DEPARTMENT OF ENVIRONMENTAL PROTECTION
Bureau of Environmental Cleanup and Brownfields

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TITLE: Verification of Emergency Containment Structures for Aboveground Storage Tanks

EFFECTIVE DATE: ~~September 8, 2012~~Effective Date

AUTHORITY: ~~Act 32 (P.L. 169) of 1989 the State~~The Storage Tank and Spill Prevention Act, ~~amendments~~P.L. 169, No. 32 of 1989, *as amended* (Tank Act), and 25 Pa. Code, Chapter~~-~~ 245 ~~rules and regulations of the Department of Environmental Protection (Department or DEP).~~(Storage Tank Regulations).

POLICY: It is the policy of the Department of Environmental Protection (Department or DEP) to carry out the provisions of the ~~Storage Tank and Spill Prevention Act of 1989~~Tank Act and related regulations.

PURPOSE: This guidance provides information to assist tank owners and professional engineers when determining the adequacy of emergency containment structures and compliance with the technical regulations for aboveground storage tanks (ASTs).

APPLICABILITY: This guidance is primarily applicable to aboveground storage tank owners and professional engineers, who determine the permeability and adequacy of existing emergency containment structures.

DISCLAIMER: The policies and procedures outlined in this guidance are intended to supplement existing requirements. Nothing in the policies or procedures shall affect regulatory requirements.

The policies and procedures herein are not an adjudication or a regulation. There is no intent on the part of ~~DEP~~ Department to give the rules in these policies that weight or deference. This document establishes the framework within which DEP will exercise its administrative discretion in the future. DEP reserves the discretion to deviate from this policy statement if circumstances warrant.

PAGE LENGTH: 10 pages

VERIFICATION OF EMERGENCY CONTAINMENT STRUCTURES FOR ABOVEGROUND STORAGE TANKS

DEFINITIONS: Regulatory and industry terms that specifically apply to this guidance.

Compatible – The ability of two or more substances to maintain their respective physical and chemical properties upon contact with one another for the design life of the tank system under conditions likely to be encountered in the tank system.

Containment structure or facility – Anything built, installed or established and designed to contain regulated substances that are spilled, leaked, emitted, discharged, escaped, leached or disposed from a storage tank or storage tank system, including a vault, a dike, a wall, a building or secondary containment.

Emergency containment - A containment structure which serves to convey, capture, and contain the total volume of an anticipated release of regulated substance from an aboveground or underground storage tank system and which is expeditiously emptied.

~~Diking system – A typical containment system constructed of earth, steel, concrete or other solid materials around aboveground storage tanks to protect adjoining property, waterways and the environment. Diking systems may be coated or lined with synthetic or natural materials and are commonly used to meet emergency containment requirements.~~

~~Permeability – The rate at which a regulated substance penetrates or passes through an emergency containment structure. This rate is measured in centimeters per second and is dependent on the substance stored, anticipated hydrostatic head pressure and the construction of the containment structure (i.e. material makeup, thickness and compaction if earthen materials).~~

~~Waters of the Commonwealth – Any and all rivers, streams, creeks, rivulets, impoundments, ditches, water courses, storm sewers, lakes, dammed water, ponds, springs and all other bodies or channels of conveyance of surface and underground water, or parts thereof, whether natural or artificial, within or on boundaries of the Commonwealth. (See Clean Streams Law, as amended)~~

TECHNICAL GUIDANCE:

~~1~~A. Subchapter F. - Technical Standards for Aboveground Storage Tanks and Facilities

25 Pa. Code, Chapter 245, Subchapter F, Section 245.542 establishes requirements for containment structures for large aboveground storage tanks (ASTs greater than 21,000 gallons capacity~~).~~) and aboveground storage tanks in underground vaults. Containment structures must be compatible with the substance stored and shall minimize deterioration to the storage tank system. Containment areas shall be designed, constructed and maintained in accordance with sound engineering practices adhering to Nationally recognized codes of practice and in compliance with State and Federal requirements.

1. Emergency containment areas, such as dike fields, shall be able to contain 110% of the capacity of the largest tank in the containment area and must meet the following requirements:

(a) NewNewly installed or replacement emergency containment structures or emergency containment structures for ASTs installed after October 11, 1997, shall have a permeability of less than 1 x 10^{-6} cm/sec at anticipated hydrostatic head and be of sufficient thickness to prevent the released regulated substance from penetrating the containment structure for a minimum of 72 hours, and until the release can be detected and recovered.

