a detailed discussion of these procedures.

2. PROCEDURES FOR SUBMITTING VARIANCE APPLICATIONS

2.1 General

This chapter provides information on how to prepare and submit variance applications and also includes a method to determine whether an owner/operator should apply for a variance from the secondary containment requirements of the hazardous waste tank system regulations. This method is termed a "preliminary screening procedure"; separate procedures apply for the risk-based and technology-based variances.

The format and contents of each type of variance application are discussed. Applicants should provide the required information in the prescribed format. The body of the application should provide the results of analyses, tests, calculations, and other procedures. Applicants are advised, however, to include as appendices any raw data, worksheets, test reports, and other supporting data that have been used to prepare the application as well as reference material (or portions thereof). For example, simply stating the lower limit of detection of a monitoring instrument and basing it on the vendor's guarantee would not be sufficient. Rather, the applicant must take the responsibility to include any of the manufacturer's test data that substantiate claims related to the performance of the device.

2.2 Format and Contents of Applications

2.2.1 Risk-Based Variance

Figure 2-1 provides a description of the format and contents of the risk-based variance application. Specific details on the information and analyses required are provided in Volume 2 of this document.

2.2.2 Technology-Based Variance

Figure 2-2 provides a description of the format and contents of the technology-based variance application. Each application will contain introductory material consisting of general information (name of company, address, and other pertinent data) and an executive summary of the technical information to follow. The executive summary must highlight the key points that lead to the conclusion that the proposed alternative design or operating practice will prevent migration of released material to the ground water or surface water at least as effectively as secondary containment.

After the introductory material, the application consists of nine parts. Each of these parts is described in detail in Chapter 3.0 of this document; Figure 2-2 provides references to the corresponding sections in Chapter 3.0.

The EPA Regional Administrator (or appropriate State official in States authorized to implement RCRA) will retain ultimate authority for determining which portions of the application must be completed. Failure to comply with the Regional or State Office's request for information may result in the application's being deemed incomplete and in the consequent denial of the variance request.

2.3 Information to Be Submitted

Applicants should submit the variance application to the EPA Regional Administrator. A list of EPA Regional Offices and the States covered by each Region is provided in Appendix A. If any of the information contained in an application is considered to be proprietary by the applicant, he or she may indicate which pages are to be treated as confidential by stamping or otherwise indicating their status and following the Confidential Business Information (CBI) procedures contained in EPA's "TSCA Confidential Business Information Security Manual" (available from NTIS, publication number PB85-137305).

Applicants must follow the procedures described in 40 CFR 264(265).193(h) for submitting variance applications, as detailed below.

2.3.1 Notice of Intent to Submit

The first step in submitting a variance application is for the owner/operator to provide the Regional Administrator a written notice of the intent to conduct and submit a demonstration for a risk- or technology-based variance. For existing tank systems, the notice of intent must be submitted at least 24 months before the date on which secondary containment must otherwise be provided (i.e., if the variance is denied). Applicants must therefore establish the date by which secondary containment would otherwise be required based on the phase-in schedule described in 40 CFR 264(265).193(a). Chapter 1.2 of this document provides applicants with more information related to this provision. (The full text of the regulation is included in Appendix B.) For new tank systems, applicants must notify the Regional Administrator of the intent to apply for a variance at least 30 days prior to entering into a contract for installation of the tank system.

INTRODUCTORY MATERIAL

General Information:

Provide name of company, address, location of tank system(s) for which variance application is being made, status of tank system (existing or new), key contact at company, and telephone number.

Executive Summary:

Provide summary of the following aspects of the variance application:

- Site and source characteristics
- Health effects evaluation
- Environmental impact evaluation
- Demonstration of no substantial present or potential hazard to human health and the environment

PART I. SOURCE CHARACTERIZATION (See Vol II, Chapter 2)

Characterize potential source of contamination, including physical and chemical characteristics of the constituents, and selecting indicator chemicals (when appropriate), worst-case release volumes.

PART II. HYDROGEOLOGIC CHARACTERIZATION (See Vol II, Chapter 3)

Characterize hydrogeology surrounding the tank system and facility, including proximity of the tank system to surface water and ground water, direction and velocity of ground-water flow, depth and composition of the unsaturated zone, and patterns of regional rainfall.

PART III. SURROUNDING WATER USE AND WATER QUALITY CHARACTERISTICS (See Vol II, Chapter 4)

Determine surrounding water use and water quality characteristics, including proximity and withdrawal rates of ground water uses, the current and future uses of ground water, surface waters, and surrounding land, and the existing quality of ground water and surface water.

PART IV. EXPOSURE POINT CONCENTRATIONS (See Vol II, Chapter 5)

Estimate potential exposure point concentrations.

PART V. HEALTH EFFECTS EVALUATION (See Vol II, Chapter 6)

Analysis of potential health effects consisting of: (1) comparison of exposure point concentrations to established acceptable concentration levels; (2) estimation of potential human intake of constituents: (3) determination of chemical toxicity values: (4) estimation of potential carinogenic and non-carcinogenic risks based on chemical toxity values and intake rates, and (5) determination of other potential health hazards of hazardous waste releases.

PART VI. ENVIRONMENTAL IMPACT EVALUATION (See Vol II, Chapter 7)

Evaluation of potential environmental impacts. Includes comparing exposure point concentrations to established quality standards for ground water, surface water, and land; and estimating potential for damage to wildlife, crops, vegetation, and physical structures.

PART VII. PREPARATION OF "NO-SUBSTANTIAL HAZARD" DEMONSTRATION (See Vol II, Chapter 8)

Summarize the results of the risk-based variance analysis.

Figure 2-1 Format and Contents of a Risk-Based Variance Application

INTRODUCTORY MATERIAL

General Information:

Provide name of company, address, location of tank system(s) for which variance application is being made, status of tank system (existing or new), key contact at company, and telephone number.

Executive Summary:

Provide summary of the following aspects of the variance application:

- Why variance is being sought
- Overall description of tank system
- Source characterization
- Site hydrogeologic conditions
- Zone of engineering control
- Demonstration of leak detection system effectiveness
- Waste travel time
- Demonstration of effectiveness of spill/leak response plan
- Demonstration that detection and remedial action is sufficient

PART I. OVERALL DESCRIPTION OF ALTERNATIVE DESIGN/OPERATING PRACTICE (See Chapter 3.1)

General description of alternative design/operating practice, with emphasis on the specific aspect(s) of design or operation that would provide containment of releases at least as effectively as secondary containment (e.g., tank design, leak detection and containment plan).

PART II. CHARACTERIZATION OF TANK SYSTEM(S) AND/OR OPERATING PROCEDURE (See Chapter 3.2)

A more detailed description of aspects of tank system that would prevent migration of hazardous waste or hazardous constituents to ground water or surface water at least as effectively as secondary containment. Must include details on tank system design, corrosion protection, information on existing tanks (age, location), overfill and spill protection features, and operation and maintenance.*

PART III. SOURCE CHARACTERIZATION (See Chapter 3.3)

Information on physical and chemical characteristics of stored materials and potential worst-case release volumes.*

PART IV. CHARACTERIZATION OF SITE HYDROGEOLOGIC CONDITIONS (See Chapter 3.4)

General information on climatic and meteorological data and site geology.*

PART V. DETERMINATION OF ZONE OF ENGINEERING CONTROL (See Chapter 3.5)

Description of dimensions of the zone of engineering control for the tank system of concern. Based on depth to ground water, distance to surface water, and distance to neighboring property.

PART VI. DEMONSTRATE LEAK DETECTION DEVICE EFFECTIVENESS (See Chapter 3.6)

Description of leak detection device, information showing effectiveness, including compatibility with tank material, device placement and spacing, data on system reliability, and leak detection time.

Figure 2-2 Format and Contents of a Technology-Based Variance Document

PART VII. DETERMINATION OF WASTE TRAVEL TIME (See Chapter 3.7)

Results of computation of waste travel time in the overland scenario (for aboveground portion of tank systems) and unsaturated zone scenario (for both above- and underground tanks).

PART VIII. DEMONSTRATE EFFECTIVENESS OF SPILL/LEAK RESPONSE PLAN (See Chapter 3.8)

Description of plan for responding to and containing spills and leaks. Must include discussions of company responsibilities, alarm mechanisms, response actions, safety, disposal, training, and financial responsibility.

PART IX. DEMONSTRATE SUFFICIENCY OF DETECTION AND REMEDIAL ACTION (See Chapter 3.9)

Final analysis which must demonstrate that the time to detect and contain a leak is sufficient to prevent migration of releases beyond the zone of engineering control.

The variance application must be signed by the owner/operator.

*Note: For variances submitted in conjunction with Part B permit applications, this information would be submitted as part of that application. Provide appropriate cross-references to the Part B application as necessary.

Figure 2-2 Format and Contents of a Technology-Based Variance Document (Continued)

The written notice for variances for new and existing hazardous waste tank systems must contain the following information:

1. Facility location;

2. Nature and quantity of the waste;

3. System or component (i.e., tank, ancillary equipment) age (if system age is not known, provide facility age);

4. Description of the steps necessary to conduct the demonstration for the technology-based or risk-based variance; and

5. Timetable for completing each of the steps of the demonstration.

Figures 2-3 and 2-4 are provided for addressing these items. These figures can serve as "worksheets" that can be submitted as part of the notice of intent to apply.

2.3.2 When to Submit Applications

Applicants must submit applications for variances within 180 days after providing the written notice of intent to apply. Therefore, the timetables in Figures 2-3 and 2-4 extend across 180 days.

2.3.3 Approval/Disapproval Procedures for Interim Status and Less Than 90-Day Accumulation Tank Systems

Procedures for approval and disapproval of variance applications are provided for interim status and less than 90-day accumulation tank systems in 40 CFR 265.193(h)(4). Under these procedures, the Regional Administrator must notify the public of the availability of the variance application. Notification is accomplished by an advertisement in a daily or weekly major local newspaper. The notice must provide the public at least 30 days (from the date of the notice) to review and comment upon the variance application.

Depending on the public response, or at the Regional Administrator's own discretion, the Regional Administrator may decide to hold a public hearing. The hearing must also be advertised by a public notice at least 30 days prior to the date of the event.

The Regional Administrator must approve or deny the request for a variance within 90 days of receipt of the application. The 90-day time period begins when the Regional Administrator determines that the application is complete. The 90-day time period may also be extended if the public comment period described above is extended.

The Regional Administrator will notify the owner or operator and each person who submitted written comments or requested notice of the variance decision (either granting or denying) in writing. If the Regional Administrator decides the demonstration, and supporting information, indicates there is a potential for migration of any hazardous waste or hazardous constituent into the groundwater or surfacewater, then the request for a technology-based variance will be denied (the owner/operator must ensure any release is detected and subsequently contained). The regulations at 40 CFR 265 do not provide a process for administrative appeal of the Regional Administrator's decision.

2.3.4 Approval/Disapproval Procedures for Tank Systems Receiving a RCRA Permit per 40 CFR Part 270.

Procedures for approval or disapproval of variance applications are provided for tank systems being permitted per 40 CFR Part 270 can be found at 40 CFR 264.193(h). Here the Regional Administrator would be granting or denying the request for variance from the secondary containment requirements at the time the permit decision is made. If the application for a technology-based variance is denied and a RCRA permit is issued, the owner/operator may petition the Administrator to review any condition of the permit decision (see 40 CFR 124.19).

2.4 Risk-Based Preliminary Screening Procedure

Appendix A of Volume II provides the potential applicant with a preliminary screening procedure for risk-based variances. The screening procedure for risk-based variances has three purposes: (1) to determine whether the tank system falls into a category that is not allowed a variance; (2) to inform the applicant of the types of issues and data involved; and (3) to identify whether an exposure pathway exists.

Upon completion of this preliminary screening procedure, the applicant should have identified the following:

- Facilities or tank systems that are exempt from the secondary containment requirement;
- Situations in which a variance from secondary containment is not allowed;
- The types of necessary data gathering efforts that are needed for a variance application; and

INSTRUCTIONS:

1. Fill In Starting Date and Finishing Date.
2. Place a ✓ at expected time of completion for each activity.
3. Next to ✓, place expected date in parenthesis (e.g., (10/25/88))

Facility ID: ____________
System/Component ID(s): ____________
System/Component Age (If unknown, then facility age): ____________
Date: ____________
Analyst: ____________

Starting Date [ ] — WEEK — Finishing Date [ ]

ACTIVITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
I. Source Characterization																										
a. Physical and Chemical Characteristics of Constituents																										
b. Indicator Chemical Selection																										
c. Potential Worst Case Release volumes																										
II. Hydrogeological Charcteristics																										
a. Proximity of Tank System to Surface and Ground Water																										
b. Ground Water																										
c. Patterns of Regional Rainfall																										
d. Facilities and Surrounding Land																										
e. Soil Characteristics																										
III. Surrounding Water Use and Water Quality Characteristics																										
a. Proximity of Tank System to Surface and Ground Water																										
b. Ground Water																										
c. Patterns of Regional Rainfall																										
d. Facilities and Surrounding Land																										
e. Soil Characteristics																										

Figure 2-3 Timetable for Demonstration of Risk-Based Variance from Secondary Containment

Starting Date

WEEK

Finishing Date

ACTIVITY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
e. Existing Quality of Ground Water																										
f. Existing Quality of Surface Water																										
IV. Exposure Point Concentration																										
a. Identify Exposure Pathways																										
b. Estimate Exposure Point Concentrations																										
V. Surrounding Water Use and Water Quality Characteristics																										
a. Compare Exposure Point Concentrations to Established Quality Standards for Health Impacts																										
b. Estimate Chemical Intakes (Doses)																										
c. Determine Chemical Toxicities																										
d. Characterize Risk																										
e. Other Potential Health Hazards																										
VI. Environmental Impact Evaluation																										
a. Compare Exposure Point Concentrations to Established Quality Standards for Environmental Impacts																										
b. Estimate Potential for Damage to Wildlife, Crops, Vegetation, and Physical Structures																										
VII. Preparation of the "No-Substantial Hazard" Demonstration																										
a. Summarize Result of the Risk-Based Assessment																										
b. Prepare Supporting Documentation																										

Figure 2-3 Timetable for Demonstration of Risk-Based Variance from Secondary Containment (Continued)

INSTRUCTIONS:

1. Fill In Starting Date and Finishing Date.
2. Place a ✓ at expected time of completion for each activity.
3. Next to ✓, place expected date in parenthesis (e.g., (10/25/88))

Facility ID: ____________

System/Component ID(s): ____________

System/Component Age (If unknown, then facility age): ____________

Date: ____________

Analyst: ____________

Starting Date: [ ] Finishing Date: [ ]

ACTIVITY	WEEK 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
I. Proposed Alternate Design and Operation																										
II. Characterization of Tank System(s) and/or Operating Procedures																										
III. Source Characterization																										
IV. Characterization of Site Hydrogeologic Conditions																										
V. Determination of Zone of Engineering Control																										
VI. Demonstrate Leak Detection Effectiveness																										
VII. Determination of Waste Travel Time																										
VIII. Demonstrate Effectiveness of Spill/Leak Response Plan																										
IX. Demonstrate Sufficiency of Detection and Remedial Action																										

Figure 2-4 Timetable for Demonstration of Technology-Based Variance from Secondary Containment

- Whether the variance application will be based on a demonstration of (1) no present or potential exposure pathways or (2) no hazard to human health and the environment due to the chemical concentrations at exposure points.

This information will assist the applicant in deciding whether or not to apply for a risk-based variance and in identifying the level of detail and effort that will likely be needed to complete the variance application.

2.5 Technology-Based Variance Preliminary Screening Procedure

This screening process was developed to facilitate the variance process and to eliminate unnecessary studies and paperwork. It is included as an aid to applicants in deciding whether to apply for a technology-based variance and in identifying the level of detail and effort that will be needed to complete the variance application. Because this analysis is for the benefit of the applicant in making the decision of whether to apply, it is not a necessary part of the variance application. Applicants may choose to include the preliminary screening analysis as an appendix to their formal application for a technology-based variance.

The purpose of this section is to provide the applicant with guidelines to quickly determine when a technology-based variance is not likely to be granted. This section was developed to flag potentially vulnerable site conditions or tank structural integrity. In the event of a catastrophic release, surface/ground waters could be contaminated very quickly; since applicants must demonstrate that released wastes would not reach ground water or surface water, their application would not be approved if such contamination were possible. The preliminary screening analysis uses catastrophic release incidents as the primary criterion in determining whether a variance application is warranted. If a catastrophic release cannot be contained or remediated before reaching ground water or surface water, a variance would not be granted. The Agency recognizes that non-catastrophic releases may also pose the potential of being undetected and contaminating ground water or surface water. The assumption of a catastrophic release, however, is more suitable for a preliminary screening analysis, since, at a minimum, applicants must be able to demonstrate containment in such instances. Another condition to consider is the integrity of the tank system; this element is also addressed in this section. Although the hydrogeology may be adequate, a lack of structural integrity of the tank system can result in denial of an application.

The criteria for determining sensitive hydrogeologic settings, transport through the unsaturated zone, transport by overland flow, and those requirements for determining existing tank system integrity are described below.

2.5.1 **Location Criteria**

A major consideration in the decision of whether a technology-based variance should be granted is proximity to ground water or surface water. In addition, tank systems subject to the RCRA Part B permit requirements must be located in compliance with the location requirements of 40 CFR 264.18. These standards are discussed in Chapter 2.5.

Since the water table surface can rise or fall depending on seasonal precipitation, it will be necessary for the applicant to determine what the seasonal high for the site is anticipated to be. This will usually be during the spring or winter.

Hydrogeologic and geologic data such as depth to the seasonal high water table and proximity to geologically sensitive areas (fault zones, mud-slide zone) will be used to determine whether the tank system location is situated in a vulnerable surface/ground-water area.

Ground water, surface water, and other geologic information can be obtained from County Soil Conservation (SCS) reports or specific United States Geological Survey (USGS) reports. Particularly useful are the USGS topographic maps.

The checklist in Figure 2-5 provides a procedure for the applicant to follow when assembling this information. The determination of whether proximity to ground water or surface water is unacceptable depends on the time of travel of the release through the unsaturated zone. The location information discussed here will be used in the manner described below to establish whether the time of travel is sufficient to allow remediation of the release.

2.5.2 Catastrophic Release and Transport Through the Unsaturated Zone

To provide a conservative estimate of the probability of a release reaching the ground water or surface water, it will be necessary to calculate the consequences of a catastrophic release.

The possibility of a such a release reaching ground water or surface water is a function of:

I. GEOGRAPHICAL LOCATION OF TANK SYSTEM SITE

II. IS TANK SYSTEM ABOVE GROUND OR PARTIALLY ABOVE GROUND?

III. IS TANK SYSTEM BELOW GROUND?

IV. DO ANY FAULTS, FAULT ZONES OR FRACTURE ZONES EXIST WITHIN 200 FEET OF THE TANK SYSTEM SITE?

V. DESCRIBE ANY OTHER GEOLOGICALLY SENSITVE ASPECTS OF THE TANK SYSTEM ENVIRONMENT (SUCH AS PROXIMITY TO ROCK– OR MUD–SLIDES)

VI. VERTICAL DISTANCE FROM TANK BOTTOM TO SEASONAL HIGH WATER TABLE

VII. VERTICAL DISTANCE FROM TANK BOTTOM TO PERCHED WATER TABLE

VIII. LIST ALL SURFACE WATER SITES, TYPE, AND LEAST HORIZONTAL DISTANCE FROM TANK SYSTEM SITE.

Name	Type	Least Horizontal Distance (feet)
a.		
b.		
c.		
d.		
e.		

Figure 2-5 Checklist for Location Criteria Portion of Preliminary Screening Determination

- Distance to ground water/surface water;
- Waste characteristics (see Chapter 3.3);
- Saturated hydraulic conductivity* of soil/sediment/rock; and
- Overland flow characteristics (see Chapter 3.7.1).

How quickly a waste or constituent reaches any water is measured in terms of the velocity of the waste or constituent and distance to the water. The waste or constituent can move horizontally over the earth's surface, and it can move vertically through the soil/sediment/rock. Normally the distance to ground water is measured vertically, whereas distances to surface waters are measured horizontally. The horizontal movement of fluid over the earth's surface is known as overland flow; the vertical movement of fluid beneath the surface of the earth to the ground-water table is known as unsaturated zone transport. Thus, if the tank system is underground, the applicant should estimate unsaturated zone transport velocity. If any portion of the tank system is aboveground, the applicant should estimate both unsaturated zone transport and velocity of overland flow.

The flow rate of any fluid in the environment is dependent upon the types of soils, sediments, and rocks, and their thickness in the subsurface. For the purpose of this application, once the nature of the subsurface is identified, unsaturated zone velocity can be estimated as the value of the saturated hydraulic conductivity. Several assumptions that must be met for this approach to be valid are:

- The waste travels with the velocity of water.
- Velocity is strictly vertical.
- Heterogeneities (such as faults, fractures) are absent.

(These conditions are addressed in Chapter 3.7.)

If there is only a short distance to the ground water and the soils are highly permeable, it is unlikely that a technology based variance would be granted. The means by which an initial (preliminary screening) determination of waste migration time can be made is discussed in detail below.

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* Saturated hydraulic conductivity is a measure of velocity of material through permeable media.

Table 2-1 lists a range of saturated hydraulic conductivities for several soil and rock types. These values can be used to estimate waste velocity within the unsaturated zone. For example, a ground-water table of moderate depth (such as 50 feet) overlain exclusively by gravel is unlikely to be protected from a catastrophic release. Assuming, for purposes of making a preliminary screening analysis, that cleanup efforts take one week, this waste could travel anywhere from 1,984 to 1,984,250 feet. With a 50-foot water table, the time of travel (TOT) from the bottom of the tank to the ground water could be 4.25 hours (50-foot depth/1,984 feet/week velocity), or less than a minute (50-foot depth/1,984,250 feet/week velocity). This example illustrates a shortcoming of this estimation method which is due to the variation of saturated hydraulic conductivities of soils, sediments, and rocks. A better method to determine saturated hydraulic conductivity of any medium is to do field measurements; however, for purposes of preliminary screening, the values in Table 2-2 are used. The applicant is advised to carefully consider the results of this preliminary screening analysis.

In contrast to the example given above, if a fairly shallow water table (10 feet deep) is overlain by 10 feet of silt, the waste will travel from less than an inch up to 19.8 feet in a week. Time of travel to the ground-water table would then range from 3.5 days to 13.7 years (10 foot depth/19.8-.002 feet/week velocity), which may, depending upon where in the range it falls, provide enough time for cleanup.

Travel times in most situations will fall between these two extremes. It is suggested that, to estimate waste velocity to the ground-water table, the applicant evaluate a soil/sediment/rock column that lists (for each medium type) its description, saturated hydraulic conductivity, and thickness. Figure 2-6 provides such an example. The water table surface and calculations of waste velocity and TOT should also be shown. The checklist in Figure 2-7 provides a recommended format for the applicant to follow when assembling this information.

2.5.3 Catastrophic Release and Surface Transport - Overland

Overland flow only needs to be calculated for inground and aboveground tank systems. It is assumed that a catastrophic release from an underground tank system will not contribute to overland flow. An analytical determination of overland flow is more difficult than that of unsaturated zone velocity, and a somewhat qualitative approach must be taken. The possibility of a catastrophic release reaching ground water or surface water from overland flow is a function of:

- Distance to the ground water/surface water;

2355s

Table 2-1 Range of Saturated Hydraulic Conductivity

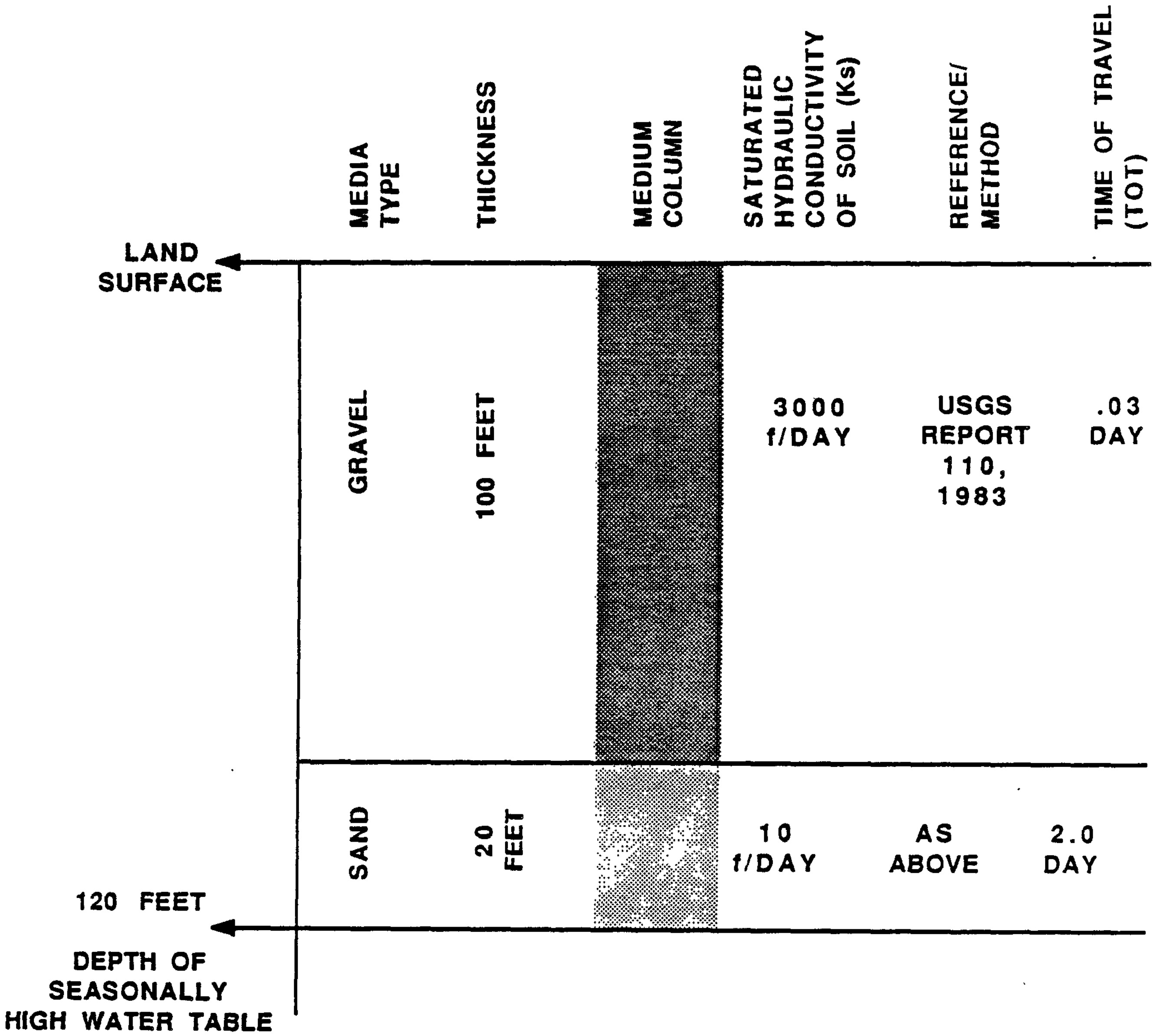
Medium	cm/sec	Feet/day	Feet/week
Soils			
Silt, loess	10^{-7} - 10^{-3}	$2.8x10^{-4}$ - $2.8x10^{0}$	$2x10^{-3}$ - $1.98x10^{1}$
Silty sand	10^{-5} - 10^{-1}	$2.8x10^{-2}$ - $2.83x10^{2}$	$2x10^{-1}$ - $1.98x10^{3}$
Clean sand	10^{-4} - 10^{0}	$2.8x10^{-1}$ - $2.835x10^{3}$	$2.0x10^{0}$ - $1.98x10^{4}$
Gravel	10^{-1} - 10^{2}	$2.83x10^{2}$ - $2.83x10^{5}$	$1.98x10^{3}$ - $1.98x10^{6}$
Rocks*			
Unfractured metamorphic and igneous	10^{-8} - 10^{-2}	$2.8x10^{-5}$ - $2.8x10^{1}$	$2x10^{-4}$ - $1.98x10^{2}$
Shale	$5x10^{-12}$ - 10^{-7}	$1.4x10^{-8}$ - $2.8x10^{-4}$	$1x10^{-7}$ - $2x10^{-3}$
Sandstone	10^{-8} - $5x10^{-4}$	$2.8x10^{-5}$ - $1.4x10^{0}$	$2x10^{-4}$ - $1.0x10^{0}$
Limestone & dolomite	$5x10^{-8}$ - $5x10^{-4}$	$1.4x10^{-4}$ - $1.4x10^{0}$	$1x10^{-3}$ - $1.0x10^{0}$
Permeable basalt	10^{-5} - 10^{0}	$2.8x10^{-2}$ - $2.83x10^{3}$	$2x10^{-1}$ - $1.98x10^{4}$

* Rocks that are faulted, fractured, or have high porosities are likely to have very high saturated hydraulic conductivities, even higher than those listed.

Table 2-2 Typical Values of Saturated
Hydraulic Conductivity (C Values)

Description of area	Runoff coefficients
Business	
Downtown areas	0.70 - 0.95
Neighborhood areas	0.50 - 0.70
Residential	
Single-family areas	0.30 - 0.50
Multiunits, detached	0.40 - 0.60
Multiunits, attached	0.60 - 0.75
Residential (suburban)	0.25 - 0.40
Apartment dwelling areas	0.50 - 0.70
Industrial	
Light areas	0.50 - 0.80
Heavy areas	0.60 - 0.90
Parks, cemeteries	0.10 - 0.25
Playgrounds	0.20 - 0.35
Railroad yard areas	0.20 - 0.40
Unimproved areas	0.10 - 0.30
Streets	
Asphaltic	0.70 - 0.95
Concrete	0.80 - 0.95
Brick	0.70 - 0.85
Drives and walks	0.75 - 0.85
Roofs	0.75 - 0.95
Lawns: Sandy soil	
Flat 2%	0.05 - 0.10
Average 2-7%	0.10 - 0.15
Str p 7%	0.15 - 0.20
Lawns: Heavy soil	
Flat 2%	0.13 - 0.17
Average 2-7%	0.18 - 0.22
Steep 7%	0.25 - 0.35

Source: Kibler 1982.



<u>CALCULATIONS:</u>

DISTANCE/VELOCITY = TIME

GRAVEL = 100 ft/3000 ft-day = .03 day

SAND = 20 ft/10ft-day = 2.0 day

TOT to SEASONALLY HIGH WATER TABLE = 2.03 days

Figure 2-6 Graphical Representation of Unsaturated Zone With Sample Calculations

I. SOIL INFORMATION

Identify all soil/sediment/rock types, their thickness, depth from the earth's surface, saturated hydraulic conductivities and method used to determine saturated hydraulic conductivity (e.g., Table 2-2, specific USGS report, field measurments).

Media	Thickness	Depth	Sat. Hyd. Cond.	Method (Reference)
a.				
b.				
c.				
d.				
e.				

II. VELOCITY OF WASTE

Estimated velocity of the waste.

III. TIME OF TRAVEL (TOT)

Estimate waste TOT from the bottom of the tank to the seasonally high groundwater table.*

IV. CLEAN UP TIME

Estimate time of clean-up from a catastrophic release.

V. TIME SUFFICIENCY FOR REMEDIATION

Determine whether TOT is less than estimated clean-up time.

*For heterogeneous subsurfaces this will require summing the travel times through each layer.

Figure 2-7 Preliminary Screening Checklist for Catastrophic Release and Transport Through the Unsaturated Zone

- Topography;
- Natural and artificial conduits;
- Form and viscosity of the waste (in terms of its velocity);
- Surface soil condition and saturated hydraulic conductivities; and
- Rainfall amount and rate.

Time of overland flow can be crudely estimated using the Federal Aviation Agency (FAA) empirical formula (Kibler 1982).

$$t_o = \frac{1.8\ (1.1 - C) D_m^{1\backslash 2}}{S^{1\backslash 3}} \qquad (2\text{-}1)$$

where

t_o = overland flow time (minutes)
C = runoff coefficient
D_m = travel distance (feet)
S = overland slope (percent).

The runoff coefficients for many types of ground cover are given in Table 2-2. The travel distance is the distance to the nearest surface water site. An overland slope can be estimated from the appropriate USGS topographic map. The FAA formula assumes the waste is mobile and that there is sufficient rainfall to keep it mobile. This preliminary screening estimation method does not consider other soil characteristics such as soil infiltration rates which can slow down the waste considerably. Chapter 3.7.1 presents the more rigorous approach to estimating overland flow velocities and volumes to be used in the actual variance application.

These conditions are conducive to rapid flow or early entrance of waste into surface waters in the event of a release:

- Short distance to surface water;
- Steep land slope towards surface water;
- High annual precipitation rates and/or frequent rain storms with large volume rainfall;

- Natural gullies or artificial conduits (drainage ditches, paved impermeable roads) that direct wastes towards surface waters;

- Absence of divergence structures that impound or shunt wastes from surface waters;

- Low waste viscosity (in terms of its ability to flow -- liquid wastes will move more readily than solid wastes);

- Absence of obstructions to flow (e.g., trees, vegetation);

- Impenetrable soil/sediment/rock surface (saturated hydraulic conductivities); and

- Storm sewers that connect the site to nearby surface water.

Two examples of overland flow extremes are illustrated below:

1. An aboveground tank system holding waste the consistency of water rests on crystalline metamorphic rock (see saturated hydraulic conductivity, Table 2-1) which slopes 15 degrees towards a creek, 5 feet downslope from the tank site. There are no impoundments, no obstructions to flow, and no shunting devices. The tank system suddenly ruptures during an intense, high volume rainstorm, spilling its contents. None of the waste seeps into the rock because the rock is impermeable and acts as a conduit toward the creek. Within seconds, the waste reaches the creek.

2. An aboveground tank system holds a solid hazardous waste. The tank system rests on very flat caliche soils (hardpan soils) in the desert. Annual rainfall is very low, and intense rain storms drop only a fraction of an inch of precipitation which is quickly taken up by dry soils. The nearest surface water, a creek that dries up during the summer, is a half-mile away. Despite the absence of obstructions or other divergence structures, it is unlikely that the waste will enter the creek by overland flow (as for <u>all</u> tank systems, unsaturated zone flow would also need to be estimated in this scenario) before cleanup efforts have been completed.

Useful information concerning these conditions can be obtained from the USGS, SCS, and local meteorological stations. It is suggested that the applicant conduct the preliminary screening analysis with a schematic representation of the tank system site in relation to surface waters. Included in this drawing should be location of natural and/or artificial conduits, divergence structures, and vegetation cover and type. In addition, the applicant should specify the site's annual rainfall, the largest expected rate of precipitation during a storm, and soil/sediment/rock hydraulic conductivities. The applicant should specify the form (solid, liquid, gas) of the waste and its viscosity. The checklist in Figure 2-8 provides a recommended format for the applicant to follow when conducting this preliminary screening analysis.

2.5.4 Existing Tank System Integrity

The applicant must meet the integrity assessment requirements for existing tank systems as outlined 40 CFR 264(265).191. The tank system must be judged fit for use; i.e., it must show no evidence of leaks, cracks, or corrosion and no tendency to collapse, rupture, or fail. In addition, the tank system must have sufficient structural strength, adequate design, and compatibility with the waste that it holds. Only through approved tests confirmed by a written assessment by an independent qualified professional engineer will such assertions be deemed valid. All data from tests and records of the tank system's past performance will also be used in assessing tank system integrity. The checklist in Figure 2-9 provides a recommended format for the applicant to follow when assembling this information.

