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FACTORS FOR SELECTING STORAGE TANKS

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Exam Preview:

1. According to the reference material, the analysis found that a AST system is cheaper than an UST system, even when the UST system is designed to meet minimum regulatory requirements.
    a. True
    b. False
2. According to citation 40 CFR 280.31(c) and 280.33(e), operators must inspect every __ days any UST system with impressed current cathodic protection to ensure that equipment is running properly.
    a. 30
    b. 60
    c. 90
    d. 120
3. Some of the most important BMP considerations are found in NFPA 30A (NFPA 2018). NFPA 30A recommends that AST capacity for an individual tank not surpass 12,000 gallons, and a __ft radius of protection be maintained around the AST
    a. 15
    b. 20
    c. 25
    d. 30
4. According to the reference material, USTs, which are more standardized by regulation, cost an estimated $74,887 annually and have a net present value of $2,333,152 after a 30-year lifetime and includes tank installation and removal cost.
    a. True
    b. False

5. Using the Glossary of the reference material, which "Waters of the United States" matches the description: seasonal wetlands located in parts of California and associated with topographic depression, soils with poor drainage, mild, wet winters and hot, dry summers.
    a. Western vernal pools
    b. Prairie potholes
    c. Texas coastal prairie wetlands
    d. Carolina bays and Delmarva bays
6. According 40 CFR 280.35(a)(2) Overfill prevention equipment must be inspected at least once every year.
    a. True
    b. False
7. At the time of this writing, the states of Georgia, Kansas, Maine, and _____ have chosen not to regulate ASTs under CWA authority. Instead, they regulate the installation and management of ASTs as part of their state or local fire code
    a. Alaska
    b. Washington
    c. Iowa
    d. Nebraska
8. Using the Glossary of the reference material, which class of operator is responsible for initially addressing emergencies presented by a spill or release from an UST system?
    a. Class A Operator
    b. Class B Operator
    c. Class C Operator
    d. Class D Operator
9. Using Table 5. Recurring annual cost comparison including AST BMP, what is the cost associated with Tank painting for an AST?
    a. $1,000
    b. $5,000
    c. $7,000
    d. $10,000
10. According to the reference material, heating oil is defined as Petroleum that is No. 1, No. 2, No. 4–light, No. 4–heavy, No. 5–light, No. 5–heavy, and No. 6–technical grades of fuel oil.
    a. True
    b. False

Abstract

The Army and Air Force Exchange Service Retail Service Station Standard Design and Specifications, and Department of Defense Fuels Facilities Engineering Panel require the use of underground storage tanks (USTs). U.S. Army Installation Management Command garrisons prefer to install aboveground storage tanks (ASTs), and have requested waivers to this standard design. The decision to select either storage tank type must consider a number of factors, including: Federal, state, and local regulatory requirements; capital costs; environmental and safety risks; and added infrastructure. This work was undertaken to provide a decision making tool to help justify granting or denying exemption requests.

Considering account installation, annual costs, and tank removal, it is estimated that AST systems are minimally 4% more expensive than USTs over their 30-year lifetime. If recommended AST practices and purchases are made, it is likely that the life cycle cost of an AST will be ~20% more expensive than that of a UST system over 30 years. It is therefore recommended that waiver requests not be given out freely, but it is also recommended that waiver requests be granted in situations where USTs can be proven to be a higher risk for leaks and failures than are ASTs.

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1 Introduction

1.1 Background

The Army and Air Force Exchange Service (AAFES) Retail Service Station Standard Design and Specifications, and Department of Defense (DoD) Fuels Facilities Engineering Panel (FFEP) require the use of underground storage tanks (USTs). However, U.S. Army Installation Management Command (IMCOM) garrisons prefer to install aboveground storage tanks (ASTs), and have requested waivers to the standard UST design. Moreover, it is anticipated that the number of requests for exemptions to the FFEP design requirement for USTs in favor of ASTs at AAFES service stations will increase. The decision to request (or grant) exceptions to the UST requirement must consider a number of factors, including: Federal, state, and local regulatory requirements; capital costs; environmental and safety risks; and added infrastructure.

The preference for ASTs over USTs is often based on the perception that ASTs are subject to fewer regulatory requirements than USTs, and that ASTs are less expensive to install and maintain than USTs. USTs and ASTs are both subject to Federal, state, and local regulatory requirements. The U.S. Environmental Protection Agency's (USEPA's) 1988 UST regulations prompted mass removal and replacement of USTs by 1998. The 2015 USEPA regulatory update related to USTs (the first major regulatory update since 1988) increased the emphasis on the proper operation and maintenance of UST equipment. Federal regulations pertaining to ASTs, as found in 40 CFR 112, were last updated in 2002. The costs associated with the installation, operation, and management of ASTs and USTs are critical components in the operation of motor vehicle fuel dispensing stations, as are the potential costs (and other consequences) of environmental and safety risks, and required added infrastructure.