(b) Existing emergencyEmergency containment structures (for ASTs installed on or before October 11, 1997) shall meet one of the following standards at the next out of service inspection, prior to the tank being put back into service (or operation).

(1) The standards for new emergency containment structures. OR

(2) Verification by a Professional Engineer (who is licensed or registered under the laws of this Commonwealth) that the emergency containment structure, coupled with the tank monitoring program and response plan is capable of detecting and recovering a release and is designed to prevent contamination of the waters of the Commonwealth.

2. Evaluation of existing emergency containment structures (For Largefor ASTs) installed on or before October 11, 1997

Tank owners must ensure that existing emergency containment structures for existing ASTs are properly maintained and evaluated to determine the integrity of the containment structure by the next scheduled out-of-service inspection period. Evaluation of the containment structure includes the determination, by a knowledgeable professional, of the structure's physical integrity, permeability, and compliance with industry codes and practices. Evaluations should consider specific site conditions and any known geological concerns. If the permeability does not meet new emergency containment standards, further verification by a professional engineer is required. The following determinations, testing, and procedures should be considered when evaluating emergency containment structures:

(a) Determining emergency containment permeability generally requires the services of a qualified industry professional, such as a professional engineer, professional geologist or soils scientist when evaluating earthen containment structures. Earthen structures will require permeability testing. Structures constructed of other materials,; such as, concrete, masonry blocks, or asphalt, may require testing. Permeability of manufactured containment,; such as, steel diking, fiberglass-plastic containment structures, various geomembrane or geosynthetic liners, and coatings, may be verified by the manufacturer. Maintenance and upkeep of liners and coatings must be considered, as these are critical to ensuring continued permeability and integrity of the containment structure.

(b) Permeability testing may be performed in the field or may involve collecting samples and laboratory analysis. Most common in-situ (field tests) methods involve standing head or falling head test protocols. Laboratory analysis may also determine water content, specific gravity, granular size, organic content, shear strength, consolidation, compaction and hydraulic conductivity, or permeability. Testing is typically performed with water according to the test methodology and then converted through calculations to determine permeability for the product(s) stored. When more than one substance is stored within the same emergency containment, testing is performed for the substance with the highest conductance or ability to permeate the containment structure.

Industry professionals should investigate the containment structure to determine appropriate test methods, test locations, depth, and the number of tests necessary to obtain an accurate representative analysis of the containment structure's floor and walls. Tests should be based on specific site conditions. When testing liners, coatings or concrete structures, one representative test or sample may be adequate, provided the structure has been adequately maintained. Earthen structures generally require several test locations or samples. A listing of several test methods used in conjunction with determining permeability is provided at Appendix A of this guidance document. Other recognized methods may also apply. American Petroleum Institute (API), ~~Draft Publication,~~ "Overview of Soil Permeability Test Methods" and American Society of Testing and Materials (ASTM) Standard D-5126-90 "Comparison of Field Methods for Determining Hydraulic Conductivity in the Vadose Zone" provide additional information.

(c) Restoration of the containment structure after testing is extremely important. Test pits, boreholes and sample core penetrations must be filled with an appropriate substance and earthen structures must be properly compacted with a grout or soil-~~-~~bentonite mixture. Failure to restore the containment structure will most likely sacrifice the containment integrity and may result in increased contamination should a release occur.

(d) Verification of containment adequacy by a professional engineer (PE), when the emergency containment structure does not meet the 1 x 10^{-6} cm/sec standard, will be based on a knowledge of the structure's permeability, structural integrity, and an evaluation of the tank monitoring program and response plan. Verification implies that in the engineer's professional judgment, the emergency containment is expected to protect the waters of the Commonwealth in the event of a release. Supporting documentation of the containment analysis should be provided to the tank owner with the verification statement signed under the PE's official seal. The following shall be considered when verifying the adequacy of emergency containment:

- Permeability of the containment structure.

- Thickness of the containment structure or lining.

- Construction, maintenance and physical integrity of the containment structure.

  – Consult appropriate technical regulations, National Fire Protection Association standards, Chemical Manufacturers Association standards, and the Federal Occupational Safety and Health Standards (OSHA) standards at 29 CFR 1910 and 29 CFR 1926.

- Regulated substance(s) stored within the containment structure.