2.6 Relationship of Other Rules, Policies, and Guidelines

This section describes other Agency rules, policies, and guidelines that are incorporated in the development of the risk-based and technology-based variance procedures.

2.6.1 Risk-Based Variance

The Agency developed the risk-based variance for hazardous waste tank systems in the context of other Agency rules, policies, and guidelines. These include the Ground-Water Protection Strategy (GWPS), the Location Standards (hydrogeologic vulnerability criteria), the Alternative Concentration Limit (ACL) Demonstration Guidance, the Superfund Exposure Assessment Manual, the Superfund Public Health Evaluation Manual, and the EPA Risk Assessment Guidelines among others. The relationship of the risk-based variance to these other documents and regulatory strategies is described in more detail in Volume 2 of this document.

2.6.2 Technology-Based Variance

Essentially two regulations also influence the procedure for technology-based variances: the Oil Pollution Prevention Plan regulation, and the location standards for treatment, storage, and disposal facilities set forth in 40 CFR 264.18. These are described in further detail below.

(1) Oil pollution prevention plan regulation. The overlap of EPA's Oil Pollution Prevention Plan and the Standards for Hazardous Waste Storage and Treatment Tank Systems occurs in certain situations where the hazardous waste stored in the tank systems falls under the jurisdiction of both regulations. The Oil Pollution Prevention Plan established procedures, methods, equipment, and other requirements to prevent the discharge of oil of any kind to "navigable waters" from non-transportation related facilities. This methodology for spill control is called a Spill Prevention Control and Countermeasure (SPCC) Plan. The Standards for Hazardous Waste Storage and Treatment Tank Systems (40 CFR Parts 264 and 265) regulate those wastes stored in hazardous waste storage and treatment tank systems as defined under the Resource Conservation and Recovery Act. The wastes that pertain to both regulations are those that contain oil contaminated with RCRA wastes (e.g., waste oil contaminated with solvents) contained in a tank system. The regulations differ in some respects. The SPCC Plan is designed to protect "navigable waters." which include water bodies used for shipping and their tributaries, interstate surface waters, intrastate lakes, rivers, and streams used for recreational or commercial fishing. The Standards for Hazardous Waste Storage and Treatment Tank Systems (40 CFR 264 and 265) are designed to protect these waters and also ground waters that are not addressed by the SPCC Plan. When applying for a technology-based variance, the engineering practices recommended for a SPCC Plan can be used for designing a spill control system but the applicant must provide proof that the protection of surface and ground waters meets the more stringent requirements of the Standards for Hazardous Waste Storage and Treatment Tank Systems.

(2) Location criteria. A technology based variance cannot be granted for new tank systems if they do not meet the location criteria set forth in 40 CFR 264.18. The criteria are divided into two parts, seismic and floodplain areas. The seismic location criteria state that new tank systems may not be located within 61 meters (200 feet) of a fault that has displayed relative movement in the last 10,000 years (within the Holocene period). The floodplain location considerations state that tank systems located in a 100-year old floodplain must be maintained to prevent washout of any hazardous waste by a 100-year flood. This requirement can be waived providing the applicant can demonstrate that procedures can be enacted to remove the hazardous waste safely before flood waters can reach the facility (40 CFR 264.18(b)).

I. TYPE OF WASTE

Identify waste viscosity, and form (solid, liquid, or gas)

II. SURFACE WATER INFORMATION

What surface water sites does the land (from the tank site) slope towards? For each surface water site, give name, type, least horizontal distance, and slope.

Name	Type	Least Horizontal Distance	Surface Slope
a.			
b.			
c.			
d.			
e.			

III. DIVERSION STRUCTURES

A. Identify diversion structures and distances of these structures from the tank system site.

B. Identify natural or artificial conduits which can direct wastes towards any surface water site.

C. Identify any obstructions (trees, vegetation, buildings) to surface flow.

IV. PRECIPITATION

Obtain annual precipitation and greatest expected rainfall rate that could occur from a rain storm at the tank system site.

V. SURFACE/SOIL

Identify and evaluate general condition of the surface (soil/sediment/rock type and saturated hydraulic conductivities).

VI. ESTIMATE TIME TO IMPACT SURFACE WATER.

VII. REMEDIATION TIME

Estimate time of clean-up from a catastrophic release.

Figure 2-8 Preliminary Screening Checklist for Overland Flow of Aboveground Tank Systems

I. TANK CONDITION

A. Does tank have any cracks, leaks or evidence of corrosion or erosion?

B. Does tank meet the requirements of 40 CFR 264(265). 191?

II. ANCILLARY SYSTEM CONDITION

A. Does the ancillary equipment (piping, flanges, pumps, etc.) have any cracks, leaks or evidence of corrosion?

B. Does the ancillary system meet the requirements of 40 CFR 264 (265). 191?

III. COMPATIBILITY

Evaluate compatibility of the tank and its contents

IV. TANK SYSTEM TESTS

A. List all tank system tests performed, test dates, and results. Include the certification/credentials of the personnel that performed the test.

B. Age (year and month) of tank and any documentation that supports the claim.

Figure 2-9 Existing Tank System Criteria Checklist for Preliminary Screening Analysis

3. TECHNOLOGY-BASED VARIANCE INFORMATION AND DATA NEEDS

This chapter provides descriptions of the type of information required for the variance application, how the data will be used, and how the information is to be presented. The overall content and format of the variance application is shown in Figure 2-2. The content of the individual parts of the application are described in each of the sections in this chapter.

In order for a variance to be granted, the application for a variance must provide a convincing and supportable demonstration that the alternative design or operating practice, together with location characteristics, will prevent the migration of releases into the ground water or surface water at least as effectively as secondary containment. Upon review of the variance application, the EPA may take one of the following actions:

- Approval of Variance Request

  If the demonstration satisfies the Regional Administrator that migration of hazardous waste or hazardous constituents to ground water or surface water is prevented as effectively as it would be through the use of a secondary containment system, a variance may be granted under 40 CFR 264(265).193(g) and (h).

- Request for More Information

  The Regional Administrator may deem the application incomplete if he or she feels that additional data are necessary to complete or more fully substantiate the premises of the demonstration. In such an instance, the Regional Administrator may request specific additional information. The decision for approval or disapproval may then be suspended until such time as the application is deemed complete.

- Denial of Technology-Based Variance Requests

  The Regional Administrator may decide that the alternative design or operating practice does not ensure that releases will be detected and contained as effectively as they would be with secondary containment. The application and supporting information may indicate the potential for migration of releases into ground water or suıface water. In this instance, the request for a variance wıll be denied and secondary containment would be necessary.

- Appeal of the Technology-Based Variance Decision

  The regulations at 40 CFR 265 (for interim status and 90-day accumulation tank systems) do not provide a process for administrative appel of Regional Administrator's decisions regarding variance requests for secondary containment. The regulations do, however, provide administrative appeal of the Regional Administrator's decisions regarding variance requests for secondary containment made during the permit process pursuit to 40 CFR Part 124.

In general, the technology-based variance application must demonstrate that a release of tank system contents can be detected soon enough to allow it to be controlled and removed before it reaches the ground water or surface water. Release detection is a very significant component of the proposal. Thus, variance applicants will be required to demonstrate that potential releases can be prevented from reaching ground water or surface water by a combination of detection methods and remedial measures. The operator must have sufficient time to effect the excavation or decontamination of the tank system discharge before it reaches the ground water or surface water. A key part of the demonstration will be a showing that the time to detect a release plus the time for remedial measures is less than the time it takes for the release to migrate to ground water or surface water. This demonstration is Part IX of the variance application and is described fully in Chapter 3.9.

3.1 Overall Description of System and Why Variance Is Being Sought

The overall description of the system for which a technology-based variance is being sought makes up the first part of the variance application. In this part, applicants should provide a brief description of the alternative design or operating practice. The discussion should emphasize the specific aspects of the design or operation that would provide containment of releases at least as effectively as secondary containment. The purpose of this section is to establish the basis for the variance, thus identifying the type of analysis that must be provided in the remainder of the application.

For example, an applicant may submit an application for a tank system design with unsaturated zone monitoring. The specific aspects that must be identified in the description would be the design of the tank system, the type and design of the unsaturated zone monitoring equipment, and the response and remediation plan. The basis for seeking a variance in such an instance would be the demonstration that releases could be detected, contained, and remediated prior to migration to the ground water and surface water.

3.2 Characterization of Tank System and/or Operating Procedures

An essential component in any application for a technology-based variance is the system's demonstrated ability to prevent releases to ground water and surface water. The Regional Administrator will assess the information provided both in this section and in Chapter 3.6 (on the design of the leak detection system) to determine whether the overall tank system's design warrants a variance from the secondary containment requirements. The design and operational procedures for a tank system owner/operator in applying for a variance must meet all of the other tank system management standards of Subpart J, except those related to the design and performance of a secondary containment system.

The information requested in this section falls into the following categories:

- Tank System Design/Installation
- Corrosion Protection
- Information on Existing Tank System
- Overfill and Spill Protection

3.2.1 Tank System Design

(1) Information required

(a) Schematic Drawing of Tank System. The drawing should be to scale and should depict the entire tank system, including any associated piping, pumps, valves, vents, or monitoring wells. The following components should be included, if applicable:

- Excavation walls, floor and cap
- Overfill prevention devices
- Observation wells
- Backfill
- Dielectric bushings on pipe connections
- Waste fill and draw-off lines
- Manways and other openings
- Sumps

- Level alarms
- Piping/pumps/valves/vents
- Flow meters/gauging lines
- Leak detection devices
- Floating suction arms
- All other pertinent information

(b) Tank System Design Information. The information to be provided relates to the general design and installation of the tank system. The codes and standards referenced in Table 3-1 at the end of this section can provide additional detail on most of the descriptive elements requested. The following is a list of information on the design features of the tank system that must be addressed in the application for a variance. The applicant may submit additional information on the design of the system if it will aid in the overall assessment of the system's ability to prevent releases.

- Material of construction of all components;

- Methods of joining components, e.g., whether pipe joints are welded or not;

- Evidence of compatibility of wastes stored with the material(s) of construction;

- Tank capacity (ft^3 or m^3);

- Tank dimensions (ft or m);

- Thickness of the primary container (in or cm);

- Location of tank system with respect to ground level (% buried);

- Depth of tank below surface (ft or m);

- Type of tank (atmospheric, low or high pressure);

- Bottom pressure - as it relates to the density of the material(s) stored and the pressure rating of the system (liquid height multiplied by liquid density);

- Backfill material and dimensions (if below grade);

- Number and types of valves (ball-check, etc.);

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Table 3-1 Nationally Accepted Tank Design Standards

Document Number	Title	Date
AA-ASD-1[a]	Aluminum Standards and Data, 1970-71	1984
AA-ED-33[a]	Engineering Data for Aluminum Structures	1981
AA-SAS-30[a]	Specifications for Aluminum Structures	1982
ACI-344R-70[b]	Design and Construction of Circular Prestressed Concrete Structures	1970
ACI-350R-77[b]	Concrete Sanitary Engineering Structures	1983
AISI-PS-268-685-5M[c]	Useful Information on the Design of Plate Structures	1985
AISI-TS-291-582-10M-NB[c]	Steel Tanks for Liquid Storage	1982
ANSI B96.1[d]	Standard for Welded Aluminum-Alloy Storage Tanks	1981
API 12B[e]	Specification for Bolted Tanks for Storage of Production Liquids, 12th Ed.	1977
API 12D[e]	Specification of Field Welded Tanks for Storage of Production Liquids, 8th Ed.	1982
API 12F[e]	Specification of Shop Welded Tanks for Storage of Production Liquids, 7th Ed.	1982
API 620[e]	Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks	1982
API 650[e]	Welded Steel Tanks for Oil Storage	1984
ASME BPV-VIII-1[f]	ASME Boiler and Pressure Vessel Code	1980
ASTM D 3299[g]	Standard Specification for Filament-Wound Glass-Fiber Reinforced Thermoset Resin Chemical Resistant Tanks	1981

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Table 3-1 (Continued)

Document Number	Title	Date
ASTM D 4021[g]	Standard Specification for Glass-Fiber Reinforced Polyester Underground Petroleum Storage Tanks	1981
AWWA-D100[h]	Standard for Welded Steel Tanks for Water Storage	1984
NFPA 30[i]	Flammable and Combustible Liquids Code	1984
UL 58[j]	Standard for Steel Underground Tanks for Flammable and Combustible Liquids	1976
UL 80[j]	Standard for Steel Inside Tanks for Oil Burner Fuel	1980
UL 142[j]	Standard for Steel Above Ground Tanks for Flammable and Combustible Liquids	1981
UL 1316[j]	Standard for Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products	1983

[a]The Aluminum Association (AA)
[b]American Concrete Institute (ACI)
[c]American Iron and Steel Institute (AISI)
[d]American National Standards Institute, Inc. (ANSI)
[e]American Petroleum Institute (API)
[f]American Society for Mechanical Engineers (ASME)
[g]American Society for Testing and Materials (ASTM)
[h]American Water Works Association (AWWA)
[i]National Fire Protection Association (NFPA)
[j]Underwriters Laboratories, Inc. (UL)

- Number and types of pumps (diaphragm, etc.);
- Anticipated or measured internal liquid, vapor pressure, and hydrostatic pressure.
- Results of tank system integrity assessment required by 40 CFR 264(265).191.

(c) Design Installation Standards/Codes. This section provides the applicant an opportunity to cite those standards or codes that are used in the design or installation of the tank system. It is recognized that standards may not apply to new or innovative designs. In lieu of applied standards, the applicant is encouraged to submit evidence that sound engineering practices have been used in the design of the system.

The applicant is also encouraged to indicate features of the tank system design installation or proposed operation that go beyond the standards promulgated in the July 14, 1986, Federal Register (51 FR 25471-25486). This information may provide additional support to the applicant's petition.

(d) Effectiveness of Design. In this section, the applicant is given the opportunity to provide evidence on the effectiveness of the proposed tank system's design. The kinds of information that would be the most useful would include data from bench or pilot studies that simulate the design and operational conditions of the system. Data supplied from manufacturers on the effectiveness of the design could also be submitted. Any evidence provided should be convincing and complete. For example, test results whether provided by the manufacturer or as a result of studies performed by the applicant would, by themselves, be incomplete without the details of the test protocols used.

(2) How data are to be used. The information received on the design of the tank system will first be evaluated to determine whether the system includes the use of innovative technologies that previously have not been considered by the Agency. The information on the use of relevant standards will be considered in determining whether the system was designed and installed according to reliable engineering practices. Evidence supplied on the effectiveness of the design will help in the overall assessment of the system's long-term capability of preventing releases.

(3) Presentation of data. Figure 3-1 provides a recommended format for presenting the data. The objective is to demonstrate the effectiveness of the proposed system in preventing releases.

3.2.2 Corrosion Protection

(1) Information required. This section of the variance application solicits information on the design, operation, and maintenance considerations that deal with corrosion protection. The applicant should note that 40 CFR 264.192 and 265.192 of the July 14, 1986, regulations require that a corrosion expert conduct an assessment of the corrosion potential for new tank systems and recommend appropriate preventative measures. Table 3-2 provides some further references on corrosion control. The same information is requested in this application.

If the tank system is at or below grade, information must be provided that relates to the potential corrosive nature of the surrounding soils. The following two standards can be used where applicable, as guidelines in making these determinations: "Recommended Practice - Control of External Corrosion on Underground or Submerged Metallic Piping Systems" (NACE 1985) and "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems" (API 1986). The kinds of information required regarding the potential for corrosion include soil moisture content, soil pH, soil sulfides, soil resistivity, structure to soil potential, influence of nearby underground metal structures, and existence of stray electric current.

Additional information required relates to the corrosion protection measures that exist or are planned for the tank system. These are: external coating, corrosion-resistant materials, electrical isolation devices, and cathodic protection systems.

The applicant will also be requested to supply information on the potential for the stored wastes to cause internal corrosion of the vessel, and, for existing tank systems, information on previously stored wastes and their compatibility with the tank system's material(s) of construction.

For the corrosion protective measures that are dependent on operational and/or maintenance practices, additional information must be provided related to the planned inspection and maintenance schedule.

Finally, information on corrosion protection must also be provided for aboveground tank systems, since these are not immune from corrosion related problems.

I. SCHEMATIC DRAWING

II. DESIGN OF LEAK DETECTION SYSTEM

A. Material of construction

1. Tank
2. Ancillary Equipment

B. Thickness of vessel (in/cm)

C. Tank capacity (ft^3/m^3)

D. Tank dimensions (ft/m)

E. Evidence supporting compatibility of waste(s) stored with material(s) of construction.

F. Location of tank with respect to ground level (% below grade)

G. Extent and location of associated piping (give lateral and vertical depiction)

H. Type of tank (atmospheric, low or high pressure)

I. Type of dimensions of backfill material if partially or completely buried.

J. Number and types of valves

K. Number and types of pumps

L. Calculated or measured:

1. Internal liquid pressure
2. Internal vapor pressure
3. Hydrostatic pressure

M. Other relevant information related to how the design of the tank system will prevent the release of hazardous wastes into the environment such as pressure shut off valves for the piping.

III. DESIGN/INSTALLATION STANDARDS OR CODES

This format should be followed for each standard or code used in the design or installation of the tank system

A. Standard used
B. Name of standard
C. Components of standard used
D. Components of standard not used
E. Components of standard exceeded (Include description of how exceeded.)
F. Description of sound engineering practices used in lieu of applicable standards.

IV. EFFECTIVENESS OF DESIGN

Figure 3-1 Format and Contents for Description of Tank System Design

A. Source of data (pilot study, manufacturers data)

B. Test protocol used.

C. Results

The preceeding format can be followed for multiple evaluations of the effectiveness of design

Figure 3-1 Format and Contents for Description of Tank System Design (Continued)

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Table 3-2 References Related to Corrosion Control

Husock, B. "Pipe-to-Soil Potential Measurements and Cathodic Protection of Underground Structures," Paper No. HC-8, Materials and Performance, Vol. 10, No. 5, May, 1971.

Husock, B. "Use of Pipe-to-Soil Potential in Analyzing Underground Corrosion Problems," Paper No. HC-7, Harco Corporation, Cathodic Protection Division, Median, OH.

Husock, B. "Cathodic Protection - One Way to to Prevent Underground Corrosion," Paper No. HC-4, Harco Corporation, Cathodic Protection Division, Median, OH.

Husock, B. "Causes of Underground Corrosion," Paper No. NC-36, Harco Corporation, Cathodic Protection Division, Median, OH.

National Association of Corrosion Engineers, Recommended Practice - Control of External Corrosion on Underground or Submerged Metallic Piping Systems, NACE Standard RP-01-69, National Association of Corrosion Engineers, Houston, TX, January 1972.

Rizzo, F. E. "Detection of Active Corrosion," Paper No. HC-14, Harco Corporation, Cathodic Protection Division, Median, OH.

Rothman, P. S. "Cathodic Protection of Tank and Underground Structures," Harco Corporation, Cathodic Protection Division, Hatboro, PA, 1978.

The Hinchman Company, Suggested Ways to Meet Corrosion Protection Codes for Underground Tanks and Piping, Job Number 1079-4542, The Hinchman Company, Corrosion Engineers, Detroit, Michigan, April 8, 1981.

U.S. Department of Agriculture, "Control of Underground Corrosion," Design Note No. 12, Soil Conservation Service, U.S. Department of Agriculture, Soil Conservation Service, February 1, 1971.

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(2) How data are to be used. The potential for either internal or external corrosion of the tank system will be assessed from the data supplied in context with both the location of the tank system in relation to the soil and the contents of the waste stored. Second, the proposed corrosion prevention measures will be evaluated for their potential to adequately inhibit the corrosion related factors identified.

(3) Presentation of data. Figure 3-2 provides a format for presenting the information discussed above. The objective is to demonstrate the effectiveness of corrosion prevention techniques.

3.2.3 Information on Existing Tank Systems

(1) Information required. The information requested in this section relates to the operational history of existing tank systems applying for a technology-based variance. The data requested will deal primarily with the problems encountered during the operational life of the system including a description of any major repair conducted or parts replaced. For release incidents, details are required on the amount and migration of the material released and the associated remedial response. In addition, the applicant will be asked to indicate the modifications in the tank system design or operational procedures that resulted from each incident.

(2) How data are to be used. The information provided here will be evaluated in terms of the system's successful operation during its operational history. The information should also illustrate the responsiveness of the personnel involved when confronted with an emergency such as a release of hazardous waste into the environment. The repair and replacement records will also demonstrate the effectiveness of the maintenance program.

(3) Presentation of data. Figure 3-3 provides a recommended format for presenting the information discussed above.

3.2.4 Overfill and Spill Protection Features

(1) Information required. The information requested in this section applies to the measures designed to prevent and/or contain spills that result during the transfer of waste into and out of the tank systems. A description of the devices, operational procedures, and maintenance schedules that are intended to prevent such incidents should be presented. Devices that are designed to sense the level in the tank system include: float-actuated devices, displacement devices, hydrostatic sensors, capacitance sensors, ultrasonic devices, optical devices, and thermal conductivity sensors. These level sensing

I. FACTORS AFFECTING THE POTENTIAL FOR CORROSION

A. Corrosive Potential of Soil

1. Soil moisture content
2. Soil pH
3. Soil sulfides level
4. Structure to soil potential
5. Influence of nearby underground metal structures
6. Existence of stray electric current
7. Soil resistivity (ohm-cm)

B. Other Corrosive Related Factors

1. Percent of system on or below ground level
2. pH range of the tank contents
3. Description of precipitation protection for tank system

II. CORROSION PREVENTIVE MEASURES

A. Cathodic Protection

1. Schematic drawing of system illustrating all components
2. Information for impressed current method

   Provide tank system soil volt potential as measured by copper-copper sulfate half cell reference, and a detailed maintenance and operational schedule.

3. Information for sacrificial anode method

   Provide number, dimensions, and material of construction of anodes used, and a detailed maintenance and operational schedule

B. Other Corrosion Protection Measures

For each of the measures selected, indicate why it was selected and provide description.

1. Soluble corrosion inhibitors
2. Paints, coatings, or linings
3. Electrical isolation
4. Corrosion allowance
5. Corrosion resistant materials of construction

C. Evidence of Adequacy of the Corrosion Protection Measures Employed

1. Provide findings of corrosion expert

   Discussion of potential for corrosion, measures necessary to ensure integrity of tank system, and protective measures recommended but not employed and reasons why they were not used.

2. Include evidence that supports the case of the corrosion protection measures employed (e.g., manufacturer's data, information on tank life)

Figure 3-2 Format and Contents for Description of Corrosion Protection

I. GENERAL INFORMATION

A. Age of tank system
B. Percent of time used since installed
C. If a treatment tank, what is volume of waste treated annually
D. If a storage tank, the average time stored before waste is removed
E. Waste characterization

II. OPERATIONAL HISTORY

A. Discuss in detail any major repairs or replacement of parts that took place since the system was installed.

B. Describe each release incident that exceeded one gallon of waste. Include, at a minimum, the following information:

- Date of release
- Volume released
- Causes(s)
- Description of remedial response
- Distance release traveled (lateral and vertical)
- Extent of surface or ground water contamination
- Modification in the design or operational practices that resulted from the incident
- Copies of any spill reports submitted to local, State, or Federal agencies

Figure 3-3 Description of Existing Tank Systems

instruments most often work in combination with alarms and/or automatic shut-off devices. Additionally, transfer lines can be equipped with spring loaded shut-off valves that prevent overfilling.

(2) How data are to be used. The data provided here will be evaluated in terms of the adequacy of the spill control measures to both prevent and contain any releases that could occur during the transfer of waste to or from the tank system. The use of proper equipment and operating practices will be analyzed from the information provided.

(3) Presentation of data. Figure 3-4 provides a format and content for presenting information on spill control equipment and procedures.

3.3 Source Characterization

This section discusses the physical and chemical properties of the waste that affect its ability to flow and those that affect tank system corrosion processes. Worst case scenarios of catastrophic releases, corrosion leak rate, and release detection problems are also discussed.

3.3.1 Physical and Chemical Characteristics of Stored Materials

(1) Information required. The chemistry of the waste and that of the tank system material can act together to accelerate the corrosion process. Factors that should be taken into consideration include pH, tank construction material, waste, total waste volume, tank volume, compatibility, protective linings and other anticorrosion methods, oxidizing agents, electrolytic activity, moisture levels, temperature, bacterial action, and soil reactivity. Each of these factors will be unique to a specific tank system, waste, and site. Most of these factors are discussed in Chapter 3.6 because they also relate to leak initiation.

Hazardous wastes stored in tank systems will not always be composed of a single chemical. Because different hazardous constituents are likely to travel at different velocities in the unsaturated zone, the determination of the velocity of a waste should take into account the chemicals' viscosity, density, and retardation capability.

Because physical-chemical properties of waste components differ from those of water, and the flow equations that will be introduced later were developed to model water velocity, modifications must be made to them to better predict waste velocity. The physical and chemical factors of waste components that affect waste velocity are density, viscosity, water solubility, precipitation, redeposition, solution composition and concentration, pH, and soil temperature. These modifications should reflect the variations in these physical-chemical properties of the waste component versus the physical-chemical properties of water.

(2) How data are to be used. The significance of a chemical varies with its concentration in the tank. For each chemical, the concentration of that chemical in the waste in terms of weight percent, volume percent, or parts per million should be determined. The largest anticipated concentration of each should be the one chosen for use in the flow equations.

Before the constituent concentration is calculated, the percent volume of water in the waste should be calculated. Then, percent volume of the hazardous wastes, or hazardous constituents, should be calculated.

Following below is a brief discussion of the correction factors that may apply in this calculation:

- Density

  Density is the mass or quantity of a substance usually measured in grams per cubic centimeter. Density is an indication of how close atoms of a substance are packed together and how heavy the material is. The heavier the material, the greater is its gravitational downward pull through the unsaturated zone, which results in faster TOTs (time of travel to the ground-water table). As a component's density increases, its hydraulic conductivity increases and its velocity increases. Density differences between the hazardous waste and water are reflected in the corrected TOT equation (see Chapter 3.7).

- Viscosity

  Viscosity is the internal fluid resistance of a substance caused by molecular attraction which makes the substance resist a tendency to flow. Generally, the more viscous a waste, the greater is its TOT to the ground-water table. A chemical's viscosity must be either measured or obtained from the literature. As a given chemical's viscosity increases, its hydraulic conductivity decreases and its velocity decreases. Differences between the hazardous waste's viscosity and water are reflected in the corrected TOT equation (see Chapter 3.7).

- Retardation

  Retardation is the process that decreases the velocity of the solute by providing soil sites for chemicals to adhere to. Clays and organic carbon are the most common retardants.

I. SPILL CONTROL EQUIPMENT

A. If the tank system employs level sensing equipment, indicate which of the following applies:

- Float-actuated
- Displacer valves
- Hydrostatic-head sensor
- Capacitance sensors
- Thermal-conductivity sensors
- Ultrasonic devices
- Optical devices
- Others

If a multiple level sensor is used, indicate the percentage of capacity that each is set for.

B. For each check valve or coupling used, provide the following applicable information:

1. Material of construction for piping
2. Distance of fill line offset from tank
3. Distance from tank bottom to termination of fill pipe
4. Method of attachment and support of fill pipe
5. Liquid-delivery/vapor-recovery system
6. Type of check valve or coupling connection including size and material of construction.

C. Indicate whether the overfill spill control system automatically shuts off the pump when a high level is indicated (safety cutoff) or the flow is diverted elsewhere (bypass). In either case, describe the sequence that takes place during a potential overfill incident, including the role of any backup systems.

D. Describe any other equipment and its role in spill control.

II. OPERATIONAL AND MAINTENANCE PROCEDURES

A. Describe the operational procedures followed during the transfer of wastes to or from the tanks with emphasis on any control measures routinely taken. Also provide any related information on the personnel that perform this function, for example, their safety record, training, and responsibilities.

B. Describe in detail the maintenance schedule and procedures related to the maintenance of the spill control equipment

Figure 3-4 Format and Contents for Description of Overfill and Spill Protection Features

Hydrophobic (lacking strong affinity for water) or cationic (positively charged ions) chemical components, if migrating in a dilute plume, are subject to retardation. In a concentrated plume, it is not necessary to model retardation because chemical components will not preferentially partition from liquid solvent to the solid "solvent." Therefore, only aqueous liquids moving in a dilute plume need to be modeled for retardation. (For aboveground tank system releases where the percolation rate (q) is less than the hydraulic conductivity (k), see Chapter 3.7.1.)

Retardation is a mass balance process dependant upon the concentration gradient of the chemical component. For net movement of the chemical from the plume to the medium surface to occur, the chemical's concentration on the medium must be smaller than that in the plume; otherwise, there will be no net movement of the chemical. The amount of chemical component adsorbed onto the media surface will be a function of the amount of organic carbon in the medium (as organic carbon content increases, adsorption increases) and the retardation factor, Rd, of that particular chemical.

The retardation factor, Rd, is a function of the medium bulk density (p) and unsaturated zone porosity (n), the partition coefficient (Koc), and fractional organic material of the medium (Foc). Bulk density and total porosity of each medium can be measured, or representative values can be selected from the literature. If Koc, organic carbon-water partition coefficient, cannot be found in the literature for that particular component, then it can be calculated using the octanol/water partition coefficient (Kow) and a regression equation (Lyman 1982).

(3) <u>Presentation of data</u>. Figures 3-5 and 3-6 provide a recommended format for presenting the data required above.

3.3.2 Potential Worst-Case Release Volumes

Wastes can be unintentionally released from tank systems in one of two volume/time scenarios: catastrophic release or non-sudden release.

(1) <u>Information required</u>. The information necessary to estimate a worst case scenario is the same as that required in Chapter 3.3.1(1).

(2) How data are to be used

- Catastrophic Release

  By definition, a catastrophic release occurs when the entire contents of the tank are released instantaneously. In certain instances (e.g., the filled tank volume is large) surface/ground waters can be contaminated quickly. Although such a release can be detected immediately by properly functioning detectors, the ability to contain such a release varies. If the filled tank volume is large, the waste is of low-viscosity, and the tank is above ground, containing the release within the zone of engineering control (defined in Chapter 3.5) may be extremely difficult. Factors such as the filled tank volume being small and the waste being viscous would lead to a better chance of containing the waste within the zone of engineering control.

  Because the volume of waste expelled by a catastrophic release is high and the period of release is short, waste velocity through the unsaturated zone or TOT (Chapter 3.7.2) is calculated using the conservative assumption of saturated flow of the waste.

- Corrosion Release

  A corrosion release can be a release that starts with the size of a pin hole and develops very slowly. The potential danger of such a release occurs when a finite volume of waste must pass by a detector before the detector is activated. It is possible that the undetected leaking waste could travel to surface/ground waters in such small quantities over such long periods of time that surface/ground waters could be contaminated. The detection limit of unsaturated zone sensors varies (Chapter 3.6.3), and the Agency has not identified an unsaturated zone sensor that can detect initial waste release from a small corrosion hole.

(3) Presentation of data. Refer to Chapter 3.3.1(3) for the data formats. The data input will be the maximum value(s) required to calculate waste velocity.

I. MAXIMUM VOLUME OF THE TANK

II. EXPECTED MAXIMUM VOLUME OF TOTAL WASTES IN THE TANK

III. RANGE OF THE VOLUME OF TOTAL WASTES IN THE TANK

IV. RANGE OF PERCENT VOLUMES OF WATER (IN COMPARISON TO TOTAL WASTE VOLUMES) IN THE TANK

V. RANGE OF PERCENT VOLUMES OF HAZARDOUS WASTES (IN COMPARISON TO TOTAL WASTE VOLUME) IN THE TANK

VI. COMPLETE CHECKLIST FOR EACH CONSTITUENT OF THE WASTE (SEE FIGURE 3-6)

Figure 3-5 Format and Contents for Source Characteristics

Complete for Each Waste Constituent:

Chemical Name

% Weight (Show Method)

% Volume (Show Method)

Denisity (Show Method or Reference)

Viscosity (Show Method or Reference)

Koc* (Show Method or Reference)

Is Chemical Organic?

Is Chemical Inorganic?

*Koc is the organic carbon partition coefficient

Figure 3-6 Checklist of Data Requirements for Waste Constituents

3.4 Characterization of Site Hydrogeologic Conditions

Hydrogeologic information constitutes part of the location data required to support the contention that releases of waste from tank systems will not migrate to ground water or surface water. Specifically, it is used to estimate the time of travel of waste through the unsaturated zone of the soil. Note that the factors listed below may not be a complete listing of all information necessary on a site-specific basis to demonstrate that a variance is warranted. For example, a site with complex subsurface structure or stratigraphy may need a more thorough characterization than one that varies uniformly across or under the site.

3.4.1 Investigative Techniques

The July 14, 1986, regulations do not prescribe specific methods; rather, the selection of appropriate methods is up to the applicant. Volume 2, Chapter 3, contains a general discussion of the types of data necessary for characterizing the hydrogeology of a site, and the types of investigative techniques to collect such data. Table 3-3 lists a number of relevant techniques that may be useful. Table 3-4 summarizes potential sources of data that may already be available. It should be noted that much of the required data may already be included in the RCRA Part B permit application for the facility, if one exists. In such instances, applicants should reference the Part B applications, rather than reintroducing data.

3.4.2 Climatic and Meteorological Data

(1) Information required. The following types of climatic and meteorological data should be included in the application (see Volume 2, Chapter 3, for more specific requirements):

- Precipitation data, including monthly and annual rainfall and snowfall (expressed as its equivalent in rainfall and at its highest levels);
- Ambient air temperature, reported as monthly and annual averages;
- Evaporation and transpiration rates at their highest levels (depth/time);
- Runoff; and
- Infiltration rate at its highest levels (depth/time).

Table 3-3 Hydrogeologic Investigative Techniques

Identification of Subsurface Materials (geology):

- Survey of existing geologic information
- Soil borings
- Rock corings
- Material tests (grain size analyses, standard penetration tests, etc.)

  Geophysical well logs (point and lateral resistivity and/or electromagnetic conductance, gamma ray, gamma density, calipher, etc.)[a]

  Surface geophysical surveys (direct current, resistivity, electromagnetic, seismic)[a]
- Hydraulic conductivity measurements of cores (unsaturated zone)
- Detailed lithologic/structural mapping of outcrops and trenches

Identification of Hydraulic Conductivities:

- Slug test and/or pump tests
- Tracer studies
- Estimates based on sieve analyses

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[a]These techniques can be used to supplement information gathered from other sources and may be necessary to perform at some sites (e.g., very heterogenous areas).

2360s

Table 3-4 Principal Sources of Geotechnical Data

Published Data:

1. USGS[a] surficial geology maps
2. USGS bedrock geology maps
3. USGS hydrological atlases
4. USGS basic data reports
5. State and County geologic and hydrologic maps and reports
6. National and local technical journals, magazines, and conference proceedings
7. USSCS[b] soil maps

Unpublished Data:

1. Local test boring and well drilling firms
2. Local and State highway departments
3. Local water departments
4. State well permit records
5. State and local transportation departments
6. State and Federal Environmental Agencies
7. State and Federal Mining Agencies
8. Army Corps of Engineers
9. Local consulting, construction and mining companies
10. Geologists, hydrologists, and engineers at local universities
11. Historical records
12. Interviews

[a]USGS - United States Geological Survey.
[b]USSCS - United States Soil Conservation Service.