This work was undertaken to create a decision making tool to help justify granting or denying requested waivers to the standard UST design. Specifically, this report focuses on the financial, operational, and in some cases, environmental costs of ASTs, compared to USTs. This information will

provide IMCOM garrisons greater access to the best possible options related to the installation, operation, and management of storage tanks, and a tool for discerning the best options for their particular circumstances.

1.2 Objectives

The overall goal of this work was to support the IMCOM decision making process for deciding whether to grant exemptions to the standard design that requires the use of USTs in all installation motor vehicle fuel dispensing stations. Specific objectives of this project were to conduct a life cycle cost analysis (LCCA) of the use of ASTs and USTs in retail fueling locations at U.S. Army IMCOM Installations, to compare the costs of the two storage tank types, and to make recommendations regarding the decision making process to justify granting or denying requested waivers to the standard UST design.

1.3 Approach

An in-depth review was done of 40 CFR 112 and 40 CFR 280 and of associated USEPA guidance provided in the preamble to these regulations and any regulatory guidance documents issued by the USEPA.

A detailed comparison was done of the Federal and DoD regulatory requirements associated with both ASTs and USTs, after which monetary values (in U.S. dollars) were assigned to those requirements in the LCCA. Because the regulations for ASTs change depending on the state and county in question, this regulatory review took a hierarchical approach to present findings on each component of fuel service tank operation:

- Chapter 4 presents the Federal mandatory minimums for the operation of each tank system.
- Chapter 5 presents information of importance at a state level.
- Chapter 6 reviews the recommended Best Management Practices (BMPs) involved in fuel tank operation.
- Chapter 6.5 presents some of the site-specific concerns that should be addressed when choosing the correct fuel storage system.

2 Underlying Assumptions

This chapter provides a comprehensive overview of the assumptions that underlie the LCCA of the use of ASTs and USTs in retail fueling locations at U.S. Army IMCOM Installations, and by extension, that form the base for that conclusions and recommendations regarding the decision making process to justify granting or denying requested waivers to the standard UST design.

2.1 Motor vehicle fuel dispensing stations

This analysis is restricted to storage tanks used for fuel (i.e., gasoline, diesel, biofuel) stored at a motor vehicle fuel dispensing station. It does not address requirements for storage tanks/containers associated with:

- emergency power generators
- airport hydrant fuel distribution systems
- field constructed USTs
- fuel farm ASTs (i.e., with capacities of 30,000 gal or more).

2.2 Legal requirements

This report is based on a comprehensive analysis of the Code of Federal Regulations (CFR) that applies to Army Installations. Note that guidance documents issued by professional and industry organizations prescribe recommended actions for regulating USTs and ASTs. However, unless these recommendations are specifically adopted by reference in a Federal, state, or local regulation, they are separate from (and in addition to) actual regulatory requirements.

2.3 Applicable laws and regulations

To quantify the life cycle costs associated with the management of an AST or a UST, it is vital to understand the structural, installation, and management requirements for each type of tank. Those requirements are promulgated in regulations based on Federal environmental laws.

The Resource Conservation and Recovery Act – Subtitle I (RCRA-I) solely governs USTs. The Clean Water Act (CWA) (1972) governs ASTs as part of

the overarching objective of the CWA to prohibit the discharge of pollutants into waters of the United States, except in compliance with a permit. The promulgating regulations are 40 CFR 280 and 40 CFR 112.

Under both of these laws, states have the opportunity to obtain primacy for regulations and enforcement if they issue regulations that are either equivalent to, or more stringent than, the pertinent Federal regulations. For USTs this is a well-defined, straightforward process. The list of states with approved state UST programs can be found at https://www.epa.gov/ust/state-underground-storage-tank-ust-programs

For the CWA, this can be a more complex process due to the multitude of CWA programs for which a state can seek primacy including the National Pollutant Discharge Elimination System (NPDES) program. In general, if a state is regulating the installation and management of its ASTs as part of the state's environmental regulations, it is safe to assume the state does so under the authority of the CWA.

States that regulate ASTs and USTs under the local fire code, and not through the CWA, which include Georgia, Kansas, Maine, and Nebraska do not legally enforce that code on Army installations. All other states regulate ASTs under the Clean Water act. Thus Army installations are required to comply with these states' regulations.

Furthermore, all states that regulate ASTs under the CWA, except Alaska, Iowa, Indiana, Montana, New Jersey, and Washington, have adopted some, or all, of 40 CFR 280 and applied it to ASTs. This means that another relevant layer has widely been added to the minimum requirements for ASTs set forth by the Code of Federal Regulations. It is not the purpose of this report to analyze the specific requirements of each state. The relevant Federal laws will be presented, but it is important to note that some requirements for USTs may be enforced on ASTs depending on the state of interest.