  – Substances stored within the same containment structure should be compatible with each other and with the containment structure. Hazardous substances are not generally considered to be adequately contained by earthen structures. Various substances may penetrate the containment structure at different rates. For example: gasoline will penetrate an earthen structure much faster than fuel oil or crude oil.

- Monitoring program for individual tank(s) and the containment structure.

  – Monitoring programs must meet or exceed regulatory requirements. Monitoring programs and frequencies that exceed requirements should increase the tank owners ability to detect a release and respond before it penetrates the containment structure. Consult API Publication 340, “Liquid Release Prevention and Detection Methods for AST Facilities”.

- Release response plan including how quickly released substance(s) can be recovered.

  – The Spill Prevention Response (SPR) plan must comply with provisions at Chapter 9 of the Storage Tank and Spill Prevention Act. An SPR plan that provides for rapid recovery of free product from the containment structure, shortly after a release~~,~~ may aid in reducing penetration of the emergency containment structure. Consideration should be given to availability of recovery equipment and alternate means of holding (temporary storage) released product. The ability to quickly flood a diking system with a few inches of water may aid in keeping released petroleum products from penetrating the containment structure while recovery is taking place.

Additional factors should be considered if the emergency containment structure is extremely permeable (porous). Some additional factors which are appropriate to consider are:

- The depth of groundwater in relation to the containment structure.

- The location(s) of surface water, feeder streams, and drainage to water sources.

- Subsurface structure and soil stratigraphy beneath and adjacent to the containment structure.

- Natural barriers such as bedrock and clay formations.

- Sensitive water resources within the area or in close proximity.

(e) Inspection of containment areas shall be accomplished by a DEP certified aboveground storage tank inspector during ~~“In~~in-service~~”~~ and ~~“Out~~out-of-service~~”~~ inspections. These inspections shall evaluate current conditions and proper maintenance of existing containment including, closing of drain valves when not in use and possible damage from weathering, animal activity, undesirable vegetation, and vehicles. Monitoring wells within the containment structure should be checked for secured lids, sealing of the lid and sealing where the well casing penetrates the containment structure. All other containment structure penetrations and seams should be checked for proper sealing. ~~At~~During the ~~out-of~~in-service ~~inspection~~ and ~~at following in~~out-of-service inspections, the inspector will require proof of verification of permeability or verification that reflects the current status of the facility by a professional engineer that the containment meets regulatory requirements.

3B. Subchapter G. - Simplified Program for Small Aboveground Storage Tanks

25 Pa. Code, Chapter 245, Subchapter G, Section 245.612(d) establishes requirements for containment structures for small aboveground storage tanks (ASTs equal to or less than 21,000 gallons capacity). Containment structures should be compatible with the substance stored, and designed and constructed in accordance with sound engineering practices, manufacturer's specifications and appropriate industry practices. Emergency containment shall contain possible releases, such as overfills, leaks and spills. Emergency containment shall be sufficiently impermeable to contain the total volume of a potential release for a minimum of 72 hours and until the release can be detected and fully recovered in an expeditious manner.

(a) Existing tanks (installed on or before October 11, 1997) which do not meet emergency containment requirements, shall be upgraded by October 11, 2000.

(b) ASTs installed in underground vaults and used for dispensing Class I and Class II motor fuels (flammable and combustible liquids) shall have a (containment structure) permeability of less than 1 x 10^{-7} cm/sec for the substance stored and shall be water tight.

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1. Evaluation of emergency containment structures (For Small ASTs)

Tank owners must ensure that emergency containment is provided for existing small ASTs by October 11, 2000.. The emergency containment must be capable of containing overfills, leaks and spills until the release can be detected and fully recovered. No specific permeability rate is required, except for (Class I and Class II motor fuel) ASTs in underground vaults. Tank owners may choose to use the verification procedures for large ASTs, provided in this guidance document. Where small ASTs and large ASTs share the same emergency containment structure, the emergency containment must meet the standards and/or verification requirements for large ASTs.

(a) Determining the adequacy of emergency containment for small ASTs requires should include consideration of how often the containment structure is checked for evidence of a release, and the facility's response capabilities. If the containment is only checked periodically or monthly, an earthen diking system may not be capable of containing a potential release until it is detected and then recovered. Additional consideration should also be given to the following:

- Double Wall Shop-Fabricated ASTs and FireguardWalled ASTs mayonly meet emergency containment requirements when they are providedoperated with some means ofthe following (See §245.612(d)):

    1) Permanently installed spill andprevention equipment at the tank fill point or containment at the remote fill point.