Rainfall and temperature data can be obtained from the National Oceanic and Atmospheric Administration (NOAA) or the National Weather Service. Daily precipitation records are published by the U.S. Environmental Data Service in "Climatological Data" and "Hourly Precipitation." Regional data may be used if they were generated within a reasonably close distance to the tank site (approximately 15 km) and are representative of rainfall conditions at the site (see Volume 2, Chapter 3). Estimated infiltration rates may be available from the Soil Conservation Service (U.S. Department of Agriculture); it may, however, be necessary to estimate this value by subtracting the average annual evaportranspiration and runoff rates from the average annual precipitation rate.

(2) How data are to be used. Climatic factors at the site are important parameters affecting the transport of contaminants in the event of a release. For example, runoff helps determine the potential for overland flow to carry a waste from the site of release to a body of surface water (see Chapter 3.7.1). The following are factors that might indicate high potential for contamination of ground and surface water:

- Moderate to high annual rainfall;
- High rainfall in one season;
- Low infiltration rate (suggesting greater overland flow);
- High infiltration rate (which may assist transport of contaminants in the unsaturated zone);
- High runoff (suggesting the possibility of overland flow); and
- Location of the site within a flood plain.

The following factors might indicate a reduced possibility of contamination:

- Low annual rainfall; and
- Infrequent storms depositing small amounts of precipitation.

(3) Presentation of data. It is recommended that climatic data be presented in the format shown in Figure 3-7.

I. TABLES

A. Monthly mean precipitation

B. Monthly range of preciptation

C. Annual mean precipitation

D. Annual range of precipitation

E. Time period sampled

F. Inches of precipitation in a 24-hour period during storms with a return frequency of 1, 10, 25, 50, and 100 years

G. Monthly average temperature and annual average temperature

H. Evaporation and transpiration rates

I. Annual surface runoff

J. Soil infiltration rate

II. MAPS

A. Location of the rain gauge with respect to the facility

B. Potential flooding from 1, 10, 25, 50, and 100-year return frequency storms (if facility is located in a flood plain)

C. Facility site map showing flood prevention stuctures, if any

Figure 3-7 Format for Presenting Climate Data

3.4.3 Site Geology

Since the technology-based variance is based on a showing that releases of hazardous waste can be "contained" by excavation before reaching ground water or surface water, the geologic site characterization focuses on the unsaturated rather than the saturated zone of the soil. This section will address two topics, surficial geology and the unsaturated zone.

(1) Information required. Factors necessary for characterizing the hydrogeologic setting of the site include the following:

- Chemical and physical characterization of the soil and underlying rocks;
- Structural features and stratigraphic relationships of the bedrock and the overlying strata;
- Types, distribution, and composition of soils;
- Heterogeneities in the underlying strata or backfill that would provide preferential transport channels through the unsaturated zone; and
- The seasonal high ground-water table level.

Geological factors that appear to present an increased possibility for contamination of ground water should be examined in detail (see "How data are to be used," below). The following types of information will be required.

- Regional geologic map. A large-scale, plan-view geologic map from a source such as the U.S. Geological Survey or State geological surveys.
- Regional structural trends. Identify regional structural trends that may have a bearing on the site (e.g., fracture patterns, folds, or faults).
- Published geologic studies. Structural, stratigraphic, and hydrologic studies relating to the location of the tank system site should be included.
- Hydrologic map. A map of regional aquifers may be obtained from sources such as the U.S. Geological Survey's Hydrologic Atlas series.

- Topographic map. A topographic map should be constructed under the supervision of a licensed surveyor; a regional topographic map prepared from published sources may also be useful. See Volume 2, Chapter 3 for further discussion.

- Site geologic map. Detailed surficial geologic information on the site should be collected and presented on a plan-view geologic map. While published sources may be helpful, the level of detail required may require onsite field and mapping surveys. See Volume 2, Chapter 3 for further discussion.

Field studies should be carried out in the unsaturated zone. The first step is defining the high and low depth to water table. All strata (rocks, sediments, and soils) above the low depth of water table should be examined in field and laboratory studies. Samples should be logged in the field by a qualified professional geologist. Drilling logs and field records should be prepared on gross petrography, gross structural interpretation of each geologic unit and structural feature, development of soil zones and vertical extent and field description of soil types, and grain-size distributions. For further discussion, see Volume 2, Chapter 3. That section also describes how to obtain the required laboratory data.

(2) How data are to be used. These data will be used at an early stage in the evaluation process to assess potentially vulnerable hydrogeologies. Data will be interpreted to determine possible aquifer recharge zones, regional stratigraphy, prevailing structures, and the presence of karst or solution passages near the tank system site.

As pointed out above, the unsaturated zone plays the major role in governing the transport of hazardous waste to ground water. For a complete discussion of factors required for time of travel estimation, see Chapter 3.7. Hydrogeologic information is also necessary to evaluate the functioning of leak detection instruments. Information on monitoring instruments and properties is presented in Chapter 3.6 of this volume.

The high water table level establishes the lower boundary of the unsaturated zone for modeling time of travel of pollutants to ground water. The lower water table level determines the lower boundary of the unsaturated zone and the depth to which stratigraphic studies should be completed. A detailed discussion of the process of unsaturated zone characterization can be found in Volume 2, Chapter 3.4.

(3) Presentation of data. Data gathered to characterize the unsaturated zone should be presented using maps, cross-sections, and tables as shown in Figure 3-8.

I. TABLES

A. Soil types and properties

B. Sediment/rock types and properties

C. Gross petrography

D. Gross structural features

E. Gross soil types

F. Grain-size distributions

II. MAPS

A. Plan-view map of soils

B. Stratigraphic maps of cross-sections displaying extent and arrangement of geological units in the unsaturated zone.[a]

III. DRILLING AND BORING LOGS

IV. LABORATORY ANALYSES

[a]This may be in the form of structural contour maps, 150 pack maps, or vertical sections.

Figure 3-8 Format for Presenting Hydrogeologic Data

3.5 Determination of Zone of Engineering Control

The "zone of engineering control" is defined in the July 14, 1986, regulations as follows (40 CFR 260.10):

> "Zone of engineering control" means an area under the control of the owner/operator that, upon detection of a hazardous waste release, can be readily cleaned up prior to the release of hazardous waste or hazardous constituents to ground water or surface water."

It includes the greatest lateral extent a material released from a tank system or the piping lattice could travel, whether surface or subsurface, and the depth to which it would travel in a specified time (discovery and remediation). For the purposes of the variance procedure described here, the zone of engineering control refers to the space in which the released material is confined for the time necessary for (1) detection, (2) remediation, and (3) complete cleanup of the released material. This section describes how the zone of engineering control is established.

3.5.1 General Procedures

(1) Information required. Information requirements for determining the zone of engineering control are described below:

- Site Plan

  Provide a site plan showing the location of the tank system, the areal extent of the zone of engineering control, property boundaries, nearest surface water, and locations of all surface and subsurface structures and utilities, both onsite and offsite, that have a bearing on establishing the zone of engineering control. Be sure that all associated piping and other ancillary and the possible extent of migration from them are included in the calculation of the areal extent.

- Water Table Map

  Provide a water table map showing the depth to the highest seasonal water table.

- Cross-sections

  Provide cross-sections showing the location of the tank system, highest seasonal water table, property boundaries, nearest surface water, and locations of all surface and subsurface structures and utilities, both onsite and offsite, that have a bearing on establishing the zone of engineering control.

- Accessibility and Obstructions

  Provide a description of all surface and subsurface structures that may restrict access for remedial actions. If any of these structures are within the zone of engineering control, describe plans to remove them to attain access for remediation. For example, if any part of the zone of engineering control lies beneath a paved area, provide information on the areal extent and thickness of the pavement and discuss the feasibility of removing the pavement to attain access to the contaminated soil within the required time frame.

- Equipment Limitations

  Identify the equipment that would be used to excavate contaminated soil in a spill/leak response. This information should also be provided in the spill/leak response plan. Describe the operational limitations of the equipment, and consider any limitations this may impose on the zone of engineering control. For example, the maximum depth of excavation may be limited by the reach of the equipment, or some equipment may be too large to get into some areas.

- Migration Pathways and Travel Times

  On the site plan and cross-sections, show the shortest flow paths along the migration routes towards surface water and ground water. Calculate the travel times within the zone of engineering control along these flow paths (using migration rates determined in Section 3.7). If there are any subsurface structures (e.g., sewer lines, water mains, or other pipelines) that may provide special pathways for waste migration, calculate travel times within the zone of engineering control along these pathways. The shortest travel time calculated is the maximum time for remediation that is available.

- Volume of Soil

  Calculate the total volume of soil contained within the zone of engineering control.

- Legal Agreements

  If there are any legal agreements to extend the area under the control of the owner/operator beyond the owner/operator's property line for the express purpose of establishing a zone of engineering control, attach all such agreements.

- Margin of Safety

  Discuss the selection of the zone of engineering control boundaries in terms of the margin of safety they provide along the migration routes towards surface water, ground water, and any structures that would obstruct access for remediation.

(2) How data are to be used. By definition, there are several constraints on the zone of engineering control. These constraints serve as a mechanism to establish the zone of engineering control and are listed below:

- The zone must be under the control of the owner/operator of the tank system.
- There can be no ground water within the zone.
- There can be no surface water within the zone.
- It must be readily accessible for cleanup.

(a) Area under control of the owner/operator. In most cases, in order for the zone of engineering control to be within the control of the owner/operator of the tank system, it must lie entirely within the owner/operator's property boundary. It is conceivable, however, that the zone of engineering control can extend beyond the property line if control by the owner/operator of the tank system can be established through a legal agreement with adjacent land owners.

(b) Determination of areas free of ground water. There can be no ground water within the zone of engineering control. The applicant must establish the location and depth of the seasonal high ground-water table at the site. This data will serve to define the depth of the zone of engineering control. As a margin of safety, the lower boundary of the zone of engineering control must be established at a depth above the seasonal high ground-water table.

(c) Determination of areas free of surface water. There can be no surface water within the zone of engineering control. The applicant must identify the nearest surface water to the tank system. For surface water, as with ground water, a margin of safety must be considered in defining the limits of the zone of engineering control.

Loose fill around subsurface structures, such as buried pipelines, may provide migration pathways for contaminants. Any surface or subsurface structures that may provide pathways for migration of contamination to surface water or ground water should be identified. If such structures exist, the applicant ultimately must demonstrate that the migration of contaminants along such pathways can be contained within the zone of engineering control. This demonstration must be shown in Chapters 3.8 and 3.9. (The relationship of other analyses in this chapter to the zone of engineering control is discussed in item (e) below.)

(d) Determining areas readily accessible for cleanup. In addition to source control actions, such as emptying or removing a leaking tank, remediation within the zone of engineering control would most likely consist of removal of contaminated soil. In some cases, other remedial measures may be suitable (e.g., soil vapor recovery, in-situ decontamination); however, soil removal is the worst-case remedial alternative. The following discussion on the accessibility of the zone of engineering control for cleanup assumes that soil removal from the zone of engineering control would be the remedial action taken in event of a spill/leak.

The zone of engineering control must be readily accessible for cleanup should a release from the tank system occur. In practical terms, this means that the zone of engineering control must contain no buildings, pavement, other surface structures, buried pipeline, utilities, or other subsurface obstructions that restrict access for remedial response. Alternatively, if such obstructions do exist, it must be demonstrated in the spill/leak response plan (Chapter 3.8) that they can be removed or circumvented to attain access as part of the remediation plan. For example, if the tank system lies beneath a paved area, removal of the pavement may be part of the spill/leak response plan. If, however, leaking material were to migrate beneath a building, it would probably not be practical to demolish the building to remediate the leak. In such a case, the edge of the zone of engineering control would have to be established somewhere between the tank system and the building. Again, some margin of safety must be provided in establishing this boundary. The boundary should be established far enough away from a structure to allow soil excavation without undermining the integrity of any foundations.

The zone of engineering control must be within the operational limitations of the equipment that would be used for remedial response. For example, it would not be practical to define the zone of engineering control to a depth of 100 feet if the equipment available for soil excavation could reach a depth of only 30 feet. Additionally, the zone of engineering control must be restricted to a volume that can reasonably be cleaned up within the time constraints imposed.

(3) Presentation of data. Figure 3-9 provides the format for presenting the information pertaining to establishment of the zone of engineering control. This is not a form, but a suggested format and order for the required information. The objective is to determine the vertical and horizontal boundaries of the zone of engineering control as defined by distance to ground water and surface water. The boundaries must be selected to provide a "margin of safety" between the unsaturated zone and ground water and surface water.

3.5.2 Relationship of Zone of Engineering Control to Migration Time and Remediation Time.

The maximum size of the zone of engineering control will depend on the proximity of the tank system to ground water and surface water, the area under control of the owner/operator of the tank system, and the area accessible for remedial action. The maximum size is also a function of the time required for detection, remediation, and complete cleanup of the released material. The size must be larger than the space through which the waste would migrate within this time.

Ultimately, the zone of engineering control is determined by the migration rates of released material along the migration routes towards surface water and ground water. This section provides the basis for establishing the initial physical boundaries of the zone of engineering control. This information will be used in conjunction with analyses in Chapters 3.7 (Determination of Time of Travel), 3.8 (Site Remediation/ Response Plan), and 3.9 (Demonstrate Sufficiency of Response and Remedial Times). The applicant must show the shortest amount of time in which released material might reach ground water or surface water. This "shortest time" is the maximum time for remediation that is available. Depending on the time of remediation required, the edge of the zone of engineering control may vary. This time must also take into account the distance travelled by any released material that may have leaked prior to detection as discussed in Chapters 3.6 and 3.9

3.6 Leak Detection System Evaluation

The purpose of this section is to provide a framework for the applicant to present a demonstration that a release from the tank system can be effectively detected. While EPA has reviewed existing tank testing and inventory monitoring techniques, it has found that they are not sufficiently reliable to serve as long-term methods of detecting leaks from hazardous waste tank systems. EPA is currently considering the applicability of existing unsaturated zone monitoring techniques in detecting releases from tank systems. It is feasible that some unsaturated zone monitoring methods could potentially be employed on a case-by-case basis as part of a technology-based variance. In the meantime, the burden of proof for a technology-based variance (for leak detection systems) will be on the applicant.

To demonstrate the effectiveness of the proposed leak detection system, the applicant must include the following:

- A description of the leak detection method to be used;
- Identification of the variables that may affect the operation of the system, and techniques to compensate for the effects of these variables;
- A description of the calibration, testing, and maintenance procedures that will be used to ensure reliable operation of the system for the life of the system, and under the range of operating conditions in which it will be used;
- A determination of the lower limit of leak detection for the system; and
- A determination of the response time of the leak detection system.

The applicant must particularly demonstrate the effectiveness, reliability, lower detection limit, and response time of the leak detection system. The validity of the demonstration method used to evaluate these factors has to be discussed in the variance application. A leak detection system may be operated on either a continuous or intermittent basis. The only limitation is that the response time for leak detection must meet the time constraints of the performance methods. Potential demonstration methods may include calculations, or bench scale, pilot scale, or in-situ physical tests. No specific demonstration technique is prescribed in this manual. It is the responsibility of the applicant to devise a method to demonstrate the validity of a particular leak detection system.

The effectiveness of the leak detection method must be demonstrated for two principal leak scenarios: (1) a catastrophic leak in which there is a rapid release of material and (2) a slow release in which it may take a long time for a detectable amount of material to escape. Timely detection of corrosion-caused leaks is critical because they may start and leak slowly for a long period of time before they reach a detectable level. The detection of catastrophic releases is less problematic in that a detectable quantity of material is released quickly.

I. SITE PLAN

II. WATER TABLE MAP

III. CROSS SECTIONS

A. Location of tank system

B. Vertical and lateral extent of zone of engineering control

C. Highest seasonal water table

D. Property boundaries

E. Nearest surface water

F. Locations of all surface and subsurface structures and utilities

IV. ACCESSIBILITY AND OBSTRUCTIONS

V. EQUIPMENT LIMITATIONS

VI. MIGRATION PATHWAYS AND TRAVEL TIMES

VII. VOLUME OF SOIL WITHIN ZONE OF ENGINEERING CONTROL

VIII. LEGAL AGREEMENTS

IX. DETERMINATION OF MARGIN OF SAFETY

Figure 3-9 Format and Contents for Determining Zone of Engineering Control

3.6.1 Internal Leak Detection Systems

(1) Information required. There are two types of internal leak testing, volumetric and non-volumetric. The volumetric methods measure leak rates, while the non-volumetric methods provide only the indication that there is a leak. Applicants will need to describe the type of testing proposed and how leaks will be measured and detected. Changes in volume can be determined by measuring parameters associated with volume change, including changes in liquid level, temperature, pressure, and density. Inventory monitoring and some types of tank testing procedures use this approach. Certain variables affect the volume change or the measurement of the volume change. These variables include, temperature, water table conditions, tank deformation, vapor pockets, evaporation of stored material, tank geometry, wind, vibration, noise, equipment accuracy, operator error, type of material stored, power variation, instrument limitation, atmospheric pressure, and tank inclination. Applicants must identify how these variables affect volume change or its measurement.

Examples of non-volumetric methods include (1) the placement of a pressurized tracer gas inside the tank and monitoring for the tracer gas outside the tank or (2) monitoring the sound caused by a leak inside a tank. Some forms of tank testing use these approaches. Non-volumetric detection methods generally require that the tank system be completely sealed so that pressure can be exerted within the system. This increase in pressure can cause or enhance a leak. These methods may not be applicable for tanks during normal use when they must be opened and closed to add or remove materials. There is also a potential for the tracer gas to react with material in the tank, possibly creating an explosion hazard. The reliability of non-volumetric leak detection methods is generally affected by the same variables as that of volumetric methods. For non-volumetric methods in which external sensors are used (e.g., for detecting tracer gas leakage), hydrogeologic variables may also affect reliability.

Finally, applicants must specify the lower limit of leak detection. The lower limit of leak detection has different significance for different leak detection methods. For volumetric leak detection methods, the lower limit of leak detection is usually expressed as the minimum rate of leakage (volume per unit time) that can be detected. For non-volumetric leak detection methods, the lower detection limit may be dependent on a minimum rate of leakage or on a minimum hole diameter for the leak.

(2) How data are to be used. The objective of the analysis of the data presented above will be to demonstrate lower leak detection limits. The applicant must be able to quantify the time (duration of release) and volume of any potential releases that fall below the leak detection limit. There must be a way to account for these small leaks that could grow large enough to be detected. Based on the above information, a final determination will be made concerning the potential for any undetected releases that can migrate to the ground water or surface water. (These determination parameters are also discussed and used in Section 3.9 of this document.)

If EPA believes that the time for release of stored materials to accumulate to detectable levels will lead to a ground-water or surface-water migration problem, EPA may deny the application.

A detailed discussion of the individual information requirements follows with an explanation as to why they are necessary in the evaluation process.

- Temperature

  Changes in temperature cause expansion or contraction in the product and in the tank dimensions, which in turn results in pressure changes within the tank. The extent of temperature effects on volume changes is dependent on the material stored in the tank, and the tank material itself. Temperature effects may also cause stratification of material within the tank, making volume corrections for temperature changes more difficult. The basic information the applicant must be concerned with is the seasonal ambient temperature (°F) at which the hazardous wastes will be stored. Furthermore, it will be necessary to provide the boiling and freezing points (°F) of the waste material.

- Water Table Conditions

  Hydrostatic head and surface tension forces caused by ground water outside a storage tank may mask leaks partially or completely. Leaks may take the form of the stored material leaving the tank or of ground water entering. Tank systems with any portion below the water table will not qualify for a technology-based variance.

- Tank Deformation

  Tank deformation may result from the change of volume of material stored in the tank or from changes in temperature and pressure. Factors that affect tank deformation include the material of tank construction, thickness of the tank walls, age of the tank, and properties of the fill material around the tank. Non-volumetric methods are generally not affected by tank deformation.

- Vapor Pockets

  Vapor pockets may form within tanks when the tank is completely full. The volume of these vapor pockets may change rapidly with changes in temperature and pressure and lead to inaccurate volumetric measurements for the liquid material in the tank. Factors that affect the formation of vapor pockets include the volatility of the material stored in the tank and the tank geometry (i.e., vapor pockets may form at the high end of an uneven tank, in a manway, or at the top of a drop line). Furthermore, ambient atmospheric pressure and temperature (°F) will have an effect on their formation.

- Evaporation

  Evaporation of the material stored in the tank causes a decrease in volume which, if not accounted for, would be interpreted as a leak by a volumetric monitoring system. The material's volatility, evaporation rate, and boiling point (°F) will be factors in evaporation, along with the ambient temperature (°F).

- Tank Geometry

  Tank geometry affects volumetric leak detection in several ways. In a horizontal, cylindrical tank, for example, the surface area of the material changes at different levels within the tank. This may cause variation in evaporative loss at different material levels. Also, a given change in the fluid level indicates different changes in volume at different levels in the tank. Non-volumetric methods are generally not affected by tank geometry.

- Wind

  Wind may affect some leak detection methods in tanks that are kept open to the atmosphere during monitoring, by creating motion within the material or by causing pressure changes or both. The data to quantify wind are broken down to wind speed and direction.

- Vibration and Noise

  Vibration can affect a volumetric measurement by causing motion in the material. It can also hinder detection of leaks because moving fluid will produce a masking "noise."

- <u>Equipment Accuracy (Sensitivity)</u>

  Changes in many of the variables described in this section are measured and corrected for by the leak detection instrumentation. Therefore, the sensitivity of the equipment to respond to these variations (e.g., temperature changes) is a limiting factor on the accuracy of the test equipment. The sensitivity of the instrumentation is subject to change at different operating conditions, such as temperature, pressure, and range of measurement. All minimum detection levels (ug/l, ug/m^3, etc.) should be listed.

- <u>Operator Error</u>

  The potential for operator error increases with increasing complexity of the monitoring procedure. A typical example of operator error is inadequate sealing of openings when a particular monitoring method requires extensive sealing of the system's openings. Also note whether wastes are added or removed from the tank system as part of normal operating conditions. This is another source of operator error.

- <u>Type of Material Stored (Compatibility)</u>

  The physical properties of the material could affect the function or accuracy of a detection method. The compatibility of the material with the components of the leak monitoring system must be demonstrated. For example, stored materials may cause corrosion of monitoring components or may coat them, rendering them inaccurate or non-functional. Waste viscosity can also affect the sound characteristics of leaks that occur below the waste level. All physical-chemical properties of the material stored and material used in tank system construction should be listed.

- <u>Power Variation</u>

  Most of the detection methods require electrical power for operation. Power variations may lead to inaccuracy. An alternative power source, such as a backup battery may also be required in case the primary power source fails. The application should state whether power is AC or DC and where there is an alternative power source.

- Instrument Limitation

  Some of the leak detection methods are to be used only under certain operating conditions, such as a specific range of temperatures or tank sizes. The selected detection method and instrumentation must be used within its design range. Proper ranges for instrument (temperature, pressure, volumes) and storage material types (gas, liquid, solid) should be described.

- Atmospheric Pressure

  Atmospheric pressure changes may cause a pressure change within the tank system resulting in contraction or expansion of the tank material. This effect may be magnified by the presence of a vapor pocket within the tank system. The range of atmospheric pressure (mm Hg) over the seasonal ambient temperatures (°F) should be given.

- Tank Inclination

  Tank inclination may affect detection accuracy for product level detection methods. This is due to the difference in cross sectional areas, at certain levels, for inclined versus level tanks. This effect can be corrected by measurement of level change due to a known material volume change. The inclination (0°-90°) from level ground should be recorded.

- Other Variables

  This category is provided to cover any miscellaneous characteristic of the site, tank system, or operating conditions that the operator has reason to believe will affect the system design and that are not covered in the sections above.

(3) Presentation of data. Figure 3-10 presents the format for Leak Detection System Evaluation. This format provides a list of the minimum information requirements for this section of the variance application and a recommended order for presenting the information. This worksheet is presented only as a recommendation for a data presentation format.

3.6.2 Perimeter Leak Detection Systems

A perimeter leak detection system is defined as a leak detection system situated on the outer surface of the tank and appropriate ancillary parts of the system (e.g., piping). Little research and development have been done in this area; however, it is mentioned here as a possible approach among monitoring possibilities because some innovative technology may lead to development of such a system. The techniques that may be developed for perimeter leak detection systems might utilize the same properties for current unsaturated zone monitoring, for example, electrical conductivity, and sensitivity to hydrocarbons, temperature, and moisture. Hypothetical examples of a perimeter leak detection system could encompass an electrical conductivity-sensitive wire grid around the tank system to detect a leak of waste material.

(1) Information required. Because a perimeter leak detection system is in contact with both the tank and its external environment, a combination of variables affecting both external and internal leak detection systems would affect this system's accuracy. Common variables are listed below. (See Chapter 3.6.1 for a more detailed discussion.)

- Temperature
- Water table conditions
- Tank deformation
- Vibration and noise
- Equipment accuracy (sensitivity)
- Operator error
- Type of material stored (compatibility)
- Power variation
- Instrument limitation
- Soil moisture
- Soil type (compatibility)
- Surface spills

(2) How data are to be used. The common variables listed above will be used in the same manner as described in Chapter 3.6.1(2). The variables listed below reflect the influence of the external environment. A brief discussion follows on their possible effect on the detection system. It must be noted that external environments will be different from site to site and variables other than those listed above may apply. The applicant must include any and all aspects of information the external environment (e.g., hydrogeology, weather) that can have any effect on the leak detection system.

- Soil Moisture

  Soil moisture conditions may vary between dry and moist conditions. A perimeter leak detection system would have to remain operational through these varying soil moisture conditions.

I. DESCRIPTION OF METHOD

Description of leak detection method including:

- Description of physical principle on which the detection method is based
- Indication of whether the method is continuous or periodic (semi-continuous intermittent)
- Indication of whether the system can operate under normal tank system operating conditions or whether special preparation conditions are required
- Description of how the system communicates leak detection.

Section may include a conceptual drawing of the leak detection method.

II. DESIGN OF LEAK DETECTION SYSTEM

Provide engineering drawings of the tank, ancillary equipment, and all components of the leak detection system. Demonstrate that the method is capable of detecting a leak occurring in any part of the tank system.

III. TECHNIQUES TO COMPENSATE FOR THE EFFECTS OF VARIABLES

For each variable listed below, provide an explanation of either (1) how the leak detection method compensates for the effects of the variable, or (2) why the effects of the variable are not applicable to or have no effect on the leak detection method.

A. Temperature

B. Tank Deformation

C. Vapor Pockets

D. Evaporation

E. Tank Geometry

F. Wind

Figure 3-10 Leak Detection Systems Evaluation Checklist

III. (Con't)

G. Vibration

H. Noise

I. Equipment Accuracy (Sensitivity)

J. Operator Error

K. Compatibility With Waste

L. Power Supply

M. Instrumentation Limitation (Provide Sensitivity Limits for All Parameters Measured by the Method)

N. Atmospheric Pressure

O. Tank Inclination

P. Addition and Removal of Material From the Tank as Part of Normal Operations

Q. Other Variables

Figure 3-10 Leak Detection Systems Evaluation Checklist (Continued)

IV. CALIBRATION, TESTING, AND MAINTENANCE PROCEDURES

Describe the procedures used to ensure reliable and accurate operation of the leak detection system throughout its useful lifetime, and under the range of operating conditions in which it will be used.

V. DETERMINATION OF LIMIT OF LEAK DETECTION

Provide lower leak detection limit (minimum leak rate, hole diameter, waste quantity or concentration, or other limiting factor) of the system, and describe how determined. Summarize all error introduced by the effects of variables described above, compensation for these effects, and a calculation of the final lower limit of leak detection. Alternatively, some physical demonstration method may be used such as a bench scale, pilot scale, or in-situ test. It is the responsibility of the applicant to devise and demonstrate the validity and reliability of a particular method under the range of operating conditions that the instrumentation is designed for. The applicant must also demonstrate the reproducibility of the data.

VI. DETERMINATION OF RESPONSE OF LEAK DETECTION

For a continuous monitoring system, the applicant must provide a determination of the lower limit of leak detection, and the time required for a leak to grow to this quantity. For intermittent monitoring, the maximum time interval between monitoring events should be added to the values determined above.

Figure 3-10 Leak Detection Systems Evaluation Checklist (Continued)

- Soil Type (Compatibility)

  The physical properties of the soil could affect the function or accuracy of a leak detector. For example, an acidic soil could corrode components of the leak detection system, or soil could agglomerate around the sensor rendering it non-functional. This also ties into the above variable since different soil types retain or lose moisture at different rates.

- Surface Spills

  With any external monitoring device, spills on the surface may infiltrate the soil and reach the detectors, and thereby be interpreted as a tank leak. Again, a demonstration that a new innovative technology for perimeter leak detection systems will work must demonstrate that each of these potentially adverse variables either does not affect the proposed detection method or incorporates techniques to compensate for the effects of the variable.

(3) Presentation of data. Figure 3-11 provides the format for presentation of the above mentioned data. It can be amended to provide a perimeter leak detection device evaluation worksheet by just adding the external environment variables under Section III of Figure 3-10.

3.6.3 Unsaturated Zone Monitoring Systems

Owners and operators of tank systems that would include unsaturated zone monitoring as an element of their leak detection program must demonstrate to the Regional Administrator that the system is sufficiently sensitive to allow leaks to be detected. This section describes the information and analysis that must be submitted by applicants.

(1) Information required. General information requirements for evaluating unsaturated zone monitoring systems are described below.

(a) Description of the physical principle(s) upon which the method relies. This section should describe how the device will determine that a leak has occurred (e.g., by measuring conductance changes in the soil, resistivity changes, pH, total volatile organic vapor, etc). Any possible problems with shielding should be discussed. For example, might the ceramic or polymer cup have a preferential adsorption pattern for the ion of concern?

(b) Device compatibility. This section will describe how the subsurface probes are expected to interact with the soil environment. For some devices, such as PVC probes used for drawing pore gas vapors, this will require little if any additional work. For other devices, however, such as gypsum blocks or ceramic cups, a demonstration will have to be made that the device will survive its environmental surroundings without self destruction or clogging.

(c) Design of leak detection system. This section is the heart of the effectiveness part of the application, describing in detail the physical characteristics of the system. Drawings should be included, if possible. It will use the information gathered to show that the proposed placement and number of probes or devices is such that no leak will go undetected. It will show that even under the worst of circumstances (e.g., extreme dilution due to precipitation events), the detection limits of the system are such that a leak will be picked up within a reasonable time. Chapters 3.8 and 3.9 will relate this reasonable time to the emergency response plan and the time of reaction needed to prevent the material from reaching the ground water). The applicant must describe in detail how the system can differentiate between actual releases and "false alarms." The degree to which "false alarms" can be minimized without losing effectiveness must be discussed.

(d) Calibration, testing, and maintenance procedures. In this section, the applicant will describe the procedures to be used to ensure reliable and accurate operation of the leak detection system throughout its useful lifetime under the range of operating conditions in which it will be used. Personnel to be used for this purpose (in-house or outside contractor) should be identified and their qualifications presented.

Some specific types of data required are as follows:

- Depth to ground water (high water mark on site). The regional or area depth is not acceptable.
- In-situ permeability tests on the most and least permeable sections of the stratigraphy between the surface and the ground water. Laboratory tests are not acceptable. At least two locations should be tested to verify continuity.
- Continuous core sampling (or other suitable technique) that will allow for accurate field logging of the soil stratigraphy down to the ground water.

I. DESCRIPTION OF METHOD

Description of leak detection method including:

- Description of physical principle on which the detection method is based
- Indication of whether the method is continuous or periodic (semi-continuous intermittent)
- Indication of whether the system can operate under normal tank operating conditions or whether special preparation conditions are required
- Description of how the system communicates leak detection.

Section may include a conceptual drawing of the leak detection method.

II. DESIGN OF LEAK DETECTION SYSTEM

Provide engineering drawings of the tank, ancillary equipment, and all components of the leak detection system. Demonstrate that the method is capable of detecting a leak occurring in any part of the tank system.

III. TECHNIQUES TO COMPENSATE FOR THE EFFECTS OF VARIABLES

For each variable listed below, provide an explanation of either (1) how the leak detection method compensates for the effects of the variable, or (2) why the effects of the variable are not applicable to or have no effect on the leak detection method.

A. Temperature

B. Tank Deformation

C. Vapor Pockets

D. Evaporation

E. Tank Geometry

F. Wind

Figure 3-11 Perimeter Leak Detection Systems Evaluation Checklist

III. (Con't)

G. Vibration

H. Noise

I. Equipment Accuracy (Sensitivity)

J. Operator Error

K. Compatibility With Waste

L. Power Supply

M. Instrumentation Limitation (Provide Sensitivity Limits for All Parameters Measured by the Method)

N. Atmospheric Pressure

O. Tank Inclination

P. Addition and Removal of Material From the Tank as Part of Normal Operations

Q. Soil Moisture

R. Soil Type

S. Surface Spills

Figure 3-11 Perimeter Leak Detection Systems Evaluation Checklist (Continued)

IV. CALIBRATION, TESTING, AND MAINTENANCE PROCEDURES

Describe the procedures used to ensure reliable and accurate operation of the leak detection system throughout its useful lifetime, and under the range of operating conditions in which it will be used.

V. DETERMINATION OF LIMIT OF LEAK DETECTION

Provide lower leak detection limit (minimum leak rate, hole diameter, waste quantity or concentration, or other limiting factor) of the system, and describe how determined. Summarize all error introduced by the effects of variables described above, compensation for these effects, and a calculation of the final lower limit of leak detection. Alternatively, some physical demonstration method may be used such as a bench scale, pilot scale, or in-situ test. It is the responsibility of the applicant to devise and demonstrate the validity and reliability of a particular method under the range of operating conditions that the instrumentation is designed for. The applicant must also demonstrate the reproducibility of the data.

VI. DETERMINATION OF RESPONSE OF LEAK DETECTION

For a continuous monitoring system, the applicant must provide a determination of the lower limit of leak detection, and the time required for a leak to grow to this quantity. For intermittent monitoring, the maximum time interval between monitoring events should be added to the values determined above.

Figure 3-11 Perimeter Leak Detection Systems Evaluation Checklist (Continued)

- For gas-based probes, calculation of the rate of diffusion of the volatile(s) of concern in the subsurface. If possible, reference should be made to published experiments that have shown this calculation to be valid in the context used. Calculations should be made such that the full range of expected moisture content of the unsaturated zone is covered.

- For liquid-based probes, calculation of the rate of flow in the subsurface. This should include a lateral spread component to allow a determination of whether the proposed density of deployment is adequate.

- For liquid-based probes, a calculation of what dilution will occur in a saturated flow condition caused by precipitation.

- For detectors in contact with the soil, a determination of compatibility with the soil chemistry. For example, one would not want to put a gypsum block in a highly acidic environment.