2.4 40 CFR 280 and 40 CFR 112

The analyses of fuel storage system requirements in this report are based on 40 CFR 280 and 40 CFR 112 as published in the Federal Register, which were incorporated into the 1 July 2016 edition of the Code of Federal Regulations. These analyses do not address the requirements related

to the upgrading and management of existing USTs. For the purposes of this work, the requirements in the 2015 UST regulatory revision that were not Federally implemented until 2018 are treated as being currently in effect. In reality, depending on the state where activities are occurring, states with primacy for operating the UST program may have already adopted what are considered future Federal requirements.

The following considerations are also applicable to these analyses:

- USTs with capacities of less than 110 gal are not regulated under 40 CFR 280 and are therefore not subject to the requirements reviewed as part of this analysis (40 CFR 280.10(b)(4)).
- It is assumed that the substance being stored in the USTs/ASTs under analysis is petroleum based.

It is assumed the vehicle fuel dispensing station is subject to the requirements of 40 CFR 112.

The thresholds for the application of 40 CFR 112 are:

- The completely buried storage capacity of the facility is greater than 42,000 U.S. gal of oil, or
- The aggregate aboveground storage capacity of the facility is greater than 1,320 U.S. gallons of oil [NOTE: Only containers with a capacity of 55 U.S. gal or greater are counted. The aggregate aboveground storage capacity of a facility excludes the capacity of:
    - a container that is "permanently closed"
    - a "motive power container"
    - hot-mix asphalt or any hot-mix asphalt container
    - a container for heating oil used solely at a single-family residence
    - pesticide application equipment and related mix containers
    - a produced water container (see definitions) and any associated piping or appurtenances downstream of the container, that meets the requirements for oil production facility bulk storage containers at 40 CFR at 112.9(c)(6)(i).

The definition of the term "facility" is important in determining the overall applicability of 40 CFR 112. The boundary or extent of a "facility" depends on site-specific circumstances. Factors that may be considered relevant in

delineating the boundaries of a facility under 40 CFR 112 may include, but are not limited to:

- ownership, management, and operation of the buildings, structures, equipment, installations, pipes, or pipelines on the site;
- similarity in functions, operational characteristics, and types of activities occurring at the site;
- adjacency; or
- shared drainage pathways (e.g., same receiving water bodies).

In the majority of cases, motor vehicle fuel dispensing stations are located within the fence line of a military installation and the installation is considered the "facility" so there is no doubt about the applicability of 40 CFR 112. In this situation, the installation is responsible for the development and implementation of the formal Spill Prevention Control and Countermeasure (SPCC) Plan required by 40 CFR 112. At the same time, all petroleum storage on the installation must conform to of 40 CFR 112 and any additional requirements outlined in the installation SPCC.

In some circumstances, the USEPA does allow contiguous or non-contiguous buildings, properties, parcels, leases, structures, installations, pipes, or pipelines under the ownership or operation of the same person (i.e., DoD) to be considered separate facilities for SPCC purposes. If the motor vehicle fuel dispensing station is considered a separate "facility" from the installation, the station would have to consider the thresholds listed above to determine whether 40 CFR 112 applies.

For the purposes of these analyses, it is assumed that 40 CFR 112 does apply.* However, since SPCCs are site-specific documents, this analysis only addresses the requirements of 40 CFR 112 and the guidance provided by USEPA for implementation of 40 CFR 112. It does not, and cannot, include any site specific requirements imposed in the SPCC for an individual location.

* Note that 40 CFR 112 does not actually use the term "AST." However, for the purposes of this analysis, whenever the regulation discusses requirements for "bulk storage containers," those requirements are associated with ASTs.

Lastly, while there are USEPA air emissions regulations for ASTs, they apply to the following types of ASTs and are not applicable for this analysis:

- ASTs at bulk gasoline terminals and pipeline breakout stations (40 CFR 63, Subpart R),
- ASTs at gasoline distribution bulk terminals, bulk plants, and pipeline facilities (40 CFR 63, Subpart BBBBBB)
- Storage vessels with capacities greater than 40,000 gal (40 CFR 60, Subpart Ka).

2.5 Capital cost vs. annual cost

When comparing the two types of storage tanks (USTs and ASTs), it is important to note the difference between capital and annual costs. The Common Levels of Support agreement states that capital costs (whether of a UST or AST) are borne by AAFES. The Directorate of Public Works (DPW) will then take over the costs of operation and maintenance of the system through the closing or excavation of the tank. Chapter 6.5 of this report, which presents the analysis, includes costs of both tank installation and eventual removal.

Furthermore, it is assumed that all costs associated with the ongoing operation of fuel storage systems are borne by the DPW. During an interview with personnel from Fort Benning, GA, it became apparent that some installations have a functional agreement between the DPW and AAFES that determines the responsibilities of each entity. This agreement would be outlined in