2) An overfill protection, such as: spill buckets and a method to alert the operator prior to overfilling the tank(s). alarm or prevention device or monitoring gauge and written shutdown procedure.
3) Block valves on product lines.
4) Solenoid valve or antisiphon device, if applicable.

- Petroleum tank owners should consult the Federal Oil Pollution Act rules at 40 CFR 112 and National Fire Protection Association standards.

- Hazardous substance tank owners should consult the OSHA rules at 40 CFR 1910 and 40 CFR 1926, and Chemical Manufacturer Association standards.

(b) Inspection of containment areas for small ASTs shall be accomplished by a DEP certified aboveground storage tank inspector when in-service inspections are requiredperformed. (See §245.616.). -Inspectors shall evaluate current conditions and proper maintenance of existing containment including, closing of drain valves when not in use and possible damage from weathering, animal activity, undesirable vegetation, and vehicles. The inspector may ask for manufacturer's specifications, documentation, or other evidence which indicates the containment is sufficiently impermeable or capable of containing a potential release. Monitoring wells within the containment structure should be checked for secured lids, sealing of the lid, and sealing where the well casing penetrates the containment structure. All other containment structure penetrations and seams should be checked for proper sealing.

5. Diking systems and other containment structures may be used to comply with emergency containment requirements for both large ASTs and small ASTs. Additional information on the different materials, maintenance concerns, liners and types of containment systems, which are typically used, is provided at Appendix B.

APPENDICES:

Appendix A. - Test methods used when evaluating emergency containment.
Appendix B. - General information on various types of emergency containment

APPENDIX A.

Test Methods Used When Evaluating Emergency Containment

Test Methods	**Determinations**	**Standard or Reference**
Constant Head Test (Laboratory)	Permeability	ASTM D-2434
Falling Head Test (Laboratory)	Permeability	ASTM D-5084
Flexible Wall Permeameter (Laboratory) (Triaxial Test)	Permeability	ASTM D-5084
Moisture Content Analysis (Laboratory)	Moisture Content	ASTM D-2216
Standard Proctor (Laboratory) Relationship to Soil	Moisture/Density	ASTM D-698
Hydrometer Analysis (Laboratory) of Fine Grained Soil	Particle Size Distribution	ASTM D-422
Sieve Analysis (Laboratory)	Particle Size Distribution	ASTM D-422
USACE, Permeability (Laboratory/Field) Test with Back Pressure	Permeability	US Army Corps of Engrs. Engrg. Manual 1110-2-1906 (Bjerrum & Huder)
Infiltrometer Test(s) (Field)	Permeability/Flow Rates	ASTM D-3385
Gulf Oil Field Test (Field) (Falling Head Method)	Permeability	Engineering Standard Similarities to ASTM D-5084 (Pace, 1979)
Slug Test (Field) (Hvorslev's Method)	Permeability	Engineering Standard John Wiley & Sons, Inc. N.Y. (Cedergren, 1989)
Borehole Test (Field)	Permeability (Saturated)	ASTM D-5126

APPENDIX B.

General Information on Various Types of Emergency Containment

Emergency containment requirements are primarily met through the use of field constructed diking systems, manufactured (shop-fabricated) diking systems, double wall tank systems and diversion systems with retention ponds or holding tanks. This Appendix will only address the more common diking systems and double wall tanks. Additional information can be obtained from API Standard 2610, "Design, Construction, Operation, Maintenance, and Inspection of Terminal & Tank Facilities", API Publication 328, "Laboratory Evaluation of Candidate Liners for Secondary Containment of Petroleum Products", API Publication 341, "A Survey of Diked-Area Liner Use at Aboveground Storage Tank Facilities"", and API Publication 315 "Assessment of Tankfield Dike Lining Materials and Methods".

1. Field constructed diking systems primarily adhere to National Fire Protection Association codes of practices and civil engineering design practices. Construction may consist of earthen materials with or without additives or liners, and concrete or other masonry materials. Occasionally fiberglass-plastic or metallic materials will be used, but these are more often manufactured (shop-fabricated) systems.

- Earthen materials should consist of native silty clay soils or soils mixed with bentonite in order to be sufficiently impervious, unless properly lined. Proper compaction is critical for ensuring structural integrity and low permeability. Even with proper compaction, some settlement may occur. Inherent permeability may vary and is seldom adequate for hazardous substance storage; however, oil resistivity may be high. Earthen containments are susceptible to degradation from weathering, animal activity, such as groundhogs, and undesirable vegetation. Retaining the proper degree of moisture can also be a concern with earthen structures. Periodic hydration can be accomplished with sprinkler systems. Often a protective layer of gravel or top soil with turf is placed on the containment surface to aid in retaining adequate moisture.