- For all in-situ detectors or detector probes, a determination that the expected concentrations under <u>all</u> foreseeable circumstances of escaping wastes will be high enough to detect. Or, if detectors are species-specific, it must be demonstrated that the presence of other materials in the waste will not mask the material of interest.

- Calculation for small and large leaks of the time required for the device to provide an indication that a release has occurred.

(2) <u>How data are to be used</u>. Unsaturated zone monitoring devices can be grouped into two large segments: those that respond to changes brought about by a saturated flow event that crosses their zone of influence (e.g., lysimeters, electrical resistance blocks) and those that respond to a change in concentration of contaminants within the gas pore space. Both of these have been shown to work with some degree of accuracy in their given areas (EPA 1983; Spittler 1985; and Marrin 1984 and 1985).

A number of problems have been attributed to these devices (USEPA 1983), and the applicant must demonstrate that these will not interfere with the devices' functioning at his/her facility. For example, problems associated with the devices used for periodic measurement of saturated flow in the unsaturated zone include clogging of pores and a tendency to absorb certain cations so that they do not appear in the collected materials in representative concentrations.

There have also been numerous reported incidents of devices such as resistance blocks dissolving under the influence of saturated flow across them, whether flow of contaminants is evident or not. The applicant must assure the Agency that subsurface conditions at the site will not cause these problems, and that an inspection and maintenance schedule will be in place to guarantee adequate performance of the equipment. Many of these devices are also associated with collection routines that are neither continuous nor connected to an alarm system. To be successful, the applicant must demonstrate that this would not adversely affect his ability to detect and respond to a leak in a timely fashion.

Vapor detection systems generally have the opposite problem. They are relatively sensitive to any increase in gas pore space contaminant concentrations at the parts-per-million level or above. This leads to the problem, especially for older industrial facilities, of trying to differentiate between a relatively high background and what could be, if the waste stream does not contain elevated levels of volatile organics, fairly low gas concentrations from a leaking system. This can be overcome (at some expense) by using a species-specific detector and by choosing (as surrogate) a waste constituent not generally used in the production process.

Finally there are the problems of travel time and spheres of influence. Most devices are relatively passive. That is, materials of interest have to come to them. They are not unlike a ground-water monitoring well where a plume on or in the ground water must pass into their screen before its existence is known. A plume can pass within a few feet of a monitoring well and not be detected.

For devices such as resistance blocks there is no sphere of influence. The material or material-influenced water must pass directly over it for detection to take place. Therefore, the applicant must calculate how far the material will spread laterally between a small point source and the positioning of the detection system. This will determine the density with which he or she will have to deploy the detection equipment.

For devices such as suction lysimeters, there is a moderate sphere of influence, usually a few inches. The same calculations will have to be made for these as for the resistance-type blocks, resulting in the number of blocks per unit area being less for some soil classes. This is because the resistance block has no ability to draw materials to it and some soils will allow small leaks to flow vertically downward with very little spread. Historically, these devices have been used to monitor land farming operations where general trends are measured since wastes are usually applied evenly across a large area. They are looking for contaminant fronts rather than point source leaks.

Gas detection equipment currently on the market is generally of two types. One consists of a passive device that is suspended in a bored, cased hole that alarms when a diffusion cloud of volatile organics passes over it. The detector is constructed of a metal oxide that operates on the principle of changing electric current due to changing gas composition in the probe. It is not highly sensitive and is not species-specific.

The second type is not as passive as the first. It is usually located out of the ground and depends on a vacuum being applied to subsurface probes to bring the pore gas to it. The sphere of influence for these devices depends directly upon how long the vacuum pumping is continued, and on the type of soil and its degree of saturation. That is, the more saturated the soil is, the more difficult it is for gasses to move through it. Since the detection device is remote and does not have to be located in the ground, its configuration, portability, sensitivity, and ability to detect species-specific chemicals can vary widely.

It will be incumbent upon the applicant to show, should he or she choose one of these instruments, that it will function under the most adverse conditions possible at his or her facility. An example might be a tank that lacks any kind of a cover (pavement, concrete) and that begins to leak on the second day of a two-week continuous rainstorm; the subsurface is sandy, and the rain generates saturated flow in the unsaturated zone. How will this affect the ability of the detection system to discover the leak before it migrates beyond the zone of engineering control? In this situation, if it is a gas detection system, the vapors as well as the escaping liquid are liable to be caught up in the downward flow and the system will never "see" the leak because of restricted lateral diffusion and dilution. If the system depends on a change in composition of the pore space liquid, then this amount of water flow may dilute a small leak so that it is missed for several weeks. If either of these situations should occur so that a small leak is missed for some period, then the system will not qualify for the technology-based variance.

(3) Presentation of data. Figure 3-12 provides the format for presenting the information pertaining to unsaturated zone monitoring. This is not a form, but a suggested format and order for the required information.

(4) Other information available. Additional information on unsaturated zone monitoring instruments and selected references on the subject are included in Appendix C.

3.7 Determination of Waste Travel Time

This section provides the applicant with procedures to determine actual waste travel time in the event of a release. The two types of travel that EPA is interested in quantifying are overland flow (horizontal surface movement) and unsaturated zone flow (vertical movement). The determination of waste travel time and subsequent evaluation of adequate spill response time will have significant bearing on whether the variance is granted.

3.7.1 Overland Flow

This section discusses the methods for determining the velocity of horizontal movement of releases from aboveground tank systems or the aboveground portion of the tank system. The movement of fluids along the surface of the earth is termed "overland flow." The analysis is concerned with catastrophic releases since it is presumed that non-sudden leaks from aboveground tank systems do not present as serious a problem. That is, the aboveground tank systems are easier to inspect than underground systems. The analysis includes the effects of diversion structures on the acceleration and retardation of the overland flow velocity.

(1) Information required. The estimation of the migration velocity of tank system contents during catastrophic releases depends on the volume of release, land topography, soil and land use characteristics, and waste characteristics. Many of the parameters discussed in Chapters 3.3 and 3.4 will be used as data for the overland flow calculations. These source characteristics are used in the equations described below.

(2) How data are to be used. The objective of the analysis is to establish a worst-case time of travel of overland flow to the edge of the zone of engineering control. The migration of waste may occur both horizontally and vertically, as the soils become saturated with released materials. The applicant must demonstrate the depth to which the released material will penetrate, and the time of travel of horizontal migration to the boundary of the zone of engineering control.

(a) Depth of penetration. Depth of penetration refers to the vertical movement of the release from the tank system. It can be calculated using the following equation:

$$D_p = V_f / A_{ED} \qquad (3-1)$$

I. DESCRIPTION OF MONITORING METHOD

A. Physical principle for monitoring

B. Detection limits

C. Device ranges of use/accuracy

D. Potential shielding/interference problems

II. DEVICE COMPATABILITY

A. Site hydrogeology/soil chemistry

B. Demonstration that instrument is compatible with soil environment

III. DESIGN OF LEAK DETECTION SYSTEM

A. Drawings of system plan and layout

B. Detection limits of the system

C. Time to detect releases

D. Demonstration that no release will occur undetected (discuss sensitivity, spacing of instruments, and worst-case performance; e.g., high dilution due to precipitation events)

IV. CALIBRATION, TESTING, AND MAINTENANCE PROCEDURES

A. Depth to seasonal high water table

B. Results of in-situ permeability tests on stratigraphy between surface and the ground water

C. Results of continuous core sampling

D. Rate of diffusion of volatiles of concern

E. Concentration dilution that may occur in a saturated flow condition caused by precipitation

F. Rate of flow in the subsurface (including lateral spread component)

G. Demonstration that expected concentrations under all forseeable release incidents will be high enough to detect

H. Time to detect releases

I. Procedures to be used to ensure reliable and accurate operation of the leak detection system

Figure 3-12 Format and Presentation of Data Pertaining to Unsaturated Zone Monitoring

where

- D_p = Depth of penetration
- A_{ED} = Downgradient surface area of the zone of engineering control (m^2)
- V_f = Total volume of the tank (m^3).

The equation conservatively assumes that the total release volume migrates downward over the area of the zone of engineering control. The volume is thus used to define the depth of penetration by making it a function of the surface area of the zone of engineering control.

An example is provided to illustrate how the equation works. The downgradient surface area of the zone of engineering control is assumed to be 312.5 m^2 and the volume, 250 m^3. Using the equation, the depth of waste penetration is 0.8 meters or 80 centimeters.

(b) Horizontal migration. Time of travel (TOT) of the release to the edge of the zone of engineering control is calculated by the following equation:

$$TOT = \frac{1.8\ (1.1 - C)\ (Dm)^{1/2}}{S^{1/3}} \qquad (3\text{-}2)$$

where

- TOT = Time of travel of release to edge of zone of engineering control
- C = Runoff coefficient
- S = Overland slope percent
- Dm = Travel distance

The equation assumes that the release has the same viscosity as that of water. If this is not a valid assumption, onsite testing can be performed to evaluate waste velocity, or the viscosity adjustments explained in Chapter 3.3 can be applied.

The runoff coefficient (C) can be estimated from Table 2-2. The overland slope percent (S) can be estimated from USGS topographic maps. An example is provided to illustrate how Equation (3-2) works. The downgradient zone of engineering control is 50 percent overlain by unimproved areas and 50 percent overlain by concrete. The C values shown in Table 2-2 indicate that for unimproved areas, C is in the range of 0.10 to 0.30, and the concrete, from 0.80 to 0.95. Taking the average of the ranges, C is estimated as 0.20 and 0.87 for the respective areas. Since both areas are distributed equally (50 percent for each), the average of the two C values is taken to obtain 0.54.

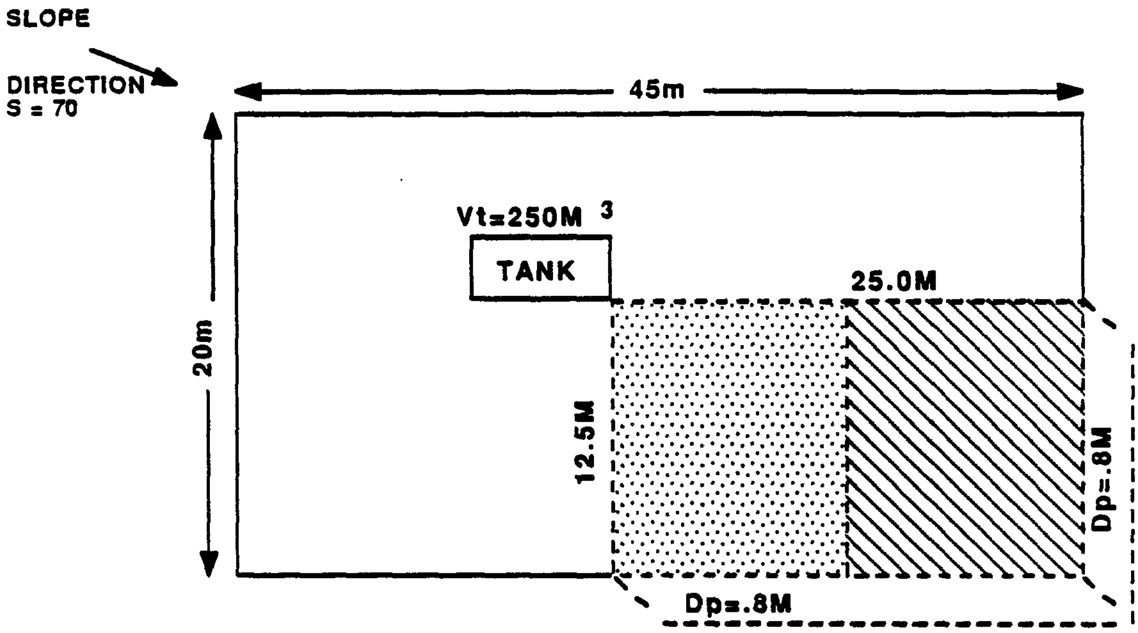
The slope is assumed to be 0.07, and the minimum distance to the edge of the zone of engineering control is 12.5 meters. Using the equation, the time of travel is estimated as 16 minutes. Figure 3-13 illustrates the example used for both the depth penetration and horizontal migration equations (3-1 and 3-2).

(c) Diversion effects. The horizontal migration equation cannot be used alone to assess the time of travel. Qualitative evaluations must be made to adjust the initial time of travel computed using the equation. In particular, diversion effects must be taken into account, such as all natural and man-made obstructions. In many instances, an unimpeded catastrophic release could result in migration beyond the zone of engineering control. The flow may be channeled or shunted to earthen berms or man-made containment devices via diversion structures such as dikes and ditches. Also, existing divergence structures such as roads or buildings may contribute to delaying the flow. On the other hand, some structures may actually accelerate overland flow.

The applicant must demonstrate to what extent any alternative spillage containment system alters the time of travel. This is critical, since the time of travel is a significant part of the final analysis in Chapter 3.9, in which it must be shown that there is sufficient time in which to detect and remediate any releases prior to migration beyond the zone of engineering control. Waste type, land surface characteristics, and the presence of diversionary structures are the main factors that must be considered in this evaluation.

This analysis, therefore, must examine the devices that control (either intentionally or incidentally) the direction and travel time of the release and must identify the final location of the release. The analysis must also address what the time of travel of releases to the boundary of the zone of engineering control can be in the event of a 25-year, 24-hour rainfall, and a release event from the largest tank in the facility. (The response plan for such an event must be addressed per the requirements of Chapter 3.8, not in the time of travel analysis.)

If no diversionary structures are used for control of releases, or if the structures are insufficient to delay migration, the type of waste stored, topography, and soil will be considered. Of particular importance in evaluating the effect of structures on travel time is the effect of shunts on overland flow. If the system shunts the flow to the subsurface and poses a potential migration to the ground water, the time of travel through the unsaturated zone should be calculated (see Chapter 3.7.2).

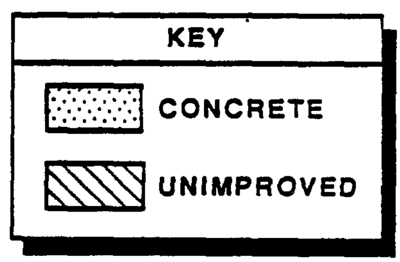


$A_{ED} = 12.5 \text{ m} \times 25 \text{ m}$

$A_{ED} = 312.5 \text{ m}^2$

$V_f = 250 \text{ m}^3$

$D_p = 250 \text{ m}^3 / 312 \text{ m}^2 = .8 \text{ m}$ or 80 cm



Dm = 12.5 m or 41 FEET (3.28 FEET/METER)

S = 7° or .07

C = .5

$$TOT = \frac{1.8\ (1.1 - C)\ D_m^{1/2}}{S^{1/3}}$$

$$TOT = \frac{1.8\ (1.1 - .54)(41)^{1/2}}{.07^{1/3}} = 15.7$$

Figure 3-13 Depth Penetration and Horizontal Migration

The following factors must be considered in evaluating the alteration of the time of travel of releases.

- Waste Characteristics

  Viscosity is a key factor that affects the velocity of the waste flow on the ground surface and infiltration rates. The velocity of the waste varies inversely with its viscosity. Volatility is also significant, since it can affect the amount of liquid available for overland flow, depending on volatilization rate, temperature, humidity, and time of exposure. (See Chapter 3.3 - Source Characterization - for more information on determining waste characteristics.)

- Soil Characteristics

  Soil factors control the rate of infiltration into the ground. These factors are hydraulic conductivity, initial water content, and surface conditions. In general, soil infiltration rates are high in the early stages of absorption and decrease to a constant rate as the soil becomes saturated.

  Hydraulic conductivity controls the velocity in which fluids can move through the soil (infiltration rate). The velocity is dependent on the particle size; large particle sizes result in high hydraulic conductivity.

  Soil surface conditions also affect the rate of infiltration. If the soil surface is open and highly porous with little compaction, the initial infiltration rate is higher than that of uniform soil. This condition can be created by macropore openings from plants and burrowing animals or by tilling or furrowing of the land. Conversely, compacted and/or crusted soil acts as a hydraulic barrier. Finally, the presence of vegetation is another surface condition that can affect overland flow.

- Topography

  The topography of the local land surface influences the direction, velocity, and the amount of fluid available for overland flow. The topographic factors are slope, surface storage, and formation of stream flow by drainage patterns. Areas with high slope have overland flows with higher velocities, thus reducing the travel time of the spill per given area. The higher velocity reduces the time in which the soil has to absorb the flow; therefore, a larger surface area is needed for the fluid volume to infiltrate completely.

Drainage patterns determine whether overland flow will be able to form stream flow. If the spill is able to form a stream flow, the distance and velocity the spill can travel are increased. The presence of rills or gullies can channel the flow and create a conduit for spilled waste to travel. In some cases, these gullies or rills are directly connected to surface water bodies. Man-made drainage patterns can also greatly influence the direction that a spill can travel. Roads (paved and unpaved), machinery tracks, and even footpaths can act as stream channels for the transportation of a spill.

- Land Use

  The evaluation of an alternative spill control system must take into consideration how normal operating procedures and equipment use will affect the system. Buildings may block or divert a waste spill. Storm sewers may act as pathways for spills to exit the zone of engineering control. Roads and pathways for vehicles may change the physical properties of the soil and reroute drainage patterns.

- Spill Control Structures

  Applicants must address how diversionary structures such as dikes, berms, or retaining walls will affect time of travel. The use of such structures as a spill control response must be discussed in the emergency response contingency plan in the next section (Chapter 3.8).

(3) Presentation of data. The checklist in Figure 3-14 provides a recommended format for the applicant to follow in presenting the data and analysis for overland flow. Figure 3-15 provides a format for submitting calculations of overland flow time of travel.

3.7.2 Unsaturated Zone Flow

This section discusses how to calculate hazardous waste travel time (TOT) through the unsaturated zone.

(1) Information required. Movement of water and solute through the unsaturated zone is dynamic and particularly sensitive to the physical properties of the soil. Because water will always move from areas of high pressure to areas of low pressure and because moisture content is a manifestation of soil pressure distribution, a complete description of

I. SCHEMATIC DIAGRAM

Provide a scale representation of the tank system site, showing dimensions of the downgradient zone of engineering control (A_{ED}) slope direction and magnitude (S), minimum distance (D_m), tank placement, tank volume (V_f), and all natural and artifical land covers or structures and approximate area covered by each.

II. VARIABLES FOR CALCULATIONS

A. Downgradient area of zone of engineering control (A_{ED} - m^2)
B. Volume of tank (m^3)
C. Maximum volume of fluid in tank (V_f - m^3; show calculation)
D. Waste depth penetration (D_p; show calculation)

$$D_p = V_f / A_{ED}$$

E. Maximum precipitation rate (cm/hr) during a 100-year rainstorm.
F. Slope (S; percent) - reference or method
G. Land use (complete table below)

Land Use Area	Percent of Total Land	C Value
a.		
b.		
c.		
d.		
e.		
f.		

H. Weighted runoff coefficient value C (show calculation)
I. Minimum distance (D_m; meters - convert to feet)
J. Overland flow travel time (TOT; show calculation)

$$TOT = 1.8(1.1-C)(D_m)^{1/2} / S^{1/3} \, *$$

K. Viscosity of waste

* If the viscosity of the waste is different from that of water, then a correction factor will need to be applied.

Figure 3-14 Checklist for Overland Flow Time Calculation

I. TYPE OF WASTE

(Information can be obtained from the Source and Tank Charactrzation sections of Variance - See Chapters 3.2 and 3.3)

A. Number of aboveground tanks in facility
B. Volume of tank (for tanks treated as a group, give volume of of largest tank)
C. Description of hazardous waste stored

1. Amount of solids, liquids and gas
2. Average viscosity of each liquid waste and density of each gas

II. CHARACTERISTIC OF LAND SURFACE

A. Describe soil characteristics within zone of engineering (ZOEC) control

1. Soil types
2. Soil surface conditions (compaction, vegetation, etc.)

B. Describe topographic features

1. Slope within the zone of engineering control
2. Provide topographic map of area showing extent of ZOEC and land features in and around ZOEC

III. OVERLAND FLOW TRAVEL TIME CALCULATION (SEE FIGURE 3-14)

IV. DIVERSION EFFECTS

A. Diagram showing
1. Tank system location,
2. The laterial extent of zone of engineering control,
3. Diversion structures,
4. Direction of slope (down gradient), and
5. Other man-made structures (roads, building, storm sewers, etc.)

B. Describe diversion system

1. Volume system can hold

2. Materials and/or soils used for the construction of the system

3. If spill control is dependent on travel time or the land surface characteristics, provide information and data to support the system and include calculations of TOT under worst case conditions.

4. Estimate release to ground water for all unlined areas that may be exposed to a spill event

Figure 3-15 Travel Time Format

the soil profile with accurate soil moisture content is indispensable for deriving accurate TOTs. Several other parameters will affect waste movement. These include, but are not limited to:

- Media type;
- Zone thickness;
- Makeup of the soil/sediment/rock column (media column);
- Saturated hydraulic conductivity of soil (K_S);
- Porosity/pore-size distribution;
- Soil moisture range (seasonally);
- Organic-carbon-water partition coefficient (K_{OC});
- Saturated hydraulic conductivity of chemical ($K_C H$);
- Density (chemical and water);
- Viscosity of water and chemical;
- Heterogeneities;
- Depth of seasonal high water table; and
- Fraction clay/organic carbon content in media (retardation factor).

The applicant must be able to provide this information so that EPA can evaluate the catastrophic release scenario (i.e., the entire tank volume is released instantaneously). It is only necessary to compute the velocity of a waste from a catastrophic release because EPA is interested in how soon the waste can reach the ground water. Waste velocity and TOT from a catastrophic release will generally be greater than from a corrosion release. Velocity prediction from a corrosion release is difficult to model because the initial leakage would be undetectable and the leakage rate could be highly variable. Modeling the corrosion release would require the pre-assignment of dimensions of the waste plume. These dimensions are sensitive to contaminant and soil specifics, and erroneous dimensions could invalidate the TOT equations.

The modeling procedure for the underground in-ground storage tank will be slightly different from that of the aboveground storage tank. To model a catastrophic release from an aboveground storage tank, the effects of overland flow must be computed. As the waste seeps into the subsurface, waste movement is by saturated or unsaturated flow. With saturated flow from catastrophic releases, the waste's travel will be limited only by the medium's characteristics (its hydraulic conductivity). Unsaturated flow occurs when the waste's movement is limited by air pockets within the media.

Only movements of liquid wastes should be modeled. Wastes that have high vapor pressures could volatilize and thereby reduce waste loading to the unsaturated zone. However, even on a site-specific basis, volitalization is difficult to quantify. Because the assumption of no volitalization will still give the same TOT (assuming saturated flow), volitalization processes and movements of vapors are considered to be insignificant. This is an admittedly conservative approach since volitalization will result in some loss, but is justified since the standard for granting a variance is equivalency to secondary containment.

(2) How data are to be used. To obtain all of the physical parameters needed to calculate TOT for the release scenarios, the applicant must:

- Perform initial hydrogeological analysis;
- Measure media properties by field analysis;
- Calculate either saturated or unsaturated flow; and
- Correct velocities (when appropriate) for viscosity, density, and retardation.

(a) Initial hydrogeological analysis. The character of a hydrogeologic setting from region to region can change rapidly. Therefore, each tank's unsaturated zone must be analyzed individually by a qualified hydrogeologist. This study should include stratigraphic and structural analyses, complete descriptions of each soil type and thickness, and depth of the high water table.

The hydrogeologist also must determine whether subsurface vertical flow is a valid assumption and whether heterogeneities (such as highly fractured sandstone layers or loosely packed material around pipes that can serve as a conduit for leaking fluids) exist that will accelerate waste velocity. The TOT to both the horizontal and vertical zones of engineering control must be calculated.

(b) Measurement of media parameters. To calculate TOT for catastrophic releases of hazardous wastes into the unsaturated zone field measurement of soil/sediment/rock properties is suggested.

Because spatial variability of soil types and moisture content are so high, description of solute movement in the unsaturated zone is complex. Using computer modeling of TOT shows the high dependency of TOT on soil type and degree of saturation (Table 3-5; Darcy's Velocities, Versar 1986). For example, solute in a 90 percent water saturated sand will travel more than 20 feet per day while solute in a 30 percent water saturated sand will travel less than 0.1 foot per day -- a difference of two orders of magnitude. The sand itself could have a wide range of saturated hydraulic conductivity. This is the measure of ease by which a medium transmits ground water. Figure 3-16 (Freeze & Cherry 1979) shows that hydraulic conductivities of sand alone span five orders of magnitude.

Thus, an acceptable portrayal of solute movement through the unsaturated zone necessitates procurement of field data -- select soil properties for each soil horizon.

The unsaturated zone is generally composed of many soil, sediments, and rock types. Thus, the hydraulic conductivity, water content, porosity, and pore size distribution must be measured for each media type. The hydraulic conductivities and water contents should be adjusted to represent the seasonal high conditions. For modeling of saturated flow, in the underground release scenario, it is only necessary to measure saturated hydraulic conductivities. Table 3-6 (Hern and Melancon 1986) lists the accepted locale of measurement and measurement method for these and other parameters.

If these properties cannot be measured for each soil, then a complete soil profile showing soil types and their thicknesses for the unsaturated zone of interest must be described in detail by the hydrogeologist. Then, using Figure 3-16 (Freeze and Cherry 1979) the highest hydraulic conductivity value for each soil will be selected. If moisture content cannot be measured for a particular soil horizon, then a moisture content of 100 percent is assumed. Along with these measured values, the equations described later in this section are used to estimate TOT.

(c) Saturated and unsaturated flow equations. A series of flow equations is shown in Table 3-7 (McWhorter and Nelson 1980). These have been developed to estimate TOT quantitatively. These flow equations fall into two categories, based on release rate into the unsaturated zone. These equations model unsaturated and saturated flow regimes and apply when:

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Table 3-5 Darcy's Velocity and Time to Ground Water for Various Degrees of Saturation

Degree of saturation	Ft/day V sand	Sand T days time to GW	Ft/day V silt sand	Silt sand T days time to GW	Ft/day V clay silt sand	Clay silt sand T days time to GW	Ft/day V high clay soil	High clay soil T days time to GW
Saturated	35	1.14	3.5	11.4	.35	114	.035	1140
90% sat.	23.45	1.7	2.345	17	.2345	170	.02395	1700
80% sat.	14.7	2.72	1.47	27.2	.147	272	.0147	2720
70% sat.	8.4	4.76	.84	47.6	.084	476	.0084	4760
60% sat.	4.38	9.1	.438	91	.0438	910	.00438	9100
50% sat.	1.82	22	.182	220	.0182	2200	.00182	22000
40% sat.	.546	73	.0546	730	.00546	7300	.00055	73000
30% sat.	.068	588	.0068	5880	.00068	58800	.00007	58800

Source: Versar 1986.

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Table 3-6 Methods of Measurement of Model Parameters or Soil Properties Relevant to Modeling and Validation

Parameter	Locale of measurement	Methodology
1. Static Soil Properties		
Porosity	Laboratory	Water content at zero suction on undisturbed cores
Bulk density	Laboratory	Coring into known volume or intact clod of soil
Particle size (% Sand, etc.)	Laboratory	Hydrometer or pipette method after sieving
Organic carbon	Laboratory	Walkley-Black chromic acid titration method
2. Water Transport and Retention Functions		
Saturated hydraulic conductivity	Field	Steady state infiltration while monitoring pressure head
	Field	Air entry permeameter
Matric potential-water content function	Laboratory	Hanging water table and pressure plate
	Field	Simultaneous tensiometer-neutron probe measurements
Unsaturated hydraulic conductivity	Field	Instantaneous profile method
	Field	Unit gradient methods
	Field	Air entry permeameter
3. Basic Chemical Properties		
Vapor pressure	Laboratory	Gas saturation
Octanol-water partition coefficient	Laboratory	Equilibration with octanol-water mix
4. Time Dependent Parameters Requiring Monitoring		
Water content	Field to laboratory	Gravimetric determination from soil core
	Field	Neutron probe
Solute concentration	Field	Solution samplers and soil cores
5. Soil Adsorption Parameters		
Distribution coefficient	Laboratory	Batch adsorption to equilibrium
Organic carbon partition coefficient	Derived	Ratio of distribution coefficient to organic carbon fraction

Source: Hern and Melancon 1986.

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Table 3-7 General Flow Equations Used to Determine Contaminant Flow in the Unsaturated Zone

---

Unsaturated Flow

$TOT_i = [(L/q)\ (n-\theta_r)(q/K)^{x/(2+3x)}]R_d$ (3-7.1)

$TOT = TOT_i + TOT_{i+1} + TOT_{i+2} + \ldots + TOT_{i+n}$ (3-7.2)

TOT_i = Travel time within a media layer
TOT = Travel time from bottom of tank to water table
L = Distance traveled by wetting front (i.e., distance between media layers)
q = Percolation rate (length/time)
n = Soil porosity (dimensionless)
θ_r = Water content below wetting front (dimensionless)
K = Hydraulic conductivity (length/time)
x = Pore size distribution index (dimensionless)
R_d = Retardation factor (dimensionless, see Equation 3-4)

Saturated Flow

$TOT = L/(K/n_e)$ (3-7.3)

TOT = Travel time
K = Hydraulic conductivity (length/time)
n_e = Effective porosity

Viscosity and Density Corrections

Kch = K(Dc/Dw)(Viw/Vic) (3-7.4)

Kch = Saturated hydraulic conductivity for chemical (length/time)
Dc = Density of chemical (gm/cm^3)
Dw = Density of water (gm/cm^3)
Viw = Viscosity of water
Vic = Viscosity of chemical
K = Hydraulic conductivity of soil (length/time)

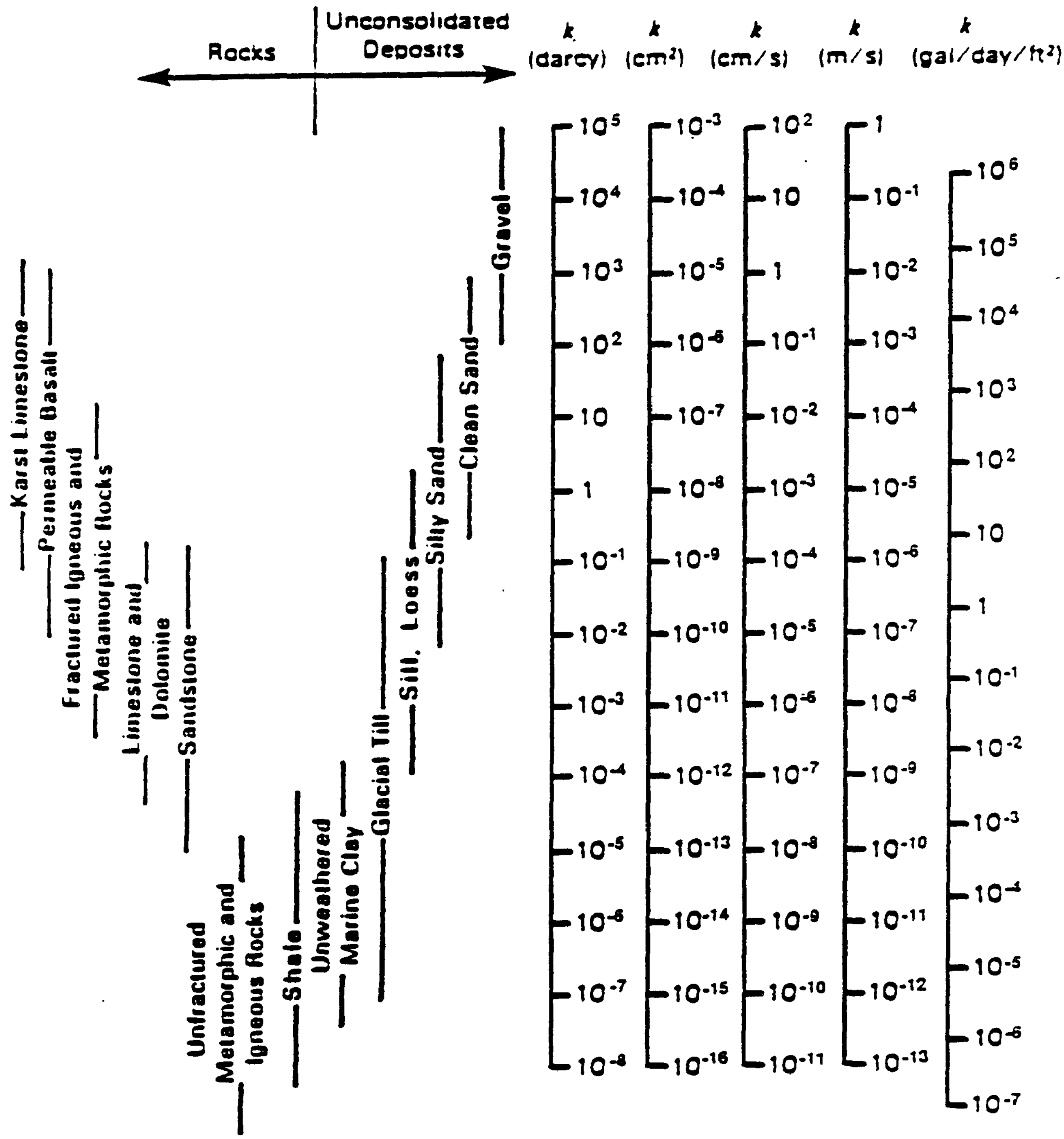
Retardation Factor

$R_d = 1.0 + (\rho/n)(Foc)(Koc)$ (3-7.5)

log Koc = 0.544 log Kow + 1.377 (3-7.6)

R_d = Retardation factor (dimensionless)
ρ = Bulk density (gm/cm^3)
n = Porosity of unsaturated zone materials (dimensionless)
Koc = Organic carbon-water partition coefficient for organic contaminant (cm^3/g)
Foc = Fractional organic carbon in the soil (dimensionless)
Kow = Octanol/water partition coefficient (dimensionless)

Source: McWhorter and Nelson, 1980.



Source: Freeze and Cherry, 1979

Figure 3-16 Range of Hydraulic Conductivities and Permeabilities

- The contaminant and interstitial water do not completely fill pore spaces (unsaturated flow corresponding to release from an aboveground tank system); and
- The contaminant and interstitial water completely fill pore spaces (saturated flow corresponding to release either from an underground or aboveground tank system).

These TOT equations are based on Darcy's flow equation and the physical properties of the subsurface media such as hydraulic conductivity and moisture content. These general flow equations grossly estimate contaminant travel times. Additional corrections to TOT, dependent on waste density, viscosity, and retardation ability, are described in a later part of this section. Thus, for each soil, sediment, or rock type of the unsaturated zone, TOT is calculated.

- Unsaturated Flow Equation

  The unsaturated flow equation may be applicable when determining TOT from aboveground catastrophic releases. Assuming one dimensional vertical flow of solute which travels as a function of the velocity of the interstitial pore waters, one can estimate TOT using Equation 3-3 (see Table 3-7, McWhorter and Nelson 1980):

$$TOT_i = [(L/q)(n-\theta_r)(q/K)^{x/(2+3x)}]R_d \tag{3-3}$$

  where

  TOT_i = Travel time within a medium layer
  L = Distance between medium layers
  q = Percolation rate (length/time)
  n = Soil porosity (dimensionless)
  θ_r = Water content below wetting front (dimensionless)
  K = Hydraulic conductivity (length/time)
  x = Pore-size distribution index (dimensionless)
  R_d = Retardation factor (dimensionless).

  There is a separate travel time calculated for each media type (TOT). Overall TOT, or travel time from the tank bottom to the ground-water table is simply the sum of these travel times (Equation 3-7.2, Table 3-7, McWhorter and Nelson 1980).

$$TOT = TOT_i + TOT_{i+1} + TOT_{i+2} + \ldots TOT_{i+n}$$

where

TOT = Travel time from tank bottom to ground-water table
TOT_i = Travel time within first layer
TOT_{i+1} = Travel time within second layer
TOT_{i+2} = Travel time within third layer
. . . = Travel time within successive layers

The parameters for porosity (n), medium water content (θ_r), hydraulic conductivity (K), and pore-size distribution index (x) need to be directly measured for each media type. The leakage rate or hydraulic loading rate "q" is a function of the area of the spill and volume of the tank. It may also include the volume that soaked into the ground. If "q" is higher than the saturated hydraulic conductivity of the most conductive layer, then Equation 3-7.3, Table 3-7, can be substituted above.

- Saturated Flow Equation

  If one-dimensional vertical flow is assumed, waste velocity from a catastrophic release of an underground tank will be solely a function of each medium's saturated hydraulic conductivity (Equation 3-7.3, Table 3-7). Only the hydraulic conductivity of each soil layer will determine waste velocity.

(d) Correction factors. Because physical/chemical conditions of the unsaturated zone media and physical/chemical conditions of wastes differ, modifications must be made to the general flow equations to enable better prediction of waste velocity. Some of the physical and chemical factors of the media that affect waste velocity are clay composition, particle size and sorting cation exchange capacity, organic matter content, root holes, macropores, soil water content, and bulk soil density. Among the properties of the waste that affect velocity are chemical density, viscosity, water solubility, precipitation and redeposition, solution composition and concentration, pH, and soil temperature.

Because the flow equations were developed assuming the moving liquid was water, there should be correction factors for each waste component to allow for property differences. For most of these factors, however, general equations or correction coefficients have not been developed because of the complexity of modeling the soil solution. Empirical relationships have been developed for: (1) viscosity and density differences, and (2) retardation capability.

Regardless of the TOT measurement approach, it may be necessary to correct the component velocity for differences in viscosity and density and effects of retardation. (See Chapter 3.3.1 to determine whether corrections are applicable for each component of the waste or whether average corrections will suffice.)

- Viscosity and Density Corrections

  TOT and velocity calculations have assumed so far that the chemical components of the waste travel with the velocity of interstitial pore water. If the waste's density and/or viscosity differ from that of water, then it may be necessary to adjust waste velocity to reflect the waste's own density and viscosity (see Chapter 3.3.1). Generally as waste density increases, its hydraulic conductivity increases and its velocity increases. Conversely, as waste viscosity increases, its hydraulic conductivity decreases and its velocity decreases.

  Velocity adjustments are simple component water density and viscosity ratios as formulated in Equation 3-7.4 (Table 3-7, McWhorter and Nelson 1980).

  $$Kch = K(Dc/Dw)(Viw/Vic)$$

  where

  Kch = Saturated hydraulic conductivity for chemical (length/time)
  K = Hydraulic conductivity (length/time)
  Dc = Density of chemical (gm/cc)
  Dw = Density of water (gm/cc)
  Viw = Viscosity of water
  Vic = Viscosity of chemical

  The Kch term in Equation 3-7.4 (the corrected hydraulic conductivity for density and viscosity) is used in lieu of K in Equations 3-3 and 3-7.3, Table 3-7.

- Retardation Capability

  Because of the conservative estimations used in these TOT calculations, retardation corrections are minor and need not be computed. However, for information purposes, a discussion follows on the potential effects of retardation.

Retardation is a decrease in the velocity of the solute due to the availability of soil sites for chemical adhesion. Clays and organic carbon are the most common retardants; however, because no definitive protocol has yet been developed for clays (Versar 1986), only retardation from carbon adsorption is discussed. Because retardation of the waste flow results in slower velocities and higher TOTs, it is not necessary to calculate for effects of retardation, though it may be in the applicant's interest to do so.

Hydrophobic (lacking strong affinity for water) or cationic (positively charged ions) chemical components, if migrating in a dilute plume, are subject to retardation. Because the technology-based variance does not allow for any material to reach the ground water, modeling retardation for concentrated plumes is not encouraged since some of the materials will get through without being retarded.

Retardation of organics is a mass balance process dependent upon the concentration gradient of the chemical component. The amount of chemical component absorbed onto the soil surface will be a function of the amount of organic carbon in the media (as organic carbon content increases, absorption increases) and the retardation factor, Rd, of that particular chemical (Equations 3-7.5 and 3-7.6, Table 3-7, McWhorter and Nelson 1980).

$$R_d = 1.0 + (\rho/n)(Foc)(Koc)$$

$$\text{Log Koc} = 0.544 \text{ Log Kow} + 1.377$$

where

R_d = Retardation factor (dimensionless)
ρ = Bulk density (gm/cc)
n = Porosity of unsaturated zone (dimensionless)
Koc = Organic carbon-water partition coefficient for organic contaminant (cm^3/g)
Foc = Fractional organic carbon in the soil (dimensionless)
Kow = Octanol/water partition coefficient (dimensionless).

The bulk density and total porosity of each medium can be measured, or representative values can be selected from the literature. If Koc, organic carbon-water partition coefficient, cannot be found in the literature for that particular component, then it can be calculated using the octanol water partition coefficient (Kow) (Equation 3-7.6, Table 3-7).

(3) Presentation of data. The checklists in Figure 3-17 provide the applicant with a recommended format to follow when assembling data.

3.8 Response Contingency Plan

A technology-based variance assumes by its very nature that the applicant will be able to control a release before it affects human health or the environment. To ensure that this is the case, the applicant will be required to develop and implement an emergency response contingency plan. This plan will be integrated into any other facility response plan (such as spill prevention, control, and countermeasure contingency plans required under the Clean Water Act). The emergency response plan will address the following areas:

- Overview discussion of the plan and company policy.
- Company responsibilities. Who in the company is responsible for what actions during a release?
- Alarm mechanisms. How a release will be detected and how its occurrence will be communicated to management.
- Response mechanism. What release scenarios are possible and what equipment and resources are available (onsite as well as from outside contractors) to deal with them. The plan must also discuss the means employed to obviate a response delay due to a holiday or weekend release.
- Safety Plan. Health and safety problems that may be encountered by responding personnel and what they should do to protect themselves.
- Disposal. Provisions that have been made to treat and/or dispose of contaminated materials.
- Training program. Programs that have been put in place or will be instituted that ensure personnel will react as predicted in this plan.
- Financial responsibilities. Costs associated with the worst-case situation and a showing that the company has the financial resources to cover it.

3.8.1 Preparation of Response Plan

(1) Information required. The following information will need to be obtained or developed before the plan can be written.

- For aboveground tank systems, a site topography map that will detail potential flow paths from the tank system to points offsite. Be sure in preparing this to take into account the full extent of the piping and ancillary equipment.
- A determination from subsurface investigation of what the zone of engineering control is and what the estimated travel time of a release through it will be. These should be readily available from Chapters 3.5 and 3.7 of the application.
- A list of all available onsite equipment or supplies that may be used for spill response and a list of any offsite contractors plus equipment/resources available from them and on what basis (i.e., immediate, within 48 hours, etc.).
- If a surface water may be affected, any vulnerable down-stream areas, identified on a topographic map and including phone numbers of responsible individuals listed (e.g., the phone number of a downstream water supply plant with a water intake on the river or lake).
- A list of disposal sites that will accept the materials from a spill cleanup.
- Plan for storage prior to disposal.
- A list of the costs for utilizing any offsite resources, including the probable cost of disposal of cleanup materials.

Additional details on what the plan must contain follow.

(a) Company Responsibilities. The applicant should develop a response team roster. The roster consists of a list of actions that need to be taken during a response and a description of the actions. It will describe in detail who, by job title, is responsible for various aspects of the response and what they are responsible for. It will lay out a notification and alert scheme to place the various assignments into a chain of command. A flow chart would be a useful adjunct to the text. An example of a partial roster would be as follows:

MEDIA TYPES						
1	2	3	4	5	ETC.	PROPERTIES
						ZONE THICKNESS
						HYDRAULIC CONDUCTIVITY of SOIL (K)
						SATURATED HYDRAULIC CONDUCTIVITY of CHEMICAL (K_{CH})
						POROSITY
						PORE-SIZE DISTRIBUTION
						SEASONAL SOIL-MOISTURE RANGE
						DEPTH of SEASONAL HIGH WATER TABLE
						ORGANIC CARBON-WATER PARTITION COEFFICIENT (K_{OC})
						OCTANOL-WATER PARTITION COEFFICIENT (K_{OW})
						DENSITY (CHEMICAL)
						DENSITY (WATER)
						VISCOSITY (CHEMICAL)
						VISCOSITY (WATER)
						FRACTION CLAY/ORGANIC CARBON CONTENT (K_{OC})
						HETEROGENEITIES
						MISCELLANEOUS SITE FACTORS
						METHODS of MEASUREMENTS
						METHODS of CALCULATION
						REFERENCES
						REMARK

Figure 3-17 Unsaturated Zone Properties Checklist

II. FULLY DESCRIBE THE UNSATURATED ZONE

III. GIVE JUSTIFICATION FOR USING EITHER SATURATED OR UNSATURATED FLOW EQUATION

IV. SHOW TOT CALCULATIONS (TOT = TIME OF TRAVEL)

V. SHOW ANY CORRECTIONS MADE TO TOT

VI. SHOW FINAL TOT, DEPTH TO MAXIMUM HEIGHT OF SEASONAL HIGH WATER TABLE AND ANTICIPATED CLEANUP TIME FROM A CATASTROPHIC RELEASE

Figure 3-17 Unsaturated Zone Properties Checklist (Continued)

- Top management
- Plant superintendent
- Cleanup operations supervisor
- Cleanup operations foreman
- Response team personnel, including any heavy equipment operators
- Techniques and materials evaluator
- Cleanup operations procurement and transportation officer
- Documentation officer
- Labor recruiter
- Government liaison officer

The roster will be more or less complex depending upon the size of the facility and the anticipated complexity of the operation.

The above descriptions for plant supervisory personnel will specifically delineate who is in charge of any offsite contractors that may be called onto the site to assist in cleanup. It is not necessary to have a different individual for each job as long as the duties are not such that they would require the person to be at two different places at once.

(b) Alarm Mechanisms. The plan should briefly describe any automatic alarm mechanisms that are to be employed for detecting leaks. It should describe in detail how personnel should respond to these alarm mechanisms, including the reaction to possible false positives, as well as the precise methods for determining whether a false positive exists. It should specifically delineate when and what process equipment, if any, will be shut down if an alarm sounds. The individual responsible for deciding whether a leak is occurring should be specifically named. There has to be an individual onsite with this responsibility for each shift.

The plan should describe the in-place system, manual or automatic, that will inform management if the alarm is not functioning because of either a malfunction or a power shut-off.

(c) Response Actions. Since this is an operational plan, descriptions of the plant site, underlying hydrology, and any vulnerable natural resources (such as an adjacent wetland) should be given. The units to be covered should be described and any expected logistical problems that may be encountered in emergency operations laid out. An example might be buried electrical cables.

As required by §§ 264.37, 265.37, 264.52(c), 265.52(c), and 264.194(c)(1), the tank system owner/operator is to include (or attempt to include) arrangements made with local authorities (police, fire departments, contractors, hospitals, and State/local response teams) in a contingency plan to a potential release. Other factors to consider in these arrangements are factors that may affect human health and safety. Tank systems may not always be located in remote areas. Physical structures such as schools, residential neighborhoods, roads/highways, recreational areas, businesses and hospitals may border or surround the tank system. The response plan should provide procedures to prevent or ensure as little disturbance as possible to these areas and their human community.

A detailed description of possible release scenarios and response actions should be given. Each scenario should contain a listing of the resources needed to contain and/or cleanup the release. From these descriptions, a master list of resource needs should be developed along with an identification of where these resources can be procured and the estimated time to do so. An example of the detail of such a list is given in Table 3-8. Equipment available and the requirements of the response action should be carefully compared to ensure compatibility. For example, if it is calculated that a release may penetrate as much as 40 feet into the subsurface, then a facility backhoe with a 20-foot reach will not be adequate, although a backhoe may be the appropriate piece of equipment to use.

Mobilization times should be developed for each scenario. These times should include not only equipment response time to the site, but also getting personnel to the site. The applicant must have a notification plan so that responses can be accomplished quickly during evenings, holidays, and weekends. This notification can include personnel being on call (or onsite 24 hours), carrying beepers, or having automatic dial-ups cued into the alarm mechanism. If there is no such notification plan, then this lack of personnel must be calculated into the release response time (see Chapter 3.9). These times must fall within the calculated travel time for the zone of engineering control. For example, if it will take one week to obtain heavy equipment from an offsite contractor and the travel time from a major release to ground water is less than a week, then this is not an acceptable response option.

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Table 3-8 Example of an Equipment List

Facility Resources

Building 1

30	18 in. sorbent rolls
70	1 ft. sq. bundles sorbent pads

Building 2

3	Dozen rubber rain gear
40	Boxes @ 100 per plastic bags
20	Flat spades
10	Wheelbarrows
200'	Sorbent boom
300'	Containment boom
10	Acid suits
10	Respirators with acid/organic vapor cartridges

Heavy Equipment

1	D-9 bulldozer
2	Backhoes (20-foot reach)
1	2,000-gallon vacuum truck

Outside Contractors

Joe's Jiffy Rent
200 Hard to Find Lane
Phone:

3	D-9 bulldozers
2	Cranes (40-ton lift capacity)
4	Backhoes (2 with 20-foot reach; two with 40-foot reach)
1	B-51 mobile drill rig
4	Graders
2	Front end loaders

Jack's Environmental
400 Long Way Road
Phone:

2	5,000-gallon vacuum trucks
1000'	Oil containment boom
500	Packages sorbent
2	14-foot motor boats
50	55-gallon overpack barrels

If an aboveground tank is involved, site maps should be developed that estimate flow direction and travel time. If there is the possibility that surface water may inadvertently be contaminated by failure to contain a release, then a specific set of scenarios should be developed to address this. Also, if surface water contamination is a possibility, then a notification procedure may be required by the Clean Water Act, CERCLA, and/or State law.

Adverse conditions due to weather should also be considered. This would include problems that may be encountered in the winter, such as frozen ground, or during the spring, such as heavy rain. The latter is of particular importance since this would not only make surface handling of contaminated materials especially difficult, but might also produce saturated flow in the unsaturated zone. This would lead to decreased travel time of the contaminant release to the ground water besides producing considerably more contaminated soil to contend with. In particular, the plan must address the response during a 25-year 24-hour rainfall, and a release from the largest tank in the facility, as discussed in Chapter 3.7.1.

(d) Safety. Since the material in the tank is hazardous by definition, the plan must address safety. The plan should address specific health hazards that may be expected to be encountered by specific personnel. It should describe what protective gear will be needed, what actions will be taken in the event of an accident, and what decontamination procedures may be required for both personnel and equipment. Any personnel whose function may require the use of special equipment, such as respirators, will need to be trained and certified in its use. The U.S. EPA Field Standard Operating Procedures for Preparation of a Site Safety Plan (USEPA 1985) provide general guidelines on the preparation of a safety plan.

(e) Disposal. Any release will produce a certain amount of contaminated materials. The plan should discuss what will be done with these materials and when. For example, if the facility has the means to treat or decontaminate soil on site, then the plan must specify where the soil will be stored until it can be treated and how this area will be protected from the elements. If the soil and/or any liquids cannot be handled on site, the plan must specify where and how they will be shipped. Note that a treatment/disposal facility that accepts liquid wastes may or may not accept contaminated soils; therefore, the acceptability of the waste should be verified and alternatives identified. Also, the question of how the facility intends to differentiate between "contaminated" and "uncontaminated" materials should be addressed.

(f) Training. The contingency plan should delineate the training needs of facility personnel and how these will be met. One such need was previously identified: that of personal safety and the use of safety equipment. Another might be the use of response equipment. Also, the plan should provide for regularly scheduled drills so that the employees will become familiar with their response duties. The regularity of these drills and the amount of staff participation will depend directly upon how much reliance is placed by management on facility resources, how vulnerable subsurface and/or offsite water resources are, and how much dependence is placed on outside contractors.

(g) Financial. In developing the various response and disposal scenarios, the applicant should estimate the out-of-pocket costs of each and prepare a discussion of his/her ability to meet them should the need arise. These costs would include:

- Cost of disposable gear (acid suits, absorbents, gloves, etc.);
- Cost of outside contractors (heavy equipment rental and operators);
- Cost of overtime for facility personnel;
- Cost of disposal of spoils; and
- Income loss due to production equipment shutdown, if applicable.

(2) <u>How data are to be used</u>. The emergency response contingency plan is a crucial factor in EPA's evaluation of the applicant's ability to control a release. Therefore, it is essential that the plan be sufficiently specific, detailed, and comprehensive to guide facility employees through an actual crisis. EPA will review the plan to ensure that it supports estimates of response and remediation times. These times are a critical part of the final analysis described in Section 3.9. Data presented in the plan must be convincing and technically and scientifically sound. Failure to provide adequate support for remediation and response times will result either in the application's being deemed incomplete or denial of the variance.

(3) <u>Presentation of data</u>. Figure 3-18 outlines a recommended format for the response plan. The applicant is not restricted to this format and should not hesitate to expand it if necessary.

3.8.2 Submittal of Response Plan

The response plan must be submitted as part of the variance application. Actual employee manuals are not a necessary part of this submittal, but may be included as an appendix to the application. Also, existing plans that are required under different programs (e.g., SPCC) can be submitted as appendices.

3.9 Demonstrate Adequacy of Detection and Remedial Action

The previous sections of this chapter have focused on tank system design, the zone of engineering control, leak detection devices, time of detection, response time, waste travel time, and remedial time. In this section, these elements are used to perform the final and most critical portion of the technology-based variance demonstration: whether remedial measures can be implemented and completed prior to the waste releases' migrating beyond the zone of engineering control. Failure to demonstrate this adequately would result in a denial of the variance application.

3.9.1 Preparation of Demonstration

(1) Information required. Some of the information required for this analysis has already been provided in order to complete the earlier analyses in this chapter. Other information will be obtained from having completed the various analyses. Cross-references to the corresponding sections in which such information is to be derived are provided in the list below.

- Zone of Engineering Control (See Chapter 3.5)

  Chapter 3.5 provides information on how the zone of engineering control is to be defined. Vertical and horizontal distances that define the zone of engineering control must be submitted for this analysis, accompanied by a diagram drawn to scale. The diagram should show neighboring properties and the location of conduits of lower porosity soils.

- Leak Detection Time (See Chapter 3.6)

  The leak detection time of the monitoring system is required for the analysis described in Chapter 3.6, and also draws upon information provided for the analysis in Chapter 3.2. There are two components to leak detection time. The first, and most significant, is related to the failure characteristics of the tank and the lower limit of leak detection of the monitoring device.

I. LIST OF PERSONNEL TO BE CONTACTED IN THE EVENT OF A RELEASE

II. OVERVIEW OF PLAN

III. COMPANY RESPONSIBILITIES – List what needs to be done and who will do it.

IV. DESCRIPTION OF ALARM MECHANISMS – Detail sequence of events if an alarm sounds.

V. DESCRIPTION OF RESPONSE ACTIONS – Describe plant layout, underlying hydrology, resources to be protected and expected logistical problems and their solution. This section should also include onsite and offsite response resources. Include actions and arrangements made with local authorities to eliminate or reduce human health and safety problems.

VI. SAFETY PLAN – Identify expected hazards to response personnel and measures to be taken to mitigate them.

VII. DISPOSAL OPTIONS – Identify how and who will treat/dispose of hazardous materials (soils etc.) created by a release.

VIII. TRAINING – List personnel assigned to response, skills needed for response and training provided to ensure these skills are obtained.

IX. FINANCIAL – Estimate costs of response to catastrophic release and available resources to meet them.

Figure 3-18 Format for Release Response Plan

Owners/operators of tank systems for which there is a potential for corrosion leaks to occur must provide information on the time delay required for a leak to grow to the point at which the rate of leakage is large enough to be detected by the monitoring system.

The second component of leak detection time is the time that the released material takes to travel from the failure point to the detector.

- Time of Travel of Released Material (See Chapter 3.7)

  Chapter 3.7 provides information on how the "release migration time" is calculated. "Release migration time" is the shortest time for the released material to migrate from the tank system to the boundary of the zone of engineering control. Depending on what is the shortest travel time, a horizontal or vertical time of travel may be required. The vertical time of travel is calculated based on the time for releases to reach the lower boundary of the zone of engineering control. The horizontal time of travel can be either the time for overland flow to the horizontal boundary of the zone of engineering control or the time for releases to migrate horizontally through a less permeable layer of the unsaturated zone to the boundary of the zone of engineering control.

- Release Response Time (See Chapter 3.8)

  Release response time is derived from the analysis to be completed in Chapter 3.8. The release response time is the sum of (1) the time between the alarm detecting the leak and human response to the alarm; (2) the time required to mobilize the equipment and personnel necessary to conduct the release response; and (3) the time required to effect the remediation.

  In calculating release response time, applicants must take into account time lost for absence of personnel during weekends, evenings, and holidays. For example, if a release occurs on a Saturday and no one is available to respond to an alarm until Monday, 48 hours must be included in calculating human response time. If personnel are available, the response plan discussed in Chapter 3.8 should include details on how personnel are notified and the approximate time delays that may occur during these periods.

(2) How data are to be used. The basic premise of the technology-based variance is that complete protection of ground water and surface water can be provided by means other than secondary containment. The purpose of this analysis is to demonstrate that releases from the subject tank system can be detected and excavated or decontaminated in sufficient time to prevent migration to the ground water or surface water. The fundamental consideration, therefore, is whether the shortest time for the release to travel to the boundary of the zone of engineering control is longer than the time required for detection and remedial measures.

The demonstration is made by first calculating the time for detection and remedial measures. This is done by (1) summing the two components of leak detection time, (2) summing the three components of release response time, and (3) summing leak detection time and release response time. The total time is then compared to the shortest time of travel. The demonstration is adequate if the shortest time of travel is longer than the sum of leak detection time and release response time.

The demonstration will be considered to be inadequate if (1) it can be shown that the shortest time of travel is less than the time for detection and remedial action or (2) there is sufficient reason to believe that undetected releases may migrate beyond the zone of engineering control.

(3) Presentation of data. Figure 3-19 provides a format for presentation of the data required for this section. This is not a "form"; rather, it is a format to guide the presentation of the data so that there will be consistency in the variance applications. The size of the sections will vary, but they should be presented in the order shown.

3.9.2 Submittal of Variance Application

The above analysis is a critical part of the variance application and should tie together the analyses that are completed in the other parts of the application. This portion of the analysis is the final demonstration, or "proof" that the alternative technology or operating design can prevent releases from migrating to ground water or surface water at least as effectively as secondary containment. The burden of proof for this analysis is on the applicant, and the request for a variance will be denied if the alternative technology or operating design is not proven to be as effective as secondary containment.

I. ZONE OF ENGINEERING CONTROL

Based on information in Parts V, VII and VIII of the variance application, submit diagram drawn to scale showing vertical and horizontal distances which define the zone of engineering control.

II. LEAK DETECTION TIME

A. Identify lower limit of leak detection of monitoring device
B. Assess time delay required for leaks to reach threshold detection limits
C. Specify time required for released material to reach detector

III. TIME OF TRAVEL OF RELEASED MATERIAL

Based on information derived from Part VII of the variance application, provide the shortest time for the released material to migrate from the tank system to the boundary of the zone of engineering control.

IV. RELEASE REPONSE TIME

A. Human response to the alarm

Derived from information provided in Part VIII of the variance application; include time lost due to releases over weekends, evenings, or holidays, if personnel not available or slower to respond at such times. (For example, if personnel are not able to respond until Monday to an alarm on a Saturday, 48 hours should be added to the response time.)

B. Identify time required to mobilize equipment and personnel

C. Identify time required for remediation

V. COMPARISON OF RELEASE RESPONSE TIME TO TIME OF TRAVEL

Describe why the total time to respond to the release, inclusive of remediation, will be less than the time required for the release to migrate beyond the zone of engineering control.

Figure 3-19 Format and Contents of Demonstration of Sufficiency of Detection and Response Times

4.0 REFERENCES

American Petroleum Institute (API). 1986. Cathodic protection of underground petroleum storage tanks and piping systems. Publication 1632. 2nd ed. Washington, D.C.: American Petroleum Institute.

Eklund, B., et al. 1986. Guidance document for developing performance standards and certification procedures for out-of-tank petroleum leak detection devices; Phase I Draft report for vendor survey. Radian Corp. EPA Contract No. 68-02-3994. U.S. Environmental Protection Agency: Environmental Monitoring Systems Laboratory. June 1986.

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Marrin, D.L. 1985. Delineation of gasoline hydrocarbons in groundwater by soil gas analysis. In Proceedings of the 1985 hazardous materials west conference.

Marrin, D.L. and Thompson, G.M. 1984. Remote detection of volatile organic contaminants in groundwater via shallow gas sampling. In Proceedings of the petroleum hydrocarbons and organic chemicals in groundwater conference.

McWhorter, D.B., and Nelson, J.D. 1980. Seepage in the partially saturated zone beneath tailings impoundments. Mining Engineering, pp. 432-439. April.

National Association of Corrosion Engineers, (NACE). 1985. Recommended practice-control of external corrosion on underground or submerged metallic piping systems. NACE Standard RP-01-69. Houston, Texas: National Association of Corrosion "ngineers. January 1972.

Spittler, T.M. 1985. Field measurement of PCB's in soil and sediment using a portable gas chromatograph. Sampling and Monitoring, pp. 105-107.

USEPA. 1983. Vadose zone monitoring for hazardous waste sites. Kaman Tempo. U.S. Environmental Protection Agency, Office of Research and Development. EPA Report No. KT-82-018(R). Las Vegas, Nevada: U.S. Environmental Protection Agency.

USEPA. 1985. Field standard operating procedures for preparation of a site safety plan. F.S.O.P. 9. Washington, D.C.: U.S. Environmental Protection Agency, Office of Emergency and Remedial Response, Hazardous Response Support Division.

Versar. 1986. Methodology for determining sources of ground-water contamination. Draft report. Washington, D.C.: U.S. Environmental Protection Agency, Office of Toxic Substances, Exposure Assessment Branch.

APPENDIX A

Information Sources for Environmental and Hydrogeologic Information

APPENDIX A

Information Sources for Environmental and Hydrogeologic Information

Federal Agencies

U.S. Environmental Protection Agency, Headquarters (U.S. EPA)
--Office of Water Enforcement and Permits
--Office of Water Regulation and Standards
--Office of Water Programs Operations
--Office of Drinking Water
--Office of Ground-Water Protection
401 M Street, S.W.
Washington, DC 20460
(202) 755-9112

U.S. Geological Survey (U.S.G.S.)
Water Resources Scientific Information Center
425 National Center
Reston, VA 22902
(703) 860-7455

U.S. Department of Agriculture (U.S.D.A.)
--Agricultural Extension Service
--Soil Conservation Service
Washington, DC 20250
(202) 447-2791

Regional EPA Offices

Region I
Water Management Division
John F. Kennedy Federal Building
Boston, MA 02203
(617) 223-7210

Region II
Water Management Division
26 Federal Plaza
New York, NY 10278
(212) 264-2525

Region III
Water Management Divi_ion
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-9800

Region IV
Water Management Division
345 Courtland Street, NE
Atlanta, Georgia 30365
(404) 881-4727

Region V
Water Division
230 South Dearborn Street
Chicago, IL 60604
(312) 353-2000

Region VI
Water Management Division
1201 Elm Street
Chicago, IL 60604
(312) 353-2000

Regional EPA Offices (cont'd)

Region VII
Water Management Division
726 Minnesota Avenue
Kansas City, KS 66101
(913) 236-2800

Region VIII
Water Management Division
726 Minnesota Avenue
Kansas City, KS 66101
(303) 293-1603

Region IX
Water Management Division
215 Fremont Street
San Francisco, CA 94105
(415) 974-8071

Region X
Water Division
1200 Sixth Avenue
Seattle, WA 98101
(206) 442-5810

Federal and State Agency Contacts

Alabama

Department of Public Health
Environmental Health Administration
Public Water Supply Division
Montgomery, AL 36130

Water Improvement Commission
749 State Office Building
Montgomery, AL 36130

U.S. Geological Survey
Water Resources Division
University of Alabama
Oil & Gas Bldg - Room 202
P. O. Box V
Tuscaloosa, AL 35486
FTS-229-2957 (205) 752-8104

Geological Survey of Alabama
P. O. Drawer 0
University, AL 35486
(205) 349-2852

U.S. Soil Conservation Service
State Conservation Office
Wright Building
138 South Gay Street
P. O. Box 311
Auburn, AL 36830
FTS-534-4535
(202) 821-8070

Federal and State Agency Contacts (cont'd)

Alaska

Water Quality and Environmental Sanitation Division
Alaska Department of Environmental Conservation
Pouch O
Juneau, AK 99811

Division of Forest, Land and Water Management
Alaska Department of Natural Resources
323 East Fourth
Anchorage, AK 99501

Alaska Division of Geology and Geophysical Surveys
3001 Porcupine Drive
Anchorage, AK 99501
(907) 279-1433

U.S. Soil Conservation Service
State Conservation Office
Suite 129, Professional Building
2221 E. Northern Lights Boulevard
Anchorage, AK 99504
(907) 276-4246 (FTS & CML)

U.S. Geological Survey
Water Resources Division
218 E. Street
Anchorage, AK 99501
FTS-399-0150
(907) 271-4138

Arizona

Planning Division
Arizona Department of Water Resources
222 North Central, Suite 850
Phoenix, AZ 85004

Larry D. Fellows
Arizona Bureau of Geology and Mineral Technology
Geological Survey Branch
845 N. Park Avenue
Tucson, AZ 85719
(602) 626-2733

Federal and State Agency Contacts (cont'd)

U.S. Soil Conservation Service
State Conservation Office
230 N. 1st Avenue
3008 Federal Building
Phoenix, AZ 85025
(602) 261-6711 (FTS & CML)

U.S. Geological Survey
Water Resources Division
Federal Building
301 W. Congress Street
Tucson, AZ 85701
FTS-762-6671
(602) 792-6671

Arkansas

Soil and Water Conservation Commission
Arkansas Department of Commerce
818 West Capital Avenue, Building A
Little Rock, AR 72202

Arkansas Geological Commission
Vardelle Parham Geological Center
3815 W. Roosevelt Road
Little Rock, AR 72204
(501) 371-1488

U.S. Soil Conservation Service
State Conservation Office
Federal Building, Room 5029
700 West Capitol Street
P. O. Box 2323
Little Rock, AR 72203
FTS-740-5445
(501) 378-5445

U.S. Geological Survey
Water Resources Division
Federal Office Bldg-Room 2301
700 West Capitol Avenue
Little Rock, AR 72201
FTS-740-6391
(501) 378-6391

Federal and State Agency Contacts (cont'd)

California

California Department of Water Resources
P. O. Box 388
Sacramento, CA 95802

California Division of Mines & Geology
California Department of Conservation
1416 9th St., Room 1341
Sacramento, CA 95814
(916) 445-1923

U.S. Soil Conservation Service
State Conservation Office
2828 Chiles Road
Davis, CA 95616
(916) 758-2200 ext. 210 (FTS & CML)

U.S. Geological Survey
Water Resources Division
855 Oak Grove Avenue
Menlo Part, CA 94025
FTS-467-2326
(415) 323-8111

Colorado

Colorado Water Resources Division
Department of Natural Resources
1313 Sherman Street
Room 818
Denver, CO 80203

Colorado Water Quality Division
Department of Health
4210 East 11th Avenue
Denver, CO 80220

Colorado Geological Survey
1313 Sherman St., Room 715
Denver, CO 80203
(303) 839-2611

Federal and State Agency Contacts (cont'd)

U.S. Soil Conservation Service
Sate Conservation Office
2490 W. 26th Avenue
P. O. Box 17107
Denver, CO 80217
FTS-327-4275
(303) 837-4275

U.S. Geological Survey
Water Resources Division
Building 53
Denver Federal Center
Lakewood, CO 80225
FTS-234-5092
(303) 234-5092

Connecticut

Connecticut Natural Resources Center
Department of Environmental Protection
State Office Bulding, Room 553
Hartford, CT 06115

Connecticut Geological & Natural History Survey
State Office Building, Room 553
165 Capitol Avenue
Hartford, CT 06115
(203) 566-3540

U.S. Soil Conservation Service
State Conservation Office
Mansfield Professional Park
Route 44A
Storrs, CT 06268
FTS-244-2547/2548
(203) 429-9361/9362

U.S. Geological Survey
Water Resources Division
135 High Street - Room 235
Hartford, CT 06103
FTS-244-2528
(203) 244-2528

Federal and State Agency Contacts (cont'd)

Delaware

Delaware Department of Natural Resources and Environmental Control
Water Supply Branch
Edward Tatnall Building
P. O. Box 1401
Dover, DE 19901

Delaware Geological Survey
University of Delaware
Newark, DE 19711
(302) 738-2833

U.S. Soil Conservation Service
State Conservation Office
Treadway Towers, Suite 2-4
9 East Loockerman Street
FTS-487-5148
(302) 678-0750

U.S. Geological Survey
Water Resources Division
Subdistrict-Dist. Office/MD
Federal Building - Room 1201
Dover, DE 19901
FTS-487-9128
(302) 734-2506

Florida

Florida Department of Environmental Regulation
Division of Environmental Programs
Groundwater Section
2600 Blair Stone Road
Tallahassee, FL 32301

Florida Bureau of Geology
903 W. Tennessee St.
Tallahassee, FL 32304
(904) 488-4191

Federal and State Agency Contacts (cont'd)

U.S. Soil Conservation Service
State Conservation Office
Federal Building
P. O. Box 1208
Gainesville, FL 32602
FTS-946-3871, ext. 100
(904) 377-8732

U.S. Geological Survey
Water Resources Division
325 John Knox Rd-Suite F-240
Tallahassee, FL 32303
FTS-946-4251
(904) 386-1118

Georgia

Georgia Department of Natural Resources
Water Protection Branch
270 Washington Street, N.W.
Atlanta, GA 30334

Georgia Department of Natural Resources
Environmental Protection Division
Geological Survey and Water Resources Section
270 Washington Street, S.W.
Atlanta, GA 30334

Georgia Department of Natural Resources
Geological & Water Resources Division
19 Dr. Martin Luther King, Jr. Drive, S.W.
Atlanta, GA
(404) 656-3214

Soil Conservation Service
State Conservation Office
Federal Building
355 E. Hancock Avenue
P. O. Box 832
Athens, GA 30603
FTS-250-2275
(404) 546-2274

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U.S. Geological Survey
Water Resources Division
Suite B
6481 Peach Tree, Indust. Blvd
Doraville, GA 30360
FTS-242-4858
(404) 221-4858

Hawaii

Hawaii Division of Water and Land Development
Department of Land and Natural Resources
P. O. Box 373
Honolulu, HI 96809
(808) 548-7533