- Reinforced concrete is widely used for containment structures, especially at smaller facilities and for hazardous substance storage tanks. Permeability is dependent on the condition of the concrete surface, particularly its degree of cracking, and proper sealing around piping supports, tank ringwalls, concrete seams, and containment structure penetrations. Cracking can often be sealed with synthetic materials, but will require monitoring and continued maintenance. Uncoated concrete is more permeable than coated or lined concrete. Concrete is relatively resistant to weathering except that uncoated concrete is more susceptible to damage from freezing. Consult American Concrete Institute standards for construction practices. For coating information consult American Society for Testing and Materials or the National Association of Corrosion Engineers standards.

- Containment structures constructed with blocks, ceramics and other masonry materials can provide permeability similar to concrete and coated concrete structures. Masonry blocks tend to be porous and should be sealed or coated. To ensure structural integrity, block walls are usually reinforced with steel rebar and filled with concrete. Particular attentionAttention should be given to adequately sealing block walls to the containment floor and to sealing around the tanks, piping supports, and all penetrations.

- Geomembrane and geosynthetic liners are available in a wide range of materials including polymeric sheets, bentonite mats, and spray-on coatings compounded with polysulfide or asphalt. Manufacturers produce materials that provide a high degree of impermeability for a wide range of petroleum and chemical products. These materials are applied in the field over earthen, concrete, asphalt, and steel structures. Only experienced qualified technicians should apply liner materials under the oversight of a Department-certified ACVL. Some materials are more susceptible to damage than others and will require more frequent maintenance. Liners can be inadvertently punctured, and most liners are easily damaged by vehicles and other equipment. Properly attaching and sealing liners around tank ringwalls, piping supports, penetrations, and containment walls is critical and will require routine observation and maintenance. Exposure to the sun and dehydration are ~~particular~~ concerns with bentonite mats. Bentonite mats are usually covered with a protective layer of sand, soil, pea gravel or crushed rock. Crushed limestone must not be used, as limestone will leach calcium and ~~delete~~deplete the ~~bentonite~~bentonite's permeability qualities.

2. Manufactured (shop-fabricated) containment systems are available in the forms of diking systems, double wall tanks, and separate holding tanks. Separate holding tanks are used less frequently, but when used they must be expeditiously emptied. If separate holding tanks routinely contain regulated substance, they must comply with specific technical standards for tanks rather than the standards for containment structures.

- Steel diking systems are usually manufactured to Underwriters Laboratories standards or Steel Tank Institute standards. They are used more frequently with horizontal tanks~~,~~ but may also be used with vertical tanks. Steel diking is essentially impermeable for petroleum products~~,~~ but may require lining for compatibility with certain hazardous substances. Compared to other diking systems steel containment structures offer the greatest resistance to weathering and other physical damage. To avoid excessive corrosion, rainwater should be drained off frequently. If rain shields are used, vents, extended vent lines, and overflow mechanisms must be designed to discharge into the diking system and not ~~unto~~onto the rain shields. When steel diking systems are fabricated in the field, extensive design and planning is required prior to installation.

- Fiberglass-plastic diking systems are usually shop-fabricated and then assembled in sections in the field. Sealing section seams and connections is critical. These systems are most often used with fiberglass-plastic hazardous substance tanks and at chemical facilities. Engineering and design is specific for each site and tank system. An ~~ultra violet~~ultraviolet protective coating is usually required. While not as durable as steel, fiberglass-plastic does provide low maintenance and reliable containment.

- Double wall tanks are frequently used for secondary and emergency containment. When used for emergency containment, these systems must be provided with some additional form of spill and overfill protection. This is usually accomplished with spill buckets or separate containment at remote fill points and a method to alert the operator prior to overfilling the tank(s). Metallic tanks may be double wall steel or Fireguard insulated and are constructed to Underwriters Laboratories and Steel Tank Institute standards. These systems require very little care or maintenance. Fiberglass-plastic double wall tanks may also be used for hazardous substances. To meet emergency and secondary containment requirements, double wall tanks should also be equipped with block valves on product lines and anti-siphon or solenoid valves where product piping drops below the maximum product level in the tank.