U.S. Soil Conservation Service
State Conservation Office
300 Ala Moana Blvd.
Room 4316
P. O. Box 5004
Honolulu, HI 96850
(808) 546-3165 (FTS & CML)

U.S. Geological Survey
Water Resources Division
P. O. Box 50166
300 Ala Moana Blvd-Rm 6110
Honolulu, HI 96850
FTS-556-0220
(808) 546-8331

Idaho

Idaho Department of Water Resources
State House
Boise, ID 83720

Idaho Bureau of Mines & Geology
Moscow, ID 83843
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U.S. Soil Conservation Service
State Conservation Office
304 North 8th Street, Room 345
Boise, ID 83702
FTS-554-1601
(208) 384-1601 ext. 1601

U.S. Geological Survey
Water Resources Division
P. O. Box 2230
Idaho Falls, ID 83401
FTS-583-2438
(208) 526-2438

Illinois

Illinois Environmental Protection Agency
Public Water Supply Division
2200 Churchill Road
Springfield, IL 62706

Illinois State Water Survey
605 E. Springfield Avenue
P. O. Box 5050, Station A
Champaign, IL 61820

Illinois State Geological Survey
121 Natural Resources Building
Urbana, IL 61801
(217) 333-5111

U.S. Soil Conservation Service
State Conservation Office
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200 W. Church Street
P. O. Box 678
Champaign, Illinois 61820
FTS-958-5271
(217) 356-3785

U.S. Geological Survey
Water Resources Division
P. O. Box 1026
605 N. Nek Street
Champaign, Illinois 61820
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Indiana

Indiana Department of Natural Resources
Division of Water
608 State Office Building
Indianapolis, IN 46204

Environmental Health
Indiana State Board of Health
1330 W. Michigan Street
Indianapolis, IN 46206

Department of Natural Resources
Indiana Geological Survey
611 North Walnut Grove
Bloomington, IN 47401
(812) 337-2862

U.S. Soil Conservation Service
State Conservation Office
Atkinson Square-West Suite 2200
5610 Crawfordsville Road
Indianapolis, IN 46224
FTS-331-6515
(317) 269-3785

U.S. Geological Survey
Water Resources Division
1819 North Meridan Street
Indianapolis, IN 46202
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(317) 269-7101

Iowa

Iowa Natural Resources Council
Wallace State Office Building
East 9th and Grand
Des Moines, IA 50319

Iowa Department of Environmental Quality
Division of Water Supply
Wallace State Office Building
East 9th and Grand
Des Moines, IA 50319

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123 N. Capitol
Iowa City, IA 52242
(319) 338-1173

U.S. Soil Conservation Service
State Conservation Office
693 Federal Building
210 Walnut Street
Des Moines, IA 50309
(515) 862-4260 (FTS & CML)

U.S. Geological Survey
Water Resources Division
Federal Building - Rm 269
P. O. Box 1230
Iowa City, IA 52244
FTS-863-6521
(319) 337-4191

Kansas

Kansas Oil Field and Environmental Geology
Department of Health and Environment
Topeka, KS 66620

State Geological Survey of Kansas
Raymond C. Moore Hall
1930 Ave. A, Campus West
Lawrence, KS 66044
(913) 864-3965

U.S. Soil Conservation Service
State Conservation Office
760 South Broadway
P. O. Box 600
Salina, KS 67401
FTS-752-4753
(913) 825-9535

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Water Resources Division
University of Kansas
Campus West
1950 Avenue A
Lawrence, KS 66045
FTS-752-2300
(913) 864-4321

Kentucky

Kentucky Division of Water Resources
Department for Natural Resources and Environmental Protection
950 Leestown Road
Frankfort, KY 40601

Kentucky Division of Water Quality
Department for Natural Resources and Environmental Protection
Capital Plaza Tower, Fifth Floor
Frankfort, KY 40601

Kentucky Geological Survey
University of Kentucky
311 Breckinridge Hall
Lexington, KY 40506
(606) 622-3720

U.S. Soil Conservation Service
State Conservation Office
333 Waller Avenue
Lexington, KY 40504
FTS-355-2749
(606) 233-2749 ext. 2749

U.S. Geological Survey
Water Resources Division
Federal Building - Room 572
600 Federal Place
Louisville, KY 40202
FTS-352-5241
(502) 582-5241

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Louisiana

Office of Public Works
Louisiana Department of Transportation and Development
1201 Capital Access Road
Baton Rouge, LA 70804

Louisiana Geological Survey
Box G. University Station
Baton Rouge, LA 70893
(504) 342-6754

U.S. Soil Conservation Service
State Conservation Office
3737 Government Street
P. O. Box 1630
Alexandria, LA 71301
FTS-497-6611
(318) 448-3421

U.S. Geological Survey
Water Resources Division
6554 Florida Boulevard
Baton Rouge, LA 70896
FTS-687-0281
(504) 389-0281

Maine

Maine Office of Legislative Assistants
State Capital
Augusta, ME 04333

Maine Geological Survey
State Office Bldg., Room 211
Augusta, ME 04330
(207) 289-2801

U.S. Soil Conservation Service
State Conservation Office
USDA Building
University of Maine
Orono, ME 04473
FTS-833-7393
(207) 866-2132/2133

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U.S. Geological Survey
Water Resources Division
(District Office in Mass.)
26 Ganneston Drive
Augusta, ME 04330
FTS-833-6411
(207) 623-4797

<u>Maryland</u>

Division of Water Supply
Maryland Department of Health and Mental Hygiene
201 W. Preston Street
O'Connor Building
Baltimore, MD 21201

Water Resources Administration
Maryland Department of Natural Resources
Tawes State Office Building
580 Taylor Avenue
Annapolis, MD 21401

Maryland Geological Survey
Merryman Hall
Johns Hopkins University
Baltimore, MD 21218
(301) 235-0771

U.S. Soil Conservation Service
State Conservation Office
Room 522, Hartwick Building
4321 Hartwick Road
College Park, MD 20740
(301) 344-4180 (FTS & CML)

U.S. Geological Survey
Water Resources Division
208 Carroll Building
8600 Lasalle Road
Towson, MD 21204
FTS-922-3311
(301) 828-1535

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Massachusetts

Massachusetts Department of Environmental Management
Water Resources Division
100 Cambridge Street
Boston, MA 02202

Water Resources Commission
Massachusetts Department of Environmental Management
100 Cambridge Street
Boston, MA 02202

Massachusetts Department of Environmental Quality Engineering
Division of Waterways - Room 532
100 Nashua Street
Boston, MA 02114
(617) 727-4793

U.S. Soil Conservation Service
State Conservation Office
29 Cottage Street
Amherst, MA 01002
(413) 549-0650 (FTS & CML)

U.S. Geological Survey
Water Resources Division
150 Causeway St., Suite 1001
Boston, MA 02114
FTS-232-2822
(617) 223-2822

Michigan

Water Quality Division
Michigan Department of Natural Resources
P. O. Box 30028
Lansing, MI 48909

Michigan Department of Natural Resources
Geological Survey Division
P. O. Box 30028
Lansing, MI 48909
(517) 373-1256

Federal and State Agency Contacts (cont'd)

Michigan Department of Public Health
Water Supply Division
3500 N. Logan
P. O. Box 30035
Lansing, MI 48909

U.S. Soil Conservation Service
State Conservation Office
1406 South Harrison Road
Room 101
East Lansing, MI 48823
FTS-374-4242
(517) 372-1910 ext. 242

U.S. Geological Survey
Water Resources Division
6520 Mercantiel Way - Suite 5
Lansing, MI 48910
FTS-374-1561
(517) 372-1910

Minnesota

Minnesota Department of Natural Resources
Water Division
300 Centennial Building
St. Paul, MN 55155

Minnesota Pollution Control Agency
1935 West County Road, B-2
Roseville, MN 55113

Minnesota Health Department
717 Delaware Street, N.E.
Minneapolis, MN 55440

Minnesota Geological Survey
1633 Eustis Street
St. Paul, MN 55108
(612) 373-3372

Federal and State Agency Contacts (cont'd)

U.S. Soil Conservation Service
State Conservation Office
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APPENDIX B

Full Text of July 14, 1986, Standards
for Hazardous Waste Storage and Treatment
Tank Systems and Generators and
August 15, 1986, Corrections

(51 FR 25471-25486)

(51 FR 29430-29431)

1. The authority citation for Part 260 is revised to read as follows:

Authority: Secs. 1006, 2002(a), 3001 through 3007, 3010, 3014, 3015, 3017, 3018, and 3019 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6905, 6912(a), 6921 through 6927, 6930, 6934, 6935, 6937, 6938, and 6939).

2. Section 260.10 is amended by adding the following terms and definitions in alphabetical order:

§ 260.10 Definitions.

* * * * *

"Aboveground tank" means a device meeting the definition of "tank" in § 260.10 and that is situated in such a way that the entire surface area of the tank is completely above the plane of the adjacent surrounding surface and the entire surface area of the tank (including the tank bottom) is able to be visually inspected.

* * * * *

"Ancillary equipment" means any device including, but not limited to, such devices as piping, fittings, flanges, valves, and pumps, that is used to distribute, meter, or control the flow of hazardous waste from its point of generation to a storage or treatment tank(s), between hazardous waste storage and treatment tanks to a point of disposal onsite, or to a point of shipment for disposal off-site.

* * * * *

"Component" means either the tank or ancillary equipment of a tank system.

* * * * *

"Corrosion expert" means a person who, by reason of his knowledge of the physical sciences and the principles of engineering and mathematics, acquired by a professional education and related practical experience, is qualified to engage in the practice of corrosion control on buried or submerged metal piping systems and metal tanks. Such a person must be certified as being qualified by the National Association of Corrosion Engineers (NACE) or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control on buried or submerged metal piping systems and metal tanks.

* * * * *

"Existing tank system" or "existing component" means a tank system or component that is used for the storage or treatment of hazardous waste and that is in operation, or for which installation has commenced on or prior to July 14, 1986. Installation will be considered to have commenced if the owner or operator has obtained all Federal, State, and local approvals or permits necessary to begin physical construction of the site or installation of the tank system and if either (1) a continuous on-site physical construction or installation program has begun, or (2) the owner or operator has entered into contractual obligations—which cannot be canceled or modified without substantial loss—for physical construction of the site or installation of the tank system to be completed within a reasonable time.

* * * * *

"Inground tank" means a device meeting the definition of "tank" in § 260.10 whereby a portion of the tank wall is situated to any degree within the ground, thereby preventing visual inspection of that external surface area of the tank that is in the ground.

* * * * *

"Installation inspector" means a person who, by reason of his knowledge of the physical sciences and the principles of engineering, acquired by a professional education and related practical experience, is qualified to supervise the installation of tank systems.

* * * * *

"Leak-detection system" means a system capable of detecting the failure of either the primary or secondary containment structure or the presence of a release of hazardous waste or accumulated liquid in the secondary containment structure. Such a system must employ operational controls (e.g., daily visual inspections for releases into the secondary containment system of aboveground tanks) or consist of an interstitial monitoring device designed to detect continuously and automatically the failure of the primary or secondary containment structure or the presence of a release of hazardous waste into the secondary containment structure.

* * * * *

"New tank system" or "new tank component" means a tank system or component that will be used for the storage or treatment of hazardous waste and for which installation has commenced after July 14, 1986; except, however, for purposes of § 264.193(g)(2) and § 265.193(g)(2), a new tank system is one for which construction commences after July 14, 1986. (See also "existing tank system.")

* * * * *

"Onground tank" means a device meeting the definition of "tank" in § 260.10 and that is situated in such a way that the bottom of the tank is on the same level as the adjacent surrounding surface so that the external tank bottom cannot be visually inspected.

* * * * *

"Sump" means any pit or reservoir that meets the definition of tank and those troughs/trenches connected to it that serves to collect hazardous waste for transport to hazardous waste storage, treatment, or disposal facilities.

* * * * *

"Tank system" means a hazardous waste storage or treatment tank and its associated ancillary equipment and containment system.

* * * * *

"Underground tank" means a device meeting the definition of "tank" in § 260.10 whose entire surface area is totally below the surface of and covered by the ground.

* * * * *

"Unfit-for use tank system" means a tank system that has been determined through an integrity assessment or other inspection to be no longer capable of storing or treating hazardous waste without posing a threat of release of hazardous waste to the environment.

* * * * *

"Zone of engineering control" means an area under the control of the owner/operator that, upon detection of a hazardous waste release, can be readily cleaned up prior to the release of hazardous waste or hazardous constituents to ground water or surface water.

* * * * *

PART 261—IDENTIFICATION AND LISTING OF HAZARDOUS WASTE

3. The authority citation for Part 261 continues to read as follows:

Authority: Secs. 1006, 2002(a), 3001, and 3002 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6905, 6912(a), 6921, and 6922).

4. Section 261.4 is amended by adding paragraph (a)(8) to read as follows:

§ 261.4 Exclusions.

(a) * * *

(8) Secondary materials that are reclaimed and returned to the original process or processes in which they were generated where they are reused in the production process provided:

(i) Only tank storage is involved, and the entire process through completion of reclamation is closed by being entirely connected with pipes or other comparable enclosed means of conveyance;

(ii) Reclamation does not involve controlled flame combustion (such as occurs in boilers, industrial furnaces, or incinerators);

(iii) The secondary materials are never accumulated in such tanks for over twelve months without being reclaimed; and

(iv) The reclaimed material is not used to produce a fuel, or used to produce products that are used in a manner constituting disposal.

* * * * *

PART 262—STANDARDS APPLICABLE TO GENERATORS OF HAZARDOUS WASTE

40 CFR Part 262 is amended as follows:

5. The authority citation for Part 262 is revised to read as follows:

Authority: Secs. 1006, 2002, 3001, 3002, 3003, 3004, 3005, and 3017 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6906, 6912, 6922, 6923, 6924, 6925, and 6937).

6. Section 262.34 is amended by revising paragraphs (a)(1) and (d)(2), by redesignating existing paragraphs (d)(3) and (d)(4) as (d)(4) and (d)(5), respectively, and by adding a new paragraph (d)(3), as follows:

§ 262.34 Accumulation time.

(a) Except as provided in paragraphs (d), (e), and (f) of this section, a generator may accumulate hazardous waste on-site for 90 days or less without a permit or without having interim status, provided that:

(1) The waste is placed in containers and the generator complies with Subpart I of 40 CFR Part 265, or the waste is placed in tanks and the generator complies with Subpart J of 40 CFR Part 265, except § 265.197(c), and § 265.200. In addition, such a generator is exempt from all the requirements in Subparts G and H of 40 CFR Part 265, except for § 265.111 and § 265.114.

* * * * *

(d) * * *

(2) The generator complies with the requirements of Subpart I of Part 265, except § 265.176;

(3) The generator complies with the requirements of § 265.201 in Subpart J of Part 265;

* * * * *

PART 264—STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

40 CFR Part 264 is amended as follows:

7. The Authority citation for Part 264 is revised to read as follows:

Authority: Secs. 1006, 2002, 3004, and 3005 of the Solid Waste Disposal Act as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6905, 6912(a), 6924, and 6925).

8. The Table of Contents and heading of Part 264, Subpart J—Tanks, is revised to read as follows:

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Subpart J—Tank Systems

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9. Section 264.15 is amended by revising paragraph (b)(4) to read as follows:

§ 264.15 General inspection requirements.

* * * * *

(b) * * *

(4) The frequency of inspection may vary for the items on the schedule. However, it should be based on the rate of possible deterioration of the equipment and the probability of an environmental or human health incident if the deterioration or malfunction of any operator error goes undetected between inspections. Areas subject to spills, such as loading and unloading areas, must be inspected daily when in use. At a minimum, the inspection schedule must include the terms and frequencies called for in §§ 264.174, 264.193, 264.195, 264.226, 264.253, 264.254, 264.303, and 264.347, where applicable.

* * * * *

10. Section 264.73 is amended by revising paragraph (b)(6) to read as follows:

§ 264.73 Operating record.

* * * * *

(b) * * *

(6) Monitoring, testing, or analytical data where required by Subpart F and §§ 264.191, 264.193, 264.195, 264.226, 264.253, 264.254, 264.276, 264.278, 264.280, 264.303, 264.309, and 264.347.

* * * * *

11. Section 264.110 is amended by adding a new paragraph (b)(3) to read as follows:

§ 264.110 Applicability.

* * * * *

(b) * * *

(3) Tank systems that are required under § 264.197 to meet the requirements for landfills.

12. Section 264.140 is amended by adding a new paragraph (b)(3) to read as follows:

§ 264.140 Applicability.

* * * * *

(b) * * *

(3) Tank systems that are required under § 264.197 to meet the requirements for landfills.

* * * * *

13. The Subpart J—Tank Systems requirements are amended by revising the Subpart as follows:

Subpart J—Tank Systems

§ 264.190 Applicability.

The requirements of this Subpart apply to owners and operators of facilities that use tank systems for storing or treating hazardous waste except as otherwise provided in paragraphs (a) and (b) of this section or in § 264.1 of this part.

(a) Tanks that are used to store or treat hazardous waste which contains no free liquids and are situated inside a building with an impermeable floor are exempted from the requirements in § 264.193. To demonstrate the absence or presence of free liquids in the stored/treated waste, EPA Method 9095 (Paint Filter Liquids Test) as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Publication No. SW-846) must be used.

(b) Tanks, including sumps, as defined in § 260.10, that serve as part of a secondary containment system to collect or contain releases of hazardous wastes are exempted from the requirements in § 264.193 of this subpart.

(Information collection requirement contained in paragraph (a) was approved by the Office of Management and Budget under control number 2050-0050.)

§ 264.191 Assessment of existing tank system's integrity.

(a) For each existing tank system that does not have secondary containment meeting the requirements of § 264.193, the owner or operator must determine that the tank system is not leaking or is unfit for use. Except as provided in paragraph (c) of this section, the owner or operator must obtain and keep on file at the facility a written assessment reviewed and certified by an independent, qualified registered professional engineer, in accordance with § 270.11(d), that attests to the tank system's integrity by January 12, 1988.

(b) This assessment must determine that the tank system is adequately designed and has sufficient structural strength and compatibility with the waste(s) to be stored or treated, to ensure that it will not collapse, rupture, or fail. At a minimum, this assessment must consider the following:

(1) Design standard(s), if available, according to which the tank and ancillary equipment were constructed;

(2) Hazardous characteristics of the waste(s) that have been and will be handled;

(3) Existing corrosion protection measures;

(4) Documented age of the tank system, if available (otherwise, an estimate of the age); and

(5) Results of a leak test, internal inspection, or other tank integrity examination such that:

(i) For non-enterable underground tanks, the assessment must include a leak test that is capable of taking into account the effects of temperature variations, tank end deflection, vapor pockets, and high water table effects, and

(ii) For other than non-enterable underground tanks and for ancillary equipment, this assessment must include either a leak test, as described above, or other integrity examination, that is certified by an independent, qualified, registered professional engineer in accordance with § 270.11(d), that addresses cracks, leaks, corrosion, and erosion.

[Note.—The practices described in the American Petroleum Institute (API) Publication, Guide for Inspection of Refinery Equipment, Chapter XIII, "Atmospheric and Low-Pressure Storage Tanks," 4th edition, 1981, may be used, where applicable, as guidelines in conducting other than a leak test.]

(c) Tank systems that store or treat materials that become hazardous wastes subsequent to July 14, 1986, must conduct this assessment within 12 months after the date that the waste becomes a hazardous waste.

(d) If, as a result of the assesament conducted in accordance with paragraph (a), a tank system is found to be leaking or unfit for use, the owner or operator must comply with the requirements of § 264.196.

Approved by the Office of Management and Budget under control number 2050–0050.)

§ 264.192 Design and installation of new tank systems or components.

(a) Owners or operators of new tank systems or components must obtain and submit to the Regional Administrator, at time of submittal of Part B information, a written assessment, reviewed and certified by an independent, qualified registered professional engineer, in accordance with § 270.11(d), attesting that the tank system has sufficient structural integrity and is acceptable for the storing and treating of hazardous waste. The assessment must show that the foundation, structural support, seams, connections, and pressure controls (if applicable) are adequately designed and that the tank system has sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection to ensure that it will not collapse, rupture, or fail. This assessment, which will be used by the Regional Administrator to review and approve or disapprove the acceptability of the tank system design, must include, at a minimum, the following information:

(1) Design standard(s) according to which tank(s) and/or the ancillary equipment are constructed;

(2) Hazardous characteristics of the waste(s) to be handled;

(3) For new tank systems or components in which the external shell of a metal tank or any external metal component of the tank system will be in contact with the soil or with water, a determination by a corrosion expert of:

(i) Factors affecting the potential for corrosion, including but not limited to:

(A) Soil moisture content;

(B) Soil pH;

(C) Soil sulfides level;

(D) Soil resistivity;

(E) Structure to soil potential;

(F) Influence of nearby underground metal structures (e.g., piping);

(G) Existence of stray electric current;

(H) Existing corrosion-protection measures (e.g., coating, cathodic protection), and

(ii) The type and degree of external corrosion protection that are needed to ensure the integrity of the tank system during the use of the tank system or component, consisting of one or more of the following:

(A) Corrosion-resistant materials of construction such as special alloys, fiberglass reinforced plastic, etc.;

(B) Corrosion-resistant coating (such as epoxy, fiberglass, etc.) with cathodic protection (e.g., impressed current or sacrificial anodes); and

(C) Electrical isolation devices such as insulating joints, flanges, etc.

[Note.—The practices described in the National Association of Corrosion Engineers (NACE) standard, "Recommended Practice (RP–02–85)—Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems," and the American Petroleum Institute (API) Publication 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems," may be used, where applicable, as guidelines in providing corrosion protection for tank systems.]

(4) For underground tank system components that are likely to be adversely affected by vehicular traffic, a determination of design or operational measures that will protect the tank system against potential damage; and

(5) Design considerations to ensure that:

(i) Tank foundations will maintain the load of a full tank;

(ii) Tank systems will be anchored to prevent flotation or dislodgment where the tank system is placed in a saturated zone, or is located within a seismic fault zone subject to the standards of § 264.18(a); and

(iii) Tank systems will withstand the effects of frost heave.

(b) The owner or operator of a new tank system must ensure that proper handling procedures are adhered to in order to prevent damage to the system during installation. Prior to covering, enclosing, or placing a new tank system or component in use, an independent, qualified installation inspector or an independent, qualified, registered professional engineer, either of whom is trained and experienced in the proper installation of tank systems or component, must inspect the system for the presence of any of the following items:

(1) Weld breaks;

(2) Punctures;

(3) Scrapes of protective coatings;

(4) Cracks;

(5) Corrosion;

(6) Other structural damage or inadequate construction/installation.

All discrepancies must be remedied before the tank system is covered, enclosed, or placed in use.

(c) New tank systems or components that are placed underground and that are backfilled must be provided with a backfill material that is a noncorrosive, porous, homogeneous substance and that is installed so that the backfill is placed completely around the tank and compacted to ensure that the tank and piping are fully and uniformly supported.

(d) All new tanks and ancillary equipment must be tested for tightness prior to being covered, enclosed, or placed in use. If a tank system is found not to be tight, all repairs necessary to remedy the leak(s) in the system must be performed prior to the tank system being covered, enclosed, or placed into use.

(e) Ancillary equipment must be supported and protected against physical damage and excessive stress due to settlement, vibration, expansion, or contraction.

[Note.—The piping system installation procedures described in American Petroleum Institute (API) Publication 1615 (November 1979), "Installation of Underground Petroleum Storage Systems," or ANSI Standard B31.3, "Petroleum Refinery Piping," and ANSI Standard B31.4 "Liquid Petroleum Transportation Piping System," may be used, where applicable, as guidelines for proper installation of piping systems.]

(f) The owner or operator must provide the type and degree of corrosion protection recommended by an independent corrosion expert, based on the information provided under paragraph (a)(3) of this section, or other corrosion protection if the Regional Administrator believes other corrosion protection is necessary to ensure the integrity of the tank system during use of the tank system. The installation of a corrosion protection system that is field fabricated must be supervised by an independent corrosion expert to ensure proper installation.

(g) The owner or operator must obtain and keep on file at the facility written statements by those persons required to certify the design of the tank system and supervise the installation of the tank system in accordance with the requirements of paragraphs (b) through (f) of this section, that attest that the tank system was properly designed and installed and that repairs, pursuant to paragraphs (b) and (d) of this section, were performed. These written statements must also include the certification statement as required in § 270.11(d) of this Chapter.

(Information collection requirements contained in paragraphs (a) and (g) were approved by the Office of Management and Budget under control number 2050–0050.)

§ 264.193 Containment and detection of releases.

(a) In order to prevent the release of hazardous waste or hazardous constituents to the environment, secondary containment that meets the requirements of this section must be provided (except as provided in paragraphs (f) and (g) of this section):

(1) For all new tank systems or components, prior to their being put into service;

(2) For all existing tank systems used to store or treat EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, and F027, within two years after January 12, 1987;

(3) For those existing tank systems of known and documented age, within two years after January 12, 1987 or when the tank system has reached 15 years of age, whichever comes later; and

(4) For those existing tank systems for which the age cannot be documented, within eight years of January 12, 1987; but if the age of the facility is greater than seven years, secondary containment must be provided by the time the facility reaches 15 years of age, or within two years of January 12, 1987, whichever comes later; and

(5) For tank systems that store or treat materials that become hazardous wastes subsequent to January 12, 1987, within the time intervals required in paragraphs (a)(1) through (a)(4) of this section, except that the date that a material becomes a hazardous waste must be used in place of January 12, 1987.

(b) *Secondary containment systems* must be:

(1) Designed, installed, and operated to prevent any migration of wastes or accumulated liquid out of the system to the soil, ground water, or surface water at any time during the use of the tank system; and

(2) Capable of detecting and collecting releases and accumulated liquids until the collected material is removed.

(c) To meet the requirements of paragraph (b) of this section, secondary containment systems must be at a minimum:

(1) Constructed of or lined with materials that are compatible with the wastes(s) to be placed in the tank system and must have sufficient strength and thickness to prevent failure owing to pressure gradients (including static head and external hydrological forces), physical contact with the waste to which it is exposed, climatic conditions, and the stress of daily operation (including stresses from nearby vehicular traffic).

(2) Placed on a foundation or base capable of providing support to the secondary containment system, resistance to pressure gradients above and below the system, and capable of preventing failure due to settlement, compression, or uplift;

(3) Provided with a leak-detection system that is designed and operated so that it will detect the failure of either the primary or secondary containment structure or the presence of any release of hazardous waste or accumulated liquid in the secondary containment system within 24 hours, or at the earliest practicable time if the owner or operator can demonstrate to the Regional Administrator that existing detection technologies or site conditions will not allow detection of a release within 24 hours; and

(4) Sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation. Spilled or leaked waste and accumulated precipitation must be removed from the secondary containment system within 24 hours, or in as timely a manner as is possible to prevent harm to human health and the environment, if the owner or operator can demonstrate to the Regional Administrator that removal of the released waste or accumulated precipitation cannot be accomplished within 24 hours.

[Note.—If the collected material is a hazardous waste under Part 261 of this chapter, it is subject to management as a hazardous waste in accordance with all applicable requirements of Parts 262 through 265 of this chapter. If the collected material is discharged through a point source to waters of the United States, it is subject to the requirements of sections 301, 304, and 402 of the Clean Water Act, as amended. If discharged to a Publicly Owned Treatment Works (POTW), it is subject to the requirements of section 307 of the Clean Water Act, as amended. If the collected material is released to the environment, it may be subject to the reporting requirements of 40 CFR Part 302.]

(d) Secondary containment for tanks must include one or more of the following devices:

(1) A liner (external to the tank);

(2) A vault;

(3) A double-walled tank; or

(4) An equivalent device as approved by the Regional Administrator

(e) In addition to the requirements of paragraphs (b), (c), and (d) of this section, secondary containment systems must satisfy the following requirements:

(1) External liner systems must be:

(i) Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary;

(ii) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity must be sufficient to contain precipitation from a 25-year, 24-hour rainfall event.

(iii) Free of cracks or gaps; and

(iv) Designed and installed to surround the tank completely and to cover all surrounding earth likely to come into contact with the waste if released from the tank(s) (i.e., capable of preventing lateral as well as vertical migration of the waste).

(2) Vault systems must be:

(i) Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary;

(ii) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity must be sufficient to contain precipitation from a 25-year, 24-hour rainfall event:

(iii) Constructed with chemical-resistant water stops in place at all joints (if any):

(iv) Provided with an impermeable interior coating or lining that is compatible with the stored waste and that will prevent migration of waste into the concrete;

(v) Provided with a means to protect against the formation of and ignition of vapors within the vault, if the waste being stored or treated:

(A) Meets the definition of ignitable waste under § 262.21 of this chapter; or

(B) Meets the definition of reactive waste under § 261.23 of this chaper, and may form an ignitable or explosive vapor.

(vi) Provided with an exterior moisture barrier or be otherwise designed or operated to prevent migration of moisture into the vault if the vault is subject to hydraulic pressure.

(3) Double-walled tanks must be:

(i) Designed as an integral structure (i.e., an inner tank completely enveloped within an outer shell) so that any release from the inner tank is contained by the outer shell.

(ii) Protected, if constructed of metal, from both corrosion of the primary tank interior and of the external surface of the outer shell: and

(iii) Provided with a built-in continuous leak detection system capable of detecting a release within 24 hours, or at the earliest practicable time, if the owner or operator can demonstrate to the Regional Administrator, and the Regional Administrator concludes, that the existing detection technology or site conditions would not allow detection of a release within 24 hours.

[Note.—The provisions outlined in the Steel Tank Institute's (STI) "Standard for Dual Wall Underground Steel Storage Tanks" may be used as guidelines for aspects of the design of underground steel double-walled tanks.]

(f) Ancillary equipment must be provided with secondary containment (e.g., trench, jacketing, double-walled piping) that meets the requirements of paragraphs (b) and (c) of this section except for:

(1) Aboveground piping (exclusive of flanges, joints, valves, and other connections) that are visually inspected for leaks on a daily basis;

(2) Welded flanges, welded joints, and welded connections, that are visually inspected for leaks on a daily basis;

(3) Sealless or magnetic coupling pumps, that are visually inspected for leaks on a daily basis; and

(4) Pressurized aboveground piping systems with automatic shut-off devices (e.g., excess flow check valves, flow metering shutdown devices, loss of pressure actuated shut-off devices) that are visually inspected for leaks on a daily basis.

(g) The owner or operator may obtain a variance from the requirements of this section if the Regional Administrator finds, as a result of a demonstration by the owner or operator that alternative design and operating practices, together with location characteristics, will prevent the migration of any hazardous waste or hazardous constituents into the ground water; or surface water at least as effectively as secondary containment during the active life of the tank system or that in the event of a release that does migrate to ground water or surface water, no substantial present or potential hazard will be posed to human health or the environment. New underground tank systems may not, per a demonstration in accordance with paragraph (g)(2) of this section, be exempted from the secondary containment requirements of this section.

(1) In deciding whether to grant a variance based on a demonstration of equivalent protection of ground water and surface water, the Regional Administrator will consider:

(i) The nature and quantity of the wastes;

(ii) The proposed alternate design and operation;

(iii) The hydrogeologic setting of the facility, including the thickness of soils present between the tank system and ground water, and

(iv) All other factors that would influence the quality and mobility of the hazardous constituents and the potential for them to migrate to ground water or surface water

(2) In deciding whether to grant a variance based on a demonstration of no substantial present or potential hazard, the Regional Administrator will consider:

(i) The potential adverse effects on ground water, surface water, and land quality taking into account:

(A) The physical and chemical characteristics of the waste in the tank system, including its potential for migration,

(B) The hydrogeological characteristics of the facility and surrounding land,

(C) The potential for health risks caused by human exposure to waste constituents,

(D) The potential for damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents, and

(E) The persistence and permanence of the potential adverse effects;

(ii) The potential adverse effects of a release on ground-water quality, taking into account:

(A) The quantity and quality of ground water and the direction of ground-water flow,

(B) The proximity and withdrawal rates of ground-water users,

(C) The current and future uses of ground water in the area, and

(D) The existing quality of ground water, including other sources of contamination and their cumulative impact on the ground-water quality;

(iii) The potential adverse effects of a release on surface water quality, taking into account:

(A) The quantity and quality of ground water and the direction of ground-water flow,

(B) The patterns of rainfall in the region,

(C) The proximity of the tank system to surface waters,

(D) The current and future uses of surface waters in the area and any water quality standards established for those surface waters, and

(E) The existing quality of surface water, including other sources of contamination and the cumulative impact on surface-water quality; and

(iv) The potential adverse effects of a release on the land surrounding the tank system, taking into account:

(A) The patterns of rainfall in the region, and

(B) The current and future uses of the surrounding land.

(3) The owner or operator of a tank system, for which a variance from secondary containment had been granted in accordance with the requirements of paragraph (g)(1) of this section, at which a release of hazardous waste has occurred from the primary tank system but has not migrated beyond the zone of engineering control (as established in the variance), must:

(i) Comply with the requirements of § 264.196, except paragraph (d), and

(ii) Decontaminate or remove contaminated soil to the extent necessary to:

(A) Enable the tank system for which the variance was granted to resume operation with the capability for the detection of releases at least equivalent to the capability it had prior to the release; and

(B) Prevent the migration of hazardous waste or hazardous constituents to ground water or surface water; and

(iii) If contaminated soil cannot be removed or decontaminated in accordance with paragraph (g)(3)(ii) of this section, comply with the requirement of § 264.197(b).

(4) The owner or operator of a tank system, for which a variance from secondary containment had been granted in accordance with the requirements of paragraph (g)(1) of this section, at which a release of hazardous waste has occurred from the primary tank system and has migrated beyond the zone of engineering control (as established in the variance), must:

(i) Comply with the requirements of § 264.196 (a), (b), (c), and (d); and

(ii) Prevent the migration of hazardous waste or hazardous constituents to ground water or surface water, if possible, and decontaminate or remove contaminated soil. If contaminated soil cannot be decontaminated or removed or if ground water has been contaminated, the owner or operator must comply with the requirements of § 264.197(b); and

(iii) If repairing, replacing, or reinstalling the tank system, provide secondary containment in accordance with the requirements of paragraphs (a) through (f) of this section or reapply for a variance from secondary containment and meet the requirements for new tank systems in § 264.192 if the tank system is replaced. The owner or operator must comply with these requirements even if contaminated soil can be decontaminated or removed and ground water or surface water has not been contaminated.

(h) The following procedures must be followed in order to request a variance from secondary containment:

(1) The Regional Administrator must be notified in writing by the owner or operator that he intends to conduct and submit a demonstration for a variance from secondary containment as allowed in paragraph (g) according to the following schedule:

(i) For existing tank systems, at least 24 months prior to the date that secondary containment must be provided in accordance with paragraph (a) of this section.

(ii) For new tank systems, at least 30 days prior to entering into a contract for installation.

(2) As part of the notification, the owner or operator must also submit to the Regional Administrator a description of the steps necessary to conduct the demonstration and a timetable for completing each of the steps. The demonstration must address each of the factors listed in paragraph (g)(1) or paragraph (g)(2) of this section;

(3) The demonstration for a variance must be completed within 180 days after notifying the Regional Administrator of an intent to conduct the demonstration; and

(4) If a variance is granted under this paragraph, the Regional Administrator will require the permittee to construct and operate the tank system in the manner that was demonstrated to meet the requirements for the variance.

(i) All tank systems, until such time as secondary containment that meets the requirements of this section is provided, must comply with the following:

(1) For non-enterable underground tanks, a leak test that meets the requirements of § 264.191(a) or other tank integrity method, as approved or required by the Regional Administrator, must be conducted at least annually.

(2) For other than non-enterable underground tanks, the owner or operator must either (i) conduct a leak test as in paragraph (i)(1) or (ii) of this section develop a schedule and procedure for an assessment of the overall condition of the tank system by an independent, qualified registered professional engineer. The schedule and procedure must be adequate to detect obvious cracks, leaks, and corrosion or erosion that may lead to cracks and leaks. The owner or operator must remove the stored waste from the tank, if necessary, to allow the condition of all internal tank surfaces to be assessed. The frequency of these assessments must be based on the material of construction of the tank and its ancillary equipment, the age of the system, the type of corrosion or erosion protection used, the rate of corrosion or erosion observed during the previous inspection, and the characteristics of the waste being stored or treated.

(3) For ancillary equipment, a leak test or other integrity assessment as approved by the Regional Administrator must be conducted at least annually.

[Note.—The practices described in the American Petroleum Institute (API) Publication Guide for Inspection of Refinery Equipment, Chapter XIII, "Atmospheric and Low-Pressure Storage Tanks," 4th edition, 1981, may be used, where applicable, as guidelines for assessing the overall condition of the tank system.]

(4) The owner or operator must maintain on file at the facility a record of the results of the assessments conducted in accordance with paragraphs (i)(1) through (i)(3) of this section.

(5) If a tank system or component is found to be leaking or unfit for use as a result of the leak test or assessment in paragraphs (i)(1) through (i)(3) of this section, the owner or operator must comply with the requirements of § 264.196.

(Information collection requirements contained in paragraphs (c), (d), (e), (g), (h), and (i) were approved by the Office of Management and Budget under control number 2050–0050.)

§ 264.194 General operating requirements.

(a) Hazardous wastes or treatment reagents must not be placed in a tank system if they could cause the tank, its ancillary equipment, or the containment system to rupture, leak, corrode, or otherwise fail.

(b) The owner or operator must use appropriate controls and practices to prevent spills and overflows from tank or containment systems. These include at a minimum:

(1) Spill prevention controls (e.g., check valves, dry disconnect couplings);

(2) Overfill prevention controls (e.g., level sensing devices, high level alarms, automatic feed cutoff, or bypass to a standby tank); and

(3) Maintenance of sufficient freeboard in uncovered tanks to prevent overtopping by wave or wind action or by precipitation.

(c) The owner or operator must comply with the requirements of § 264.196 if a leak or spill occurs in the tank system.

(Information collection requirements contained in paragraph (c) were approved by the Office of Management and Budget under control number 2050–0050)

§ 264.195 Inspections.

(a) The owner or operator must develop and follow a schedule and procedure for inspecting overfill controls.

(b) The owner or operator must inspect at least once each operating day:

(1) Aboveground portions of the tank system, if any, to detect corrosion or releases of waste;

(2) Data gathered from monitoring and leak detection equipment (e.g., pressure or temperature gauges, monitoring wells) to ensure that the tank system is being operated according to its design; and

(3) The construction materials and the area immediately surrounding the externally accessible portion of the tank system, including the secondary containment system (e.g., dikes) to detect erosion or signs of releases of hazardous waste (e.g., wet spots, dead vegetation).

[Note.—Section 264.15(c) requires the owner or operator to remedy any deterioration or malfunction he finds. Section 264.196 requires the owner or operator to notify the Regional Administrator within 24 hours of confirming a leak. Also, 40 CFR Part 302 may require the owner or operator to notify the National Response Center of a release.]

(c) The owner or operator must inspect cathodic protection systems, if present, according to, at a minimum, the following schedule to ensure that they are functioning properly:

(1) The proper operation of the cathodic protection system must be confirmed within six months after initial installation and annually thereafter; and

(2) All sources of impressed current must be inspected and/or tested, as appropriate, at least bimonthly (i.e., every other month).

[Note.—The practices described in the National Association of Corrosion Engineers (NACE) standard, "Recommended Practice (RP-02-85)—Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems," and the American Petroleum Institute (API) Publication 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems," may be used, where applicable, as guidelines in maintaining and inspecting cathodic protection systems.]

(d) The owner or operator must document in the operating record of the facility an inspection of those items in paragraphs (a) through (c) of this section.

(Information collection requirements contained in paragraph (a) and (d) were approved by the Office of Management and Budget under control number 2050-0050)

§ 264.196 Response to leaks or spills and disposition of leaking or unfit-for-use tank systems.

A tank system or secondary containment system from which there has been a leak or spill, or which is unfit for use, must be removed from service immediately, and the owner or operator must satisfy the following requirements:

(a) *Cessation of Use; prevent flow or addition of wastes.* The owner or operator must immediately stop the flow of hazardous waste into the tank system or secondary containment system and inspect the system to determine the cause of the release.

(b) *Removal of waste from tank system or secondary containment system.* (1) If the release was from the tank system, the owner/operator must, within 24 hours after detection of the leak or, if the owner/operator demonstrates that it is not possible, at the earliest practicable time, remove as much of the waste as is necessary to prevent further release of hazardous waste to the environment and to allow inspection and repair of the tank system to be performed.

(2) If the material released was to a secondary containment system, all released materials must be removed within 24 hours or in as timely a manner as is possible to prevent harm to human health and the environment.

(c) *Containment of visible releases to the environment.* The owner/operator must immediately conduct a visual inspection of the release and, based upon that inspection:

(1) Prevent further migration of the leak or spill to soils or surface water; and

(2) Remove, and properly dispose of, any visible contamination of the soil or surface water.

(d) *Notifications, reports.* (1) Any release to the environment, except as provided in paragraph (d)(2) of this section, must be reported to the Regional Administrator within 24 hours of its detection. If the release has been reported pursuant to 40 CFR Part 302, that report will satisfy this requirement.

(2) A leak or spill of hazardous waste that is:

(i) Less than or equal to a quantity of one (1) pound and

(ii) Immediately contained and cleaned-up is exempted from the requirements of this paragraph.

(3) Within 30 days of detection of a release to the environment, a report containing the following information must be submitted to the Regional Administrator:

(i) Likely route of migration of the release;

(ii) Characteristics of the surrounding soil (soil composition, geology, hydrogeology, climate);

(iii) Results of any monitoring or sampling conducted in connection with the release (if available). If sampling or monitoring data relating to the release are not available within 30 days, these data must be submitted to the Regional Administrator as soon as they become available.

(iv) Proximity to downgradient drinking water, surface water, and population areas; and

(v) Description of response actions taken or planned.

(e) *Provision of secondary containment, repair, or closure.* (1) Unless the owner/operator satisfies the requirements of paragraphs (e)(2) through (4) of this section, the tank system must be closed in accordance with § 264.197.

(2) If the cause of the release was a spill that has not damaged the integrity of the system, the owner/operator may return the system to service as soon as the released waste is removed and repairs, if necessary, are made.

(3) If the cause of the release was a leak from the primary tank system into the secondary containment system, the system must be repaired prior to returning the tank system to service.

(4) If the source of the release was a leak to the environment from a component of a tank system without secondary containment, the owner/operator must provide the component of the system from which the leak occurred with secondary containment that satisfies the requirements of § 264.193 before it can be returned to service, unless the source of the leak is an aboveground portion of a tank system that can be inspected visually. If the source is an aboveground component that can be inspected visually, the component must be repaired and may be returned to service without secondary containment as long as the requirements of paragraph (f) of this section are satisfied. If a component is replaced to comply with the requirements of this subparagraph, that component must satisfy the requirements for new tank systems or components in §§ 264.192 and 264.193. Additionally, if a leak has occurred in any portion of a tank system component that is not readily accessible for visual inspection (e.g., the bottom of an inground or onground tank), the entire component must be provided with secondary containment in accordance with § 264.193 prior to being returned to use.

(f) *Certification of major repairs.* If the owner/operator has repaired a tank system in accordance with paragraph (e) of this section, and the repair has been extensive (e.g., installation of an internal liner; repair of a ruptured primary containment or secondary containment vessel), the tank system must not be returned to service unless the owner/operator has obtained a certification by an independent, qualified, registered, professional engineer in accordance with § 270.11(d) that the repaired system is capable of handling hazardous wastes without release for the intended life of the system. This certification must be submitted to the Regional Administrator within seven days after returning the tank system to use.

[Note.—The Regional Administrator may, on the basis of any information received that there is or has been a release of hazardous waste or hazardous constituents into the environment, issue an order under RCRA sections 3004(w), 3008(h), or 7003(a) requiring corrective action or such other response as deemed necessary to protect human health or the environment.]

[Note.—See § 264.15(c) for the requirements necessary to remedy a failure. Also, 40 CFR Part 302 may require the owner or operator to notify the National Response Center of certain releases.]

(Information collection requirements contained in paragraphs (d), (e), and (f) were approved by the Office of Management and Budget under control number 2050-0050)

§ 264.197 Closure and post-closure care.

(a) At closure of a tank system, the owner or operator must remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated soils, and structures and equipment contaminated with waste, and manage them as hazardous waste, unless § 261.3(d) of this Chapter applies. The closure plan, closure activities, cost estimates for closure, and financial responsibility for tank systems must meet all of the requirements specified in Subparts G and H of this Part.

(b) If the owner or operator demonstrates that not all contaminated soils can be practicably removed or decontaminated as required in paragraph (a) of this section, then the owner or operator must close the tank system and perform post-closure care in accordance with the closure and post-closure care requirements that apply to landfills (§ 264.310). In addition, for the purposes of closure, post-closure, and financial responsibility, such a tank system is then considered to be a landfill, and the owner or operator must meet all of the requirements for landfills specified in Subparts G and H of this Part.

(c) If an owner or operator has a tank system that does not have secondary containment that meets the requirements of § 264.193 (b) through (f) and is not exempt from the secondary containment requirements in accordance with § 264.193(g), then:

(1) The closure plan for the tank system must include both a plan for complying with paragraph (a) of this section and a contingent plan for complying with paragraph (b) of this section.

(2) A contingent post-closure plan for complying with paragraph (b) of this section must be prepared and submitted as part of the permit application.

(3) The cost estimates calculated for closure and post-closure care must reflect the costs of complying with the contingent closure plan and the contingent post-closure plan, if those costs are greater than the costs of complying with the closure plan prepared for the expected closure under paragraph (a) of this section.

(4) Financial assurance must be based on the cost estimates in paragraph (c)(3) of this section.

(5) For the purposes of the contingent closure and post-closure plans, such a tank system is considered to be a landfill, and the contingent plans must meet all of the closure, post-closure, and financial responsibility requirements for landfills under Subparts G and H of this Part.

(Information collection requirements contained in paragraphs (a)-(c) were approved by the Office of Management and Budget under control number 2050-0050)

§ 264.198 Special requirements for ignitable or reactive wastes.

(a) Ignitable or reactive waste must not be placed in tank systems, unless:

(1) The waste is treated, rendered, or mixed before or immediately after placement in the tank system so that:

(i) The resulting waste, mixture, or dissolved material no longer meets the definition of ignitable or reactive waste under §§ 261.21 or 261.23 of this Chapter, and

(ii) Section 264.17(b) is complied with; or

(2) The waste is stored or treated in such a way that it is protected from any material or conditions that may cause the waste to ignite or react; or

(3) The tank system is used solely for emergencies.

(b) The owner or operator of a facility where ignitable or reactive waste is stored or treated in a tank must comply with the requirements for the maintenance of protective distances between the waste management area and any public ways, streets, alleys, or an adjoining property line that can be built upon as required in Tables 2-1 through 2-6 of the National Fire Protection Association's "Flammable and Combustible Liquids Code," (1977 or 1981), (incorporated by reference, see § 260.11).

§ 264.199 Special requirements for incompatible wastes.

(a) Incompatible wastes, or incompatible wastes and materials, must not be placed in the same tank system, unless § 264.17(b) is complied with.

(b) Hazardous waste must not be placed in a tank system that has not been decontaminated and that previously held an incompatible waste or material, unless § 264.17(b) is complied with.

PART 265—INTERIM STATUS STANDARDS FOR OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES

40 CFR Part 265 is amended as follows:

14. The Authority citation for Part 265 continues to read as follows:

Authority: Secs. 1006, 2002(a), 3004, 3005, and 3015 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6905, 6912(a), 6924, 6925, and 6935).

15. The Table of Contents and the heading of Part 265, Subpart J—Tanks is revised to read as follows:

* * * * *

Subpart J—Tank Systems

* * * * *

16. Section 265.13 is amended by revising paragraph (b)(6) to read as follows:

§ 265.13 General waste analysis.

* * * * *

(b) * * *

(6) Where applicable, the methods that will be used to meet the additional waste analysis requirements for specific waste management methods as specified in §§ 265.200, 265.225, 265.252, 265.273, 265.314, 265.345, 265.375, and 265.402.

* * * * *

17. Section 265.15 is amended by revising paragraph (b)(4) to read as follows:

§ 265.15 General inspection requirements.

* * * * *

(b) * * *

(4) The frequency of inspection may vary for the items on the schedule. However, it should be based on the rate of possible deterioration of the

equipment and the probability of an environmental or human health incident if the deterioration, or malfunction, or any operator error goes undetected between inspections. Areas subject to spills, such as loading and unloading areas, must be inspected daily when in use. At a minimum, the inspection schedule must include the items and frequencies called for in §§ 265.174, 265.193, 265.195, 265.226, 265.347, 265.377, and 265.403.

* * * * *

18. Section 265.73 is amended by revising paragraphs (b)(3) and (b)(6) to read as follows:

§ 265.73 Operating record.

* * * * *

(b) * * *

(3) Records and results of waste analysis and trial tests performed as specified in §§ 265.13, 265.200, 265.225, 265.252, 265.273, 265.314, 265.341, 265.375, and 265.402.

* * * * *

(6) Monitoring, testing, or analytical data when required by §§ 265.90, 265.94, 265.191, 265.193, 265.195, 265.276, 265.278, 265.280(d)(1), 265.347, and 265.377; and

* * * * *

19. Section 265.110 is amended by revising paragraph (b)(2) to read as follows:

§ 265.110 Applicability.

* * * * *

(b) * * *

(2) Tank systems that are required under § 265.197 to meet requirements for landfills.

* * * * *

20. Section 265.140 is amended by revising paragraph (b) to read as follows:

§ 265.140 Applicability.

* * * * *

(b) The requirements of §§ 265.144 and 265.146 apply only to owners and operators of disposal facilities and tank systems that are required under § 265.197 to meet the requirements for landfills

* * * * *

21. The Subpart J is revised to read as follows:

Subpart J—Tank Systems

§ 265.190 Applicability.

The regulations of this Subpart apply to owners or operators of facilities that use tank systems for storing or treating hazardous waste, except as otherwise provided in paragraphs (a) and (b) of this section or in § 265.1 of this part.

(a) Tanks that are used to store or treat hazardous waste containing no free liquids and that are situated inside a building with an impermeable floor are exempted from the requirements of § 265.193 of this subpart. To demonstrate the absence or presence of free liquids in the stored/treated waste, EPA Method 9095 (Paint Filter Liquids Test) as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Publication No. SW-846) must be used.

(b) Tanks, including sumps, as defined in § 260.10, that serve as part of a secondary containment system to collect or contain releases of hazardous wastes are exempted from the requirements in § 265.193.

(Information collection requirement contained in paragraph (a) was approved by the Office of Management and Budget under control number 2050-0050.)

§ 265.191 Assessment of existing tank system's integrity.

(a) For each existing tank system that does not have secondary containment meeting the requirements of § 265.193, the owner or operator must determine that the tank system is not leaking or is unfit for use. Except as provided in paragraph (c) of this section, the owner or operator must obtain and keep on file at the facility a written assessment reviewed and certified by an independent, qualified, registered professional engineer in accordance with § 270.11(d), that attests to the tank system's integrity by January 12, 1988.

(b) This assessment must determine that the tank system is adequately designed and has sufficient structural strength and compatibility with the waste(s) to be stored or treated to ensure that it will not collapse, rupture, or fail. At a minimum, this assessment must consider the following:

(1) Design standard(s), if available, according to which the tank and ancillary equipment were constructed;

(2) Hazardous characteristics of the waste(s) that have been or will be handled;

(3) Existing corrosion protection measures;

(4) Documented age of the tank system, if available, (otherwise, an estimate of the age); and

(5) Results of a leak test, internal inspection, or other tank integrity examination such that:

(i) For non-enterable underground tanks, this assessment must consist of a leak test that is capable of taking into account the effects of temperature variations, tank end deflection, vapor pockets, and high water table effects.

(ii) For other than non-enterable underground tanks and for ancillary equipment, this assessment must be either a leak test, as described above, or an internal inspection and/or other tank integrity examination certified by an independent, qualified, registered professional engineer in accordance with § 270.11(d) that addresses cracks, leaks, corrosion, and erosion.

[Note.—The practices described in the American Petroleum Institute (API) Publication, Guide for Inspection of Refinery Equipment, Chapter XIII, "Atmospheric and Low-Pressure Storage Tanks," 4th edition, 1981, may be used, where applicable, as guidelines in conducting the integrity examination of an other than non-enterable underground tank system.]

(c) Tank systems that store or treat materials that become hazardous wastes subsequent to July 14, 1986 must conduct this assessment within 12 months after the date that the waste becomes a hazardous waste.

(d) If, as a result of the assessment conducted in accordance with paragraph (a) of this section, a tank system is found to be leaking or unfit for use, the owner or operator must comply with the requirements of § 265.196.

(Information collection requirements contained in paragraphs (a)-(d) were approved by the Office of Management and Budget under control number 2050-0050.)

§ 265.192 Design and installation of new tank systems or components.

(a) Owners or operators of new tank systems or components must ensure that the foundation, structural support, seams, connections, and pressure controls (if applicable) are adequately designed and that the tank system has sufficient structural strength, compatibility with the waste(s) to be stored or treated, and corrosion protection so that it will not collapse, rupture, or fail. The owner or operator must obtain a written assessment reviewed and certified by an independent, qualified, registered professional engineer in accordance with § 270.11(d) attesting that the system has sufficient structural integrity and is acceptable for the storing and treating of hazardous waste. This assessment must include, at a minimum, the following information:

(1) Design standard(s) according to which the tank(s) and ancillary equipment is or will be constructed.

(2) Hazardous characteristics of the waste(s) to be handled.

(3) For new tank systems or components in which the external shell of a metal tank or any external metal component of the tank system is or will be in contact with the soil or with water, a determination by a corrosion expert of:

(i) Factors affecting the potential for corrosion, including but not limited to:

(A) Soil moisture content;

(B) Soil pH;

(C) Soil sulfides level;

(D) Soil resistivity;

(E) Structure to soil potential;

(F) Influence of nearby underground metal structures (e.g., piping);

(G) Stray electric current;

(H) Existing corrosion-protection measures (e.g., coating, cathodic protection), and

(ii) The type and degree of external corrosion protection that are needed to ensure the integrity of the tank system during the use of the tank system or component, consisting of one or more of the following:

(A) Corrosion-resistant materials of construction such as special alloys, fiberglass-reinforced plastic, etc.;

(B) Corrosion-resistant coating (such as epoxy, fiberglass, etc.) with cathodic protection (e.g., impressed current or sacrificial anodes); and

(C) Electrical isolation devices such as insulating joints, flanges, etc.

[Note.—The practices described in the National Association of Corrosion Engineers (NACE) standard, "Recommended Practice (RP-02-85)—Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems," and the American Petroleum Institute (API) Publication 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems," may be used, where applicable, as guidelines in providing corrosion protection for tank systems.]

(4) For underground tank system components that are likely to be affected by vehicular traffic, a determination of design or operational measures that will protect the tank system against potential damage; and

(5) Design considerations to ensure that:

(i) Tank foundations will maintain the load of a full tank;

(ii) Tank systems will be anchored to prevent flotation or dislodgement where the tank system is placed in a saturated zone, or is located within a seismic fault zone; and

(iii) Tank systems will withstand the effects of frost heave.

(b) The owner or operator of a new tank system must ensure that proper handling procedures are adhered to in order to prevent damage to the system during installation. Prior to covering, enclosing, or placing a new tank system or component in use, an independent, qualified installation inspector or an independent, qualified, registered professional engineer, either of whom is trained and experienced in the proper installation of tank systems, must inspect the system or component for the presence of any of the following items:

(1) Weld breaks;

(2) Punctures;

(3) Scrapes of protective coatings;

(4) Cracks;

(5) Corrosion;

(6) Other structural damage or inadequate construction or installation.

All discrepancies must be remedied before the tank system is covered, enclosed, or placed in use.

(c) New tank systems or components and piping that are placed underground and that are backfilled must be provided with a backfill material that is a noncorrosive, porous, homogeneous substance and that is carefully installed so that the backfill is placed completely around the tank and compacted to ensure that the tank and piping are fully and uniformly supported.

(d) All new tanks and ancillary equipment must be tested for tightness prior to being covered, enclosed or placed in use. If a tank system is found not to be tight, all repairs necessary to remedy the leak(s) in the system must be performed prior to the tank system being covered, enclosed, or placed in use.

(e) Ancillary equipment must be supported and protected against physical damage and excessive stress due to settlement, vibration, expansion or contraction.

[Note.—The piping system installation procedures described in American Petroleum Institute (API) Publication 1615 (November 1979), "Installation of Underground Petroleum Storage Systems," or ANSI Standard B31.3, "Petroleum Refinery System," may be used, where applicable, as guidelines for proper installation of piping systems.]

(f) The owner or operator must provide the type and degree of corrosion protection necessary, based on the information provided under paragraph (a)(3) of this section, to ensure the integrity of the tank system during use of the tank system. The installation of a corrosion protection system that is field fabricated must be supervised by an independent corrosion expert to ensure proper installation.

(g) The owner or operator must obtain and keep on file at the facility written statements by those persons required to certify the design of the tank system and supervise the installation of the tank system in accordance with the requirements of paragraphs (b) through (f) of this section to attest that the tank system was properly designed and installed and that repairs, pursuant to paragraphs (b) and (d) of this section were performed. These written statements must also include the certification statement as required in § 270.11(d) of this chapter.

(Information collection requirements contained in paragraphs (a) and (g) were approved by the Office of Management and Budget under control number 2050-0050.)

§ 265.193 Containment and detection of releases.

(a) In order to prevent the release of hazardous waste or hazardous constituents to the environment, secondary containment that meets the requirements of this section must be provided (except as provided in paragraphs (f) and (g) of this section):

(1) For all new tank systems or components, prior to their being put into service;

(2) For all existing tanks used to store or treat EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, and F027, within two years after January 12, 1987;

(3) For those existing tank systems of known and documentable age, within two years after January 12, 1987, or when the tank systems have reached 15 years of age, whichever comes later;

(4) For those existing tank system for which the age cannot be documented, within eight years of January 12, 1987; but if the age of the facility age is greater than seven years, secondary containment must be provided by the time the facility reaches 15 years of age, or within two years of January 12, 1987, whichever comes later; and

(5) For tank systems that store or treat materials that become hazardous wastes subsequent to January 12, 1987, within the time intervals required in paragraphs (a)(1) through (a)(4) of this section, except that the date that a material becomes a hazardous waste must be used in place of January 12, 1987.

(b) Secondary containment systems must be:

(1) Designed, installed, and operated to prevent any migration of wastes or accumulated liquid out of the system to the soil, ground water, or surface water at any time during the use of the tank system; and

(2) Capable of detecting and collecting releases and accumulated liquids until the collected material is removed.

(c) To meet the requirements of paragraph (b) of this section, secondary containment systems must be at a minimum:

(1) Constructed of or lined with materials that are compatible with the waste(s) to be placed in the tank system and must have sufficient strength and thickness to prevent failure due to pressure gradients (including static head and external hydrological forces),

physical contact with the waste to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation (including stresses from nearby vehicular traffic);

(2) Placed on a foundation or base capable of providing support to the secondary containment system and resistance to pressure gradients above and below the system and capable of preventing failure due to settlement, compression, or uplift;

(3) Provided with a leak detection system that is designed and operated so that it will detect the failure of either the primary and secondary containment structure or any release of hazardous waste or accumulated liquid in the secondary containment system within 24 hours, or at the earliest practicable time if the existing detection technology or site conditions will not allow detection of a release within 24 hours;

(4) Sloped or otherwise designed or operated to drain and remove liquids resulting from leaks, spills, or precipitation. Spilled or leaked waste and accumulated precipitation must be removed from the secondary containment system within 24 hours, or in as timely a manner as is possible to prevent harm to human health or the environment, if removal of the released waste or accumulated precipitation cannot be accomplished within 24 hours.

[Note.—If the collected material is a hazardous waste under Part 261 of this chapter, it is subject to management as a hazardous waste in accordance with all applicable requirements of Parts 262 through 265 of this chapter. If the collected material is discharged through a point source to waters of the United States, it is subject to the requirements of sections 301, 304, and 402 of the Clean Water Act, as amended. If discharged to Publicly Owned Treatment Works (POTWs), it is subject to the requirements of section 307 of the Clean Water Act, as amended. If the collected material is released to the environment, it may be subject to the reporting requirements of 40 CFR Part 302.]

(d) Secondary containment for tanks must include one or more of the following devices:

(1) A liner (external to the tank);

(2) A vault;

(3) A double-walled tank; or

(4) An equivalent device as approved by the Regional Administrator.

(e) In addition to the requirements of paragraphs (b), (c), and (d) of this section, secondary containment systems must satisfy the following requirements:

(1) External liner systems must be:

(i) Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary;

(ii) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity must be sufficient to contain precipitation from a 25-year, 24-hour rainfall event;

(iii) Free of cracks or gaps; and

(iv) Designed and installed to completely surround the tank and to cover all surrounding earth likely to come into contact with the waste if released from the tank(s) (i.e., capable of preventing lateral as well as vertical migration of the waste).

(2) Vault systems must be:

(i) Designed or operated to contain 100 percent of the capacity of the largest tank within its boundary;

(ii) Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient to contain run-on or infiltration. Such additional capacity must be sufficient to contain precipitation from a 25-year, 24-hour rainfall event;

(iii) Constructed with chemical-resistant water stops in place at all joints (if any);

(iv) Provided with an impermeable interior coating or lining that is compatible with the stored waste and that will prevent migration of waste into the concrete;

(v) Provided with a means to protect against the formation of and ignition of vapors within the vault, if the waste being stored or treated:

(A) Meets the definition of ignitable waste under § 262.21 of this chapter, or

(B) Meets the definition of reactive waste under § 262.21 of this chapter and may form an ignitable or explosive vapor; and

(vi) Provided with an exterior moisture barrier or be otherwise designed or operated to prevent migration of moisture into the vault if the vault is subject to hydraulic pressure.

(3) Double-walled tanks must be:

(i) Designed as an integral structure (i.e., an inner tank within an outer shell) so that any release from the inner tank is contained by the outer shell;

(ii) Protected, if constructed of metal, from both corrosion of the primary tank interior and the external surface of the outer shell; and

(iii) Provided with a built-in, continuous leak detection system capable of detecting a release within 24 hours or at the earliest practicable time, if the owner or operator can demonstrate to the Regional Administrator, and the Regional Administrator concurs, that the existing leak detection technology or site conditions will not allow detection of a release within 24 hours.

[Note.—The provisions outlined in the Steel Tank Institute's (STI) "Standard for Dual Wall Underground Steel Storage Tank" may be used as guidelines for aspects of the design of underground steel double-walled tanks.]

(f) Ancillary equipment must be provided with full secondary containment (e.g., trench, jacketing, double-walled piping) that meets the requirements of paragraphs (b) and (c) of this section except for:

(1) Aboveground piping (exclusive of flanges, joints, valves, and connections) that are visually inspected for leaks on a daily basis;

(2) Welded flanges, welded joints, and welded connections that are visually inspected for leaks on a daily basis;

(3) Sealless or magnetic coupling pumps that are visually inspected for leaks on a daily basis; and

(4) Pressurized aboveground piping systems with automatic shut-off devices (e.g., excess flow check valves, flow metering shutdown devices, loss of pressure actuated shut-off devices) that are visually inspected for leaks on a daily basis.

(g) The owner or operator may obtain a variance from the requirements of this Section if the Regional Administrator finds, as a result of a demonstration by the owner or operator, either:

(1) That alternative design and operating practices, together with location characteristics, will prevent the migration of hazardous waste or hazardous constituents into the ground water or surface water at least as effectively as secondary containment during the active life of the tank system or (2) that in the event of a release that does migrate to ground water or surface water, no substantial present or potential hazard will be posed to human health or the environment. New underground tank systems may not, per a demonstration in accordance with paragraph (g)(2) of this section, be exempted from the secondary containment requirements of this section. Application for a variance as allowed in paragraph (g) of this section does not waive compliance with the requirements of this Subpart for new tank systems.

(1) In deciding whether to grant a variance based on a demonstration of equivalent protection of ground water and surface water, the Regional Administrator will consider:

(i) The nature and quantity of the waste;

(ii) The proposed alternate design and operation;

(iii) The hydrogeologic setting of the facility, including the thickness of soils between the tank system and ground water; and

(iv) All other factors that would influence the quality and mobility of the hazardous constituents and the potential for them to migrate to ground water or surface water.

(2) In deciding whether to grant a variance, based on a demonstration of no substantial present or potential hazard, the Regional Administrator will consider:

(i) The potential adverse effects on ground water, surface water, and land quality taking into account:

(A) The physical and chemical characteristics of the waste in the tank system, including its potential for migration,

(B) The hydrogeological characteristics of the facility and surrounding land,

(C) The potential for health risks caused by human exposure to waste constituents,

(D) The potential for damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents, and

(E) The persistence and permanence of the potential adverse effects;

(ii) The potential adverse effects of a release on ground-water quality, taking into account:

(A) The quantity and quality of ground water and the direction of ground-water flow,

(B) The proximity and withdrawal rates of water in the area,

(C) The current and future uses of ground water in the area, and

(D) The existing quality of ground water, including other sources of contamination and their cumulative impact on the ground-water quality;

(iii) The potential adverse effects of a release on surface water quality, taking into account:

(A) The quantity and quality of ground water and the direction of ground-water flow,

(B) The patterns of rainfall in the region,

(C) The proximity of the tank system to surface waters,

(D) The current and future uses of surface waters in the area and any water quality standards established for those surface waters, and

(E) The existing quality of surface water, including other sources of contamination and the cumulative impact on surface-water quality; and

(iv) The potential adverse effects of a release on the land surrounding the tank system, taking into account:

(A) The patterns of rainfall in the region, and

(B) The current and future uses of the surrounding land.

(3) The owner or operator of a tank system, for which a variance from secondary containment had been granted in accordance with the requirements of paragraph (g)(1) of this section, at which a release of hazardous waste has occurred from the primary tank system but has not migrated beyond the zone of engineering control (as established in the variance), must:

(i) Comply with the requirements of § 265.196, except paragraph (d); and

(ii) Decontaminate or remove contaminated soil to the extent necessary to:

(A) Enable the tank system, for which the variance was granted, to resume operation with the capability for the detection of and response to releases at least equivalent to the capability it had prior to the release, and

(B) Prevent the migration of hazardous waste or hazardous constituents to ground water or surface water; and

(iii) If contaminated soil cannot be removed or decontaminated in accordance with paragraph (g)(3)(ii) of this section, comply with the requirements of § 264.197(b);

(4) The owner or operator of a tank system, for which a variance from secondary containment had been granted in accordance with the requirements of paragraph (g)(1) of this section, at which a release of hazardous waste has occurred from the primary tank system and has migrated beyond the zone of engineering control (as established in the variance), must:

(i) Comply with the requirements of § 265.196(a), (b), (c), and (d); and

(ii) Prevent the migration of hazardous waste or hazardous constituents to ground water or surface water, if possible, and decontaminate or remove contaminated soil. If contaminated soil cannot be decontaminated or removed, or if ground water has been contaminated, the owner or operator must comply with the requirements of § 265.197(b);

(iii) If repairing, replacing, or reinstalling the tank system, provide secondary containment in accordance with the requirements of paragraphs (a) through (f) of this section or reapply for a variance from secondary containment and meet the requirements for new tank systems in § 265.192 if the tank system is replaced. The owner or operator must comply with these requirements even if contaminated soil can be decontaminated or removed, and ground water or surface water has not been contaminated.

(h) The following procedures must be followed in order to request a variance from secondary containment:

(1) The Regional Administrator must be notified in writing by the owner or operator that he intends to conduct and submit a demonstration for a variance from secondary containment as allowed in paragraph (g) of this section according to the following schedule:

(i) For existing tank systems, at least 24 months prior to the date that secondary containment must be provided in accordance with paragraph (a) of this section; and

(ii) For new tank systems, at least 30 days prior to entering into a contract for installation of the tank system.

(2) As part of the notification, the owner or operator must also submit to the Regional Administrator a description of the steps necessary to conduct the demonstration and a timetable for completing each of the steps. The demonstration must address each of the factors listed in paragraph (g)(1) or paragraph (g)(2) of this section.

(3) The demonstration for a variance must be completed and submitted to the Regional Administrator within 180 days after notifying the Regional Administrator of intent to conduct the demonstration.

(4) The Regional Administrator will inform the public, through a newspaper notice, of the availability of the demonstration for a variance. The notice shall be placed in a daily or weekly major local newspaper of general circulation and shall provide at least 30 days from the date of the notice for the public to review and comment on the demonstration for a variance. The Regional Administrator also will hold a public hearing, in response to a request or at his own discretion, whenever such a hearing might clarify one or more issues concerning the demonstration for a variance. Public notice of the hearing will be given at least 30 days prior to the date of the hearing and may be given at the same time as notice of the opportunity for the public to review and comment on the demonstration. These two notices may be combined.

(5) The Regional Administrator will approve or disapprove the request for a variance within 90 days of receipt of the demonstration from the owner or operator and will notify in writing the owner or operator and each person who submitted written comments or requested notice of the variance decision. If the demonstration for a variance is incomplete or does not

include sufficient information, the 90-day time period will begin when the Regional Administrator receives a complete demonstration, including all information necessary to make a final determination. If the public comment period in paragraph (h)(4) of this section is extended, the 90-day time period will be similarly extended.

(i) All tank systems, until such time as secondary containment meeting the requirements of this section is provided, must comply with the following:

(1) For non-enterable underground tanks, a leak test that meets the requirements of § 265.191(a) must be conducted at least annually;

(2) For other than non-enterable underground tanks and for all ancillary equipment, an annual leak test, as described in paragraph (i)(1) of this section, or an internal inspection or other tank integrity examination by an independent, qualified, registered professional engineer that addresses cracks, leaks, corrosion, and erosion must be conducted at least annually. The owner or operator must remove the stored waste from the tank, if necessary, to allow the condition of all internal tank surfaces to be assessed.

[Note.—The practices described in the American Petroleum Institute (API) Publication Guide for Inspection of Refining Equipment, Chapter XIII, "Atmospheric and Low Pressure Storage Tanks," 4th edition, 1981, may be used, when applicable, as guidelines for assessing the overall condition of the tank system.]

(3) The owner or operator must maintain on file at the facility a record of the results of the assessments conducted in accordance with paragraphs (i)(1) through (i)(3) of this section.

(4) If a tank system or component is found to be leaking or unfit-for-use as a result of the leak test or assessment in paragraphs (i)(1) through (i)(3) of this section, the owner or operator must comply with the requirements of § 265.196.

(Information collection requirements contained in paragraphs (c)–(e) and (g)–(i) were approved by the Office of Management and Budget under control number 2050–0050.)

§ 265.194 General operating requirements.

(a) Hazardous wastes or treatment reagents must not be placed in a tank system if they could cause the tank, its ancillary equipment, or the secondary containment system to rupture, leak, corrode, or otherwise fail.

(b) The owner or operator must use appropriate controls and practices to prevent spills and overflows from tank or secondary containment systems. These include at a minimum:

(1) Spill prevention controls (e.g., check valves, dry discount couplings);

(2) Overfill prevention controls (e.g., level sensing devices, high level alarms, automatic feed cutoff, or bypass to a standby tank); and

(3) Maintenance of sufficient freeboard in uncovered tanks to prevent overtopping by wave or wind action or by precipitation.

(c) The owner or operator must comply with the requirements of § 265.196 if a leak or spill occurs in the tank system.

(Information collection requirements contained in paragraphs (c) were approved by the Office of Management and Budget under control number 2050–0050.)

§ 265.195 Inspections.

(a) The owner or operator must inspect, where present, at least once each operating day:

(1) Overfill/spill control equipment (e.g., waste-feed cutoff systems, bypass systems, and drainage systems) to ensure that it is in good working order;

(2) The aboveground portions of the tank system, if any, to detect corrosion or releases of waste;

(3) Data gathered from monitoring equipment and leak-detection equipment, (e.g., pressure and temperature gauges, monitoring wells) to ensure that the tank system is being operated according to its design; and

(4) The construction materials and the area immediately surrounding the externally accessible portion of the tank system including secondary containment structures (e.g., dikes) to detect erosion or signs of releases of hazardous waste (e.g., wet spots, dead vegetation);

[Note.—Section 265.15(c) requires the owner or operator to remedy any deterioration or malfunction he finds. Section 265.196 requires the owner or operator to notify the Regional Administrator within 24 hours of confirming a release. Also, 40 CFR Part 302 may require the owner or operator to notify the National Response Center of a release.]

(b) The owner or operator must inspect cathodic protection systems, if present, according to, at a minimum, the following schedule to ensure that they are functioning properly:

(1) The proper operation of the cathodic protection system must be confirmed within six months after initial installation, and annually thereafter; and

(2) All sources of impressed current must be inspected and/or tested, as appropriate, at least bimonthly (i.e., every other month).

[Note.—The practices described in the National Association of Corrosion Engineers (NACE) standard, "Recommended Practice (RP–02–85)—Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems," and the American Petroleum Institute (API) Publication 1632, "Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems," may be used, where applicable, as guidelines in maintaining and inspecting cathodic protection systems.]

(c) The owner or operator must document in the operating record of the facility an inspection of those items in paragraphs (a) and (b) of this section.

(Information collection requirements contained in paragraphs (a)–(c) were approved by the Office of Management and Budget under control number 2050–0050.)

§ 265.196 Response to leaks or spills and disposition of leaking or unfit-for-use tank systems.

A tank system or secondary containment system from which there has been a leak or spill, or which is unfit for use, must be removed from service immediately, and the owner or operator must satisfy the following requirements:

(a) *Cessation of use; prevent flow or addition of wastes.* The owner or operator must immediately stop the flow of hazardous waste into the tank system or secondary containment system and inspect the system to determine the cause of the release.

(b) *Removal of waste from tank system or secondary containment system.* (1) If the release was from the tank system, the owner or operator must, within 24 hours after detection of the leak or, if the owner or operator demonstrates that that is not possible, at the earliest practicable time remove as much of the waste as is necessary to prevent further release of hazardous waste to the environment and to allow inspection and repair of the tank system to be performed.

(2) If the release was to a secondary containment system, all released materials must be removed within 24 hours or in as timely a manner as is possible to prevent harm to human health and the environment.

(c) *Containment of visible releases to the environment.* The owner or operator must immediately conduct a visual inspection of the release and, based upon that inspection:

(1) Prevent further migration of the leak or spill to soils or surface water; and

(2) Remove, and properly dispose of, any visible contamination of the soil or surface water.

(d) *Notifications, reports.* (1) Any release to the environment, except as provided in paragraph (d)(2) of this section, must be reported to the Regional Administrator within 24 hours of detection. If the release has been reported pursuant to 40 CFR Part 302, that report will satisfy this requirement.

(2) A leak or spill of hazardous waste that is:

(i) Less than or equal to a quantity of one (1) pound, and

(ii) Immediately contained and cleaned-up is exempted from the requirements of this paragraph.

(3) Within 30 days of detection of a release to the environment, a report containing the following information must be submitted to the Regional Administrator:

(i) Likely route of migration of the release;

(ii) Characteristics of the surrounding soil (soil composition, geology, hydrogeology, climate);

(iii) Results of any monitoring or sampling conducted in connection with the release, (if available). If sampling or monitoring data relating to the release are not available within 30 days, these data must be submitted to the Regional Administrator as soon as they become available.;

(iv) Proximity to downgradient drinking water, surface water, and population areas; and

(v) Description of response actions taken or planned.

(e) *Provision of secondary containment, repair, or closure.* (1) Unless the owner or operator satisfies the requirements of paragraphs (e) (2) through (4) of this section, the tank system must be closed in accordance with § 265.197.

(2) If the cause of the release was a spill that has not damaged the integrity of the system, the owner/operator may return the system to service as soon as the released waste is removed and repairs, if necessary, are made.

(3) If the cause of the release was a leak from the primary tank system into the secondary containment system, the system must be repaired prior to returning the tank system to service.

(4) If the source of the release was a leak to the environment from a component of a tank system without secondary containment, the owner/operator must provide the component of the system from which the leak occurred with secondary containment that satisfies the requirements of § 265.193 before it can be returned to service, unless the source of the leak is an aboveground portion of a tank system. If the source is an aboveground component that can be inspected visually, the component must be repaired and may be returned to service without secondary containment as long as the requirements of paragraph (f) of this section are satisfied. If a component is replaced to comply with the requirements of this subparagraph, that component must satisfy the requirements for new tank systems or components in §§ 265.192 and 265.193. Additionally, if a leak has occurred in any portion of a tank system component that is not readily accessible for visual inspection (e.g., the bottom of an inground or onground tank), the entire component must be provided with secondary containment in accordance with § 265.193 prior to being returned to use.

(f) *Certification of major repairs.* If the owner or operator has repaired a tank system in accordance with paragraph (e) of this section, and the repair has been extensive (e.g., installation of an internal liner; repair of a ruptured primary containment or secondary containment vessel), the tank system must not be returned to service unless the owner/operator has obtained a certification by an independent, qualified, registered professional engineer in accordance with § 270.11(d) that the repaired system is capable of handling hazardous wastes without release for the intended life of the system. This certification must be submitted to the Regional Administrator within seven days after returning the tank system to use.

[Note.—The Regional Administrator may, on the basis of any information received that there is or has been a release of hazardous waste or hazardous constituents into the environment, issue an order under RCRA sections 3004(w), 3008(h), or 7003(a) requiring corrective action or such other response as deemed necessary to protect human health or the environment.]

[Note.—See § 265.15(c) for the requirements necessary to remedy a failure. Also, 40 CFR Part 302 requires the owner or operator to notify the National Response Center of a release of any "reportable quantity."]

(Information collection requirements contained in paragraphs (d)–(f) were approved by the Office of Management and Budget under control number 2050-0050.)

§ 265.197 Closure and post-closure care.

(a) At closure of a tank system, the owner or operator must remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated soils, and structures and equipment contaminated with waste, and manage them as hazardous waste, unless § 261.3(d) of this Chapter applies. The closure plan, closure activities, cost estimates for closure, and financial responsibility for tank systems must meet all of the requirements specified in Subparts G and H of this Part.

(b) If the owner or operator demonstrates that not all contaminated soils can be practicably removed or decontaminated as required in paragraph (a) of this section, then the owner or operator must close the tank system and perform post-closure care in accordance with the closure and post-closure care requirements that apply to landfills (§ 265.310) In addition, for the purposes of closure, post-closure, and financial responsibility, such a tank system is then considered to be a landfill, and the owner or operator must meet all of the requirements for landfills specified in Subparts G and H of this Part.

(c) If an owner or operator has a tank system which does not have secondary containment that meets the requirements of § 265.193(b) through (f) and which is not exempt from the secondary containment requirements in accordance with § 265.193(g), then,

(1) The closure plan for the tank system must include both a plan for complying with paragraph (a) of this section and a contingent plan for complying with paragraph (b) of this section.

(2) A contingent post-closure plan for complying with paragraph (b) of this section must be prepared and submitted as part of the permit application.

(3) The cost estimates calculated for closure and post-closure care must reflect the costs of complying with the contingent closure plan and the contingent post-closure plan, if these costs are greater than the costs of complying with the closure plan prepared for the expected closure under paragraph (a) of this section.

(4) Financial assurance must be based on the cost estimates in paragraph (c)(3) of this section.

(5) For the purposes of the contingent closure and post-closure plans, such a tank system is considered to be a landfill, and the contingent plans must meet all of the closure, post-closure, and financial responsibility requirements for landfills under Subparts G and H of this Part.

(Information collection requirements contained in paragraphs (a)–(c) were approved by the Office of Management and Budget under control number 2050-0050.)

§ 265.198 Special requirements for ignitable or reactive wastes.

(a) Ignitable or reactive waste must not be placed in a tank system, unless:

(1) The waste is treated, rendered, or mixed before or immediately after placement in the tank system so that:

(i) The resulting waste, mixture, or dissolved material no longer meets the definition of ignitable or reactive waste under §§ 261.21 or 261.23 of this Chapter; and

(ii) Section 265.17(b) is complied with; or

(2) The waste is stored or treated in such a way that it is protected from any material or conditions that may cause the waste to ignite or react; or

(3) The tank system is used solely for emergencies.

(b) The owner or operator of a facility where ignitable or reactive waste is stored or treated in tanks must comply with the requirements for the maintenance of protective distances between the waste management area and any public ways, streets, alleys, or an adjoining property line that can be built upon as required in Tables 2–1 through 2–6 of the National Fire Protection Association's "Flammable and Combustible Liquids Code," (1977 or 1981), (incorporated by reference, see § 260.11).

§ 265.199 Special requirements for incompatible wastes.

(a) Incompatible wastes, or incompatible waste and materials, must not be placed in the same tank system, unless § 265.17(b) is complied with.

(b) Hazardous waste must not be placed in a tank system that has not been decontaminated and that previously held an incompatible waste or material, unless § 265.17(b) is complied with.

§ 265.200 Waste analysis and trial tests.

In addition to performing the waste analysis required by § 265.13, the owner or operator must, whenever a tank system is to be used to treat chemically or to store a hazardous waste that is substantially different from waste previously treated or stored in that tank system; or treat chemically a hazardous waste with a substantially different process than any previously used in that tank system:

(a) Conduct waste analyses and trial treatment or storage tests (e.g., bench-scale or pilot-plant scale tests); or

(b) Obtain written, documented information on similar waste under similar operating conditions to show that the proposed treatment or storage will meet the requirements of § 265.194(a).

[Note.—Section 265.13 requires the waste analysis plan to include analyses needed to comply with §§ 265.198 and 265.199. Section 265.73 requires the owner or operator to place the results from each waste analysis and trial test, or the documented information, in the operating record of the facility.]

§ 265.201 Special requirements for generators of between 100 and 1,000 kg/mo that accumulate hazardous waste in tanks.

(a) The requirements of this section apply to small quantity generators of more than 100 kg but less than 1,000 kg of hazardous waste in a calendar month, that accumulate hazardous waste in tanks for less than 180 days (or 270 days if the generator must ship the waste greater than 200 miles), and do not accumulate over 6,000 kg on-site at any time.

(b) Generators of between 100 and 1,000 kg/mo hazardous waste must comply with the following general operating requirements:

(1) Treatment or storage of hazardous waste in tanks must comply with § 265.17(b).

(2) Hazardous wastes or treatment reagents must not be placed in a tank if they could cause the tank or its inner liner to rupture, leak, corrode, or otherwise fail before the end of its intended life.

(3) Uncovered tanks must be operated to ensure at least 60 centimeters (2 feet) of freeboard, unless the tank is equipped with a containment structure (e.g., dike or trench), a drainage control system, or a diversion structure (e.g., standby tank) with a capacity that equals or exceeds the volume of the top 60 centimeters (2 feet) of the tank.

(4) Where hazardous waste is continuously fed into a tank, the tank must be equipped with a means to stop this inflow (e.g., waste feed cutoff system or by-pass system to a stand-by tank).

[Note.—These systems are intended to be used in the event of a leak or overflow from the tank due to a system failure (e.g., a malfunction in the treatment process, a crack in the tank, etc.).]

(c) Generators of between 100 and 1,000 kg/mo accumulating hazardous waste in tanks must inspect, where present:

(1) Discharge control equipment (e.g., waste feed cutoff systems, by-pass systems, and drainage systems) at least once each operating day, to ensure that it is in good working order;

(2) Data gathered from monitoring equipment (e.g., pressure and temperature gauges) at least once each operating day to ensure that the tank is being operated according to its design;

(3) The level of waste in the tank at least once each operating day to ensure compliance with § 265.192(c);

(4) The construction materials of the tank at least weekly to detect corrosion or leaking of fixtures or seams; and

(5) The construction materials of, and the area immediately surrounding, discharge confinement structures (e.g., dikes) at least weekly to detect erosion or obvious signs of leakage (e.g., wet spots or dead vegetation).

[Note.—As required by § 265.15(c), the owner or operator must remedy any deterioration or malfunction he finds.]

(d) Generators of between 100 and 1,000 kg/mo accumulating hazardous waste in tanks must, upon closure of the facility, remove all hazardous waste from tanks, discharge control equipment, and discharge confinement structures.

[Note.—At closure, as throughout the operating period, unless the owner or operator can demonstrate, in accordance with § 261.3(c) or (d) of this chapter, that any solid waste removed from his tank is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of Parts 262, 263, and 265 of this chapter.]

(e) Generators of between 100 and 1,000 kg/mo must comply with the following special requirements for ignitable or reactive waste:

(1) Ignitable or reactive waste must not be placed in a tank, unless:

(i) The waste is treated, rendered, or mixed before or immediately after placement in a tank so that (A) the resulting waste, mixture, or dissolution of material no longer meets the definition of ignitable or reactive waste under § 261.21 or § 261.23 of this Chapter, and (B) § 265.17(b) is complied with; or

(ii) The waste is stored or treated in such a way that it is protected from any material or conditions that may cause the waste to ignite or react; or

(iii) The tank is used solely for emergencies.

(2) The owner or operator of a facility which treats or stores ignitable or reactive waste in covered tanks must comply with the buffer zone requirements for tanks contained in Tables 2–1 through 2–6 of the National Fire Protection Association's "Flammable and Combustible Liquids Code," (1977 or 1981) (incorporated by reference, see § 260.11).

(f) Generators of between 100 and 1,000 kg/mo must comply with the following special requirements for incompatible wastes:

(1) Incompatible wastes, or incompatible wastes and materials, (see Appendix V for examples) must not be placed in the same tank, unless § 265.17(b) is complied with.

(2) Hazardous waste must not be placed in an unwashed tank which previously held an incompatible waste

or material, unless § 265.17(b) is complied with.

PART 270—EPA ADMINISTERED PERMIT PROGRAMS: THE HAZARDOUS WASTE PERMIT PROGRAM

40 CFR Part 270 is amended as follows:

22. The authority citation for Part 270 continues to read as follows:

Authority: Secs. 1006, 2002, 3005, 3007, 3019, and 7004 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6905, 6912, 6925, 6927, 6939, and 6974).

23. Section 270.14 is amended by revising paragraphs (b)(5) and (b)(13) to read as follows:

§ 270.14 Contents of Part B: general requirements.

* * * * *

(b) * * *

(5) A copy of the general inspection schedule required by § 264.15(b); include where applicable, as part of the inspection schedule, specific requirements in §§ 264.174, 264.193(i), 264.195, 264.226, 264.254, 264.273, and 264.303.

* * * * *

(13) A copy of the closure plan and, where applicable, the post-closure plan required by §§ 264.112, 264 118, and 264.197. Include, where applicable, as part of the plans, specific requirements in §§ 264.178, 264.197, 264.228, 264.258, 264.280, 264 310, and 264.351.

* * * * *

24. Section 270.16, is revised to read as follows:

§ 270.16 Specific Part B information requirements for tank systems.

Except as otherwise provided in § 264.190, owners and operators of facilities that use tanks to store or treat hazardous waste must provide the following additional information:

(a) A written assessment that is reviewed and certified by an independent, qualified, registered professional engineer to the structural integrity and suitability for handling hazardous waste of each tank system, as required under §§ 264.191 and 264.192;

(b) Dimensions and capacity of each tank;

(c) Description of feed systems, safety cutoff, bypass systems, and pressure controls (e.g., vents);

(d) A diagram of piping, instrumentation, and process flow for each tank system;

(e) A description of materials and equipment used to provide external corrosion protection, as required under § 264.191(c);

(f) For new tank systems, a detailed description of how the tank system(s) will be installed in compliance with § 264.192 (b), (c), (d), and (e);

(g) Detailed plans and description of how the secondary containment system for each tank system is or will be designed, constructed, and operated to meet the requirements of § 264.193 (a), (b), (c), (d), (e), and (f);

(h) For tank systems for which a variance from the requirements of § 264.193 is sought (as provided by §§ 264.193(g)):

(1) Detailed plans and engineering and hydrogeologic reports, as appropriate, describing alternate design and operating practices that will, in conjunction with location aspects, prevent the migration of any hazardous waste or hazardous constituents into the ground water or surface water during the life of the facility, or

(2) A detailed assessment of the substantial present or potential hazards posed to human health or the environment should a release enter the environment.

(i) Description of controls and practices to prevent spills and overflows, as required under § 264.194(b); and

(j) For tank systems in which ignitable, reactive, or incompatible wastes are to be stored or treated, a description of how operating procedures and tank system and facility design will achieve compliance with the requirements of §§ 264.198 and 264.199.

(Information collection requirements contained in paragraphs (a)–(j) were approved by the Office of Management and Budget under control number 2050–0050.)

§ 270.72 [Amended].

25. In § 270.72, paragraph (e) is amended by adding the following sentence after the last sentence:

§ 270.72 Changes during interim status.

* * * * *

(e) * * * Changes under this section do not include changes made solely for the purpose of complying with requirements of § 265.193 for tanks and ancillary equipment.

PART 271—REQUIREMENTS FOR AUTHORIZATION OF STATE HAZARDOUS WASTE PROGRAMS

26. The authority citation for Part 271 continues to read as follows:

Authority: Sec. 1006, 2002(a), and 3006 of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6905, 6912(a), and 6926).

§ 271.1 [Amended]

27. In § 271.1, paragraph (j) is amended by adding the following entry to Table 1 in chronological order by date of publication:

TABLE 1.—REGULATIONS IMPLEMENTING THE HAZARDOUS AND SOLID WASTE AMENDMENTS OF 1984

Date	Title of Regulation	Federal Register Reference
* * *	*	*
July 14, 1986	Hazardous Waste Tank Regulations[1]—260.10; 262.34(a)(1); 264.110; 264.140; 264.190–264.199; 265.110; 265.140; 265.190–265.200; 270.14(b); 270.16; and 270.72(e).	51 FR [Insert page number]
* * *	*	*

[1]These regulations implement HSWA only to the extent that they apply to tank systems owned or operated by small quantity generators, establish leak detection requirements for all new underground tank systems, and establish permitting standards for underground tank systems that cannot be entered for inspection.

[FR Doc. 86–15265 Filed 7–11–86; 8:45 am]

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ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 260, 261, 262, 264, 265, 270, and 271

[SWH-FRL-3066-1]

Hazardous Waste Management System; Standards for Hazardous Waste Storage and Treatment Tank Systems

AGENCY: Environmental Protection Agency.

ACTION: Final rule; correction.

SUMMARY: This document corrects typographical and other errors in a final rule for hazardous waste storage and treatment tank systems under the Resource Conservation and Recovery Act (RCRA) that appeared in the Federal Register of Monday, July 14, 1986, (51 FR 25422).

FOR FURTHER INFORMATION CONTACT: The RCRA/Superfund Hotline, at (800) 424-9346 (toll free) or (202) 382-3000 in Washington, DC, or William J. Kline, Office of Solid Waste (WH-565), U.S. Environmental Protection Agency, Washington, DC 20460, (202) 382-7917.

SUPPLEMENTARY INFORMATION: On July 14, 1986 (51 FR 25422), EPA issued a final rule that revised the standards for hazardous waste storage and treatment tank systems. Today, EPA is correcting several typographical and other errors contained in the July 14 final rule.

Dated: August 8, 1986.

J.W. McGraw,

Acting Assistant Administrator for Office of Solid Waste and Emergency Response.

The following corrections are made in the preamble for FRL 3023-9 (FR Doc. 15266), The Hazardous Waste Management System: Standards for Hazardous Waste Storage and Treatment Tank Systems, published in the Federal Register on July 14, 1986, (51 FR 25422).

1. On page 25444, column 3, the second sentence of the first full paragraph, which reads "Concurrently, in today's Federal Register, EPA is proposing revised tank system standards that would apply to these generators," is corrected to read as follows: "In the future, EPA will propose revised tank system standards that would apply to these generators."

2. On page 25447, column 1, first paragraph, last line, "§§ 264.191 and 265.191" is corrected to read "§§ 264.192 and 265.192."

3. On page 25455, column 3, last paragraph, second line, §§ 264.196(b) and 265.196(b)" is corrected to read "§§ 264.196(e) and 265.196(e)."

4. On page 25456, column 2, first full paragraph, fifth line, "§§ 264.196(b) and 265.196(b)" is corrected to read "§§ 264.196(f) and 265.196(f)."

5. On page 25469, column 2, first full paragraph, fourth line, "June 16, 1985" is corrected to read "June 26, 1985."

The following corrections are made in the rules for FRL 3023-9, the Hazardous Waste Management System: Standards for Hazardous Waste Storage and Treatment Tank System, published in the Federal Register on July 14, 1986, (51 FR 25422).

§ 264.190 [Corrected]

1. On page 25472, column 3, § 264.190, paragraph (b), line 6, the reference to "§ 264 193" is corrected to read "§ 264.193."

§ 264.191 [Corrected]

2. On page 25473, column 1, § 264.191, the last sentence, "Approved by the Office of Management and Budget under control number 2050-0050.)" is corrected to read "(Information collection requirements contained in paragraphs (a) thru (d) were approved by the Office of Management and Budget under control number 2050-0050.)"

§ 264.192 [Corrected]

3. On page 25473, column 3, § 264.192, the word "component" in line 13 of paragraph (b) is corrected to read "components."

§ 264.193 [Corrected]

4. On page 25474, column 2, § 264.193, the word "and" at the end of line 5 of paragraph (a)(3) is removed.

5. On page 25474, column 3, § 264.193, line 4 of paragraph (e)(1)(iv) is corrected by inserting the words "the waste is" after the word "if."

6. On page 25475, column 1, § 264.193, the word "Joints" in line 3 of paragraph (e)(2)(iii) is corrected to read "joints."

7. On page 25475, column 2, § 264.193, the word "Joints" in line 1 of paragraph (f)(2) is corrected to read "joints."

8. On page 25476, column 2, § 264.193, paragraph (i)(1), the reference to "§ 264.191(a)" is corrected to read "§ 264.191(b)(5)."

9. On page 25476, column 2, § 264.193, paragraph (i)(2), lines 3 through 5 which read "operator must either (i) conduct a leak test as in paragraph (i)(1) or (ii) of this section develop a schedule and" are corrected to read as follows: "operator must either conduct a leak test as in paragraph (i)(1) of this section or develop a schedule and."

§ 264.196 [Corrected]

10. On page 25477, column 2, § 264.196, paragraph (d)(2) is corrected to read as follows:

(2) A leak or spill of hazardous waste is exempted from the requirements of this paragraph if it is:

(i) Less than or equal to a quantity of one (1) pound, and

(ii) Immediately contained and cleaned up.

11. On page 25477, column 2, § 264.196, paragraph (d)(3)(iv), the word "population" is corrected to read "populated."

12. On page 25478, column 1, § 264.196, line 4, the reference to "sections 3004(w)" is corrected to read "sections 3004(u)."

§ 265.192 [Corrected]

13. On page 25478, column 1, § 264.197, paragraph (c), line 5 is corrected by removing the words "is not exempt" and inserting in their place, the words "has not been granted a variance."

§ 264.192 [Corrected]

14. On page 25480, column 1, § 265.192, paragraph (a)(3)(i)(G) is corrected to read as follows: "(G) Stray electric current; and ,".

15. On page 25480, column 1, § 265.192, paragraph (a)(3)(ii)(A), line 3 is corrected by deleting the term "etc."

16. On page 25480, column 1, § 265.192, paragraph (a)(3)(ii)(B) line 2 is corrected by removing the term "etc."

17. On page 25480, column 1, § 265.192, paragraph (a)(3)(ii)(C), line 2 is corrected to read "insulating joints and flanges."

§ 265.193 [Corrected]

18. On page 25480, column 3, § 265.193, paragraph (a)(4), line 4 is corrected by removing the word "age" that appears after the word "facility."

19. On page 25481, column 2, § 265.193, paragraph (e)(2)(ii), line 5 is corrected by inserting the words "excess capacity" after the word "sufficient."

20. On page 25481, column 3, § 265.193, paragraph (g), line 6 is corrected by removing the number "(1)," lower-casing "that" and making the text continuous after the colon.

21. On page 25481, column 3, § 265.193, paragraph (g), line 14 is corrected by italicizing the word "or" and removing the number "(2)."

22. On page 25483, column 1, § 265.193, paragraph (i)(1), line 3, the reference to "§ 265.191(a)" is corrected to read "§ 265.191(b)(5)."

§ 270.16 [Corrected]

23. On page 25486, column 1, § 270.16, paragraph (a), line 4 is corrected by inserting the word "as" after the word "engineer."

24. On page 25486, column 2, § 270.16, paragraph (e), line 4, the reference to § 264.191(c)" is corrected to read "§ 264.192(a)(3)(ii)."

§ 271.1 [Corrected]

25. On page 25486, column 3, § 271.1 Table 1 is corrected by inserting the page number "25422" under the heading of "Federal Register Reference."

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APPENDIX C

Unsaturated Zone Monitoring Instruments

APPENDIX C

UNSATURATED ZONE MONITORING INSTRUMENTS

C1. SOIL SAMPLER MONITORING INSTRUMENTS

C1.1 Soil Samplers

Numerous soil samplers are available that extract both cores and soil chips. The samples obtained by these samplers may analyze both the solid and pore water portion of the sample. Both the solids and the pore water may be analyzed for these samples. Soil sampling is a destructive technique, however, since it does not allow repeated samples at the same location and also could create pathways for waste to migrate to a greater depth at a faster speed than predicted. Therefore, soil sampling is not recommended as an unsaturated zone monitoring method for hazardous waste tank systems.

C1.2 Pore Water Samplers

Pore water samplers are used to extract interstitial water from sediments during movement through the unsaturated zone. They are effective during unsaturated flow in soils or sediments in which most liquids move through the pore spaces. Samples are drawn into the instruments through porous ceramic, teflon, or aluminum cups or tubing that become continuous with the pore spaces of the soil when properly installed. When a negative pressure is applied, pore water flows into the cup and a sample can be withdrawn. Other designs use absorbent fibers to draw pore water from the soil to the sampling instrument.

C1.2.1 Limitations of Pore Water Samplers

A primary limitation of pore water sampling is the lag time for analysis of the pore fluid. The hazardous waste tank system regulations require interstitial monitoring devices to detect a leak within 24 hours (or at the earliest practicable time if the owner/operator can demonstrate to the Regional Administrator that the existing detection technologies or site conditions will not allow detection within 24 hours). If a significant lag time such as 14 to 30 days exists before chemical analysis, the monitoring system may not qualify for a variance because of the possibility that waste constituents may contaminate the ground water before they are detected.

To improve detection of releases from hazardous waste tank systems, tank system owners or operators might consider using tracer chemicals which can be analyzed quickly. Fluorescent dyes detected by ultraviolet lights, radioactive tracers, and volatile chemicals for vapor monitoring devices may be appropriate tracers. As part of the demonstration for the variance, the tank owner must show that the waste constituents or sediments will not inhibit the property of the tracer being analyzed.

In order to be effective, pore water samplers must be operated under the range of conditions for which they were designed. During the demonstration for a variance, the tank owner or operator must first specify the ranges of potential matrices, soil moisture, pore size, and grain size in the unsaturated zone at the site. Second, the owner or operator must show that the monitoring instruments are effective under the site specific conditions to which they will be subjected. Data from bench scale lab tests, the technical literature, and the manufacturer may be used to illustrate this instrument effectiveness. (See Everett 1985 for operating ranges of suction lysimeters.) The demonstration should include bench scale tests for both a low and high soil moisture content.

Proper installation is another critical factor in the performance of these systems. The tank owner/operator should be prepared to document that the installation procedures followed are compatible with operation of the instruments. Table C-1 summarizes common problems in the use of suction-type samplers.

For an effective monitoring network, suction pore-water samplers should be spaced neither too close together nor too far apart. The sampling radius or radius of influence is the area from which the instrument can draw pore water. Morrison and Szecsody (1985) calculated that for lysimeter diameters of 2.2 to 10.1 cm, the maximum radius of influence ranged from 43 cm for the smallest lysimeter to 92 cm for the largest lysimeter in fine soil, since fine soils have the greatest radius of sampling influence. Morrison and Szecsody also determined that a lysimeter with a diameter of 5.1 cm has a sampling radius of less than 10 cm in coarse soils, and about 65 cm in fine soils. These types of calculations will be necessary to determine the number and placement of lysimeters (Morrison 1986; Morrison 1983).

Table C-1 Factors Limiting the Operation of Suction-Type Sampling Devices

Soil physical properties	Hydraulic factors	Cup waste water	Climatic factors/ interactions
1. Contact between cup and soils difficult to maintain in very coarse textured soils (e.g., gravels). 2. In highly structured soils and fractured material, the composition of fluid in cracks may differ from that in pores. Cups sample only from small pores. Consequently, cup samples may not be representative of "average fluid.	1. Samples cannot be obtained when soils dry to the point that soil-water suction is great enough to allow air to enter cups when applying vacuum. 2. For very wet conditions, fluid will move more rapidly in layer pores and cracks. Because of time lag, sample for cups may not be representative.	1. Solids moving with fluid may plug cups. 2. Bacteria may plug cups. 3. Trace metals may be attenuated during flow through cups. 4. Sorption of NH_4-N may occur. 5. Sorption of some organics (e.g., chlorinated hydrocarbons) may occur.	1. In frozen soils, the tension of unfrozen water is greater than air entry value of cups. 2. In freezing-thawing soils, the unit may shift in the profile and lose contact.

Source: (Everett 1984)

Lysimeter placement is affected by both the sampling radius of the instrument and the lateral spreading of waste through the unsaturated zone. Because of lateral spreading, a lysimeter with a radius of 22 cm can effectively sample a larger area, since a point-source leak will flow and diffuse down through the unsaturated zone.

C1.3 Gravity-flow Samplers

In saturated or near-saturated flow conditions, suction-type samplers will not provide an accurate assessment of water quality in the unsaturated zone because most pore water or waste moves through macropores or large interconnected pore spaces in a rapid pulse.

Suction-type samplers could easily miss the fluid in macropores because the porous cup is a continuation of the micropore spaces of the soil, which contain slow moving pore water. Therefore, free drainage or gravity-flow samplers should be used to sample macropores (Hornby 1986). In well structured soils, macropore flow is particularly important because it accounts for the majority of water flow and flow of chemical constituents that can be lost from the soil by leaching (Shaffer 1979).

Gravity-flow samplers physically collect pore water for later analysis as the water flows down through the unsaturated zone.

C1.3.1 Limitations of Gravity-Flow Samplers

For free drainage or gravity-flow samplers, the biggest limitation is that the flow may miss the sample collector. For this reason, it is useful to have as large a collecting pan as possible or to have a large number of samplers. In addition, if the saturated flow diminishes to unsaturated flow, a sample cannot be taken and alternate means of sampling should be in place.

C2. VAPOR DETECTION SAMPLING METHODS

C2.1 Vapor Detectors

Many hazardous chemicals are volatile. This property allows them to diffuse very quickly as gases through the unsaturated zone. A vapor well or vapor detector in an existing well may allow early detection of release of volatile chemicals on a continuous basis. These monitors allow continuous monitoring and may be established as networks with several monitors sending signals to a single data acquisition system.

C2.1.2 Limitations of Vapor Detectors

The two primary limitations governing the actions of vapor detectors are their compatibility with the wastes and their ability to distinguish background concentrations from a bona fide leak. To avoid the former problem, the waste or waste constituent of interest should exhibit a good response factor with the device. The latter is a more challenging problem especially when the constituent of interest is at a low concentration. What will then face the applicant is how to determine that a slight increase in detected concentration is an actual leak. For the most common of these devices, a certain level of "total" detection for a specific parameter is set and an alarm goes off if it is exceeded. If a site has an elevated background level to begin with, then the addition of a few more parts per million of detectable compound may not matter. If on the other hand the waste is basically a spent solvent, then its release will result in a fairly concentrated front that the device should have little difficulty in detecting.

C3. NON-SAMPLING (INDIRECT) METHODS

C3.1 Salinity Sensing (Indirect) Methods

For polar or ionic liquid wastes, electrical resistivity or salinity sensors might be effective in detection of a release in the unsaturated zone. Common instruments that could detect changes in these physical properties are the salinity sensor, the electrical conductivity probe, and the four probe method. All of these methods measure either the electrical conductivity or resistivity of the soil and relate this to salinity.

C3.1.2 Limitations of Salinity Sensors

Salinity sensors should be calibrated to the natural conductivity or resistivity of the site. This may require testing of each layer of sediment. In addition, a variable soil moisture content may cause inaccurate readings by causing variation in the soil resistivity with time. As with other non-sampling methods, means should be available to draw a sample for analysis after the alarm is activated.

C4. MONITORING CHANGES IN MOISTURE CONTENT OR FLUX IN THE UNSATURATED ZONE

A broad range of monitoring tools are used to measure changes in the amount of water moving through the unsaturated zone. If run-on to the tank system site is controlled, an increase in the volume of pore water probably indicates a leak. The following methods are used to measure changes in moisture in the unsaturated zone (flux):

- Gravimetric
- Neutron Moisture Logging
- Gamma Ray Attenuation
- Tensiometers
- Hygrometer/Psychrometer
- Heat Dissipation Sensor
- Resistor/Capacitor Type sensors

These methods (Everett 1982) may be useful for indicating a leak event, but the ability to withdraw samples for analysis should be designed into the overall monitoring system to differentiate between leaks and rainfall surges. Instruments or wells used for monitoring of soil moisture content should be demonstrated to be within the sampling radius of the instruments.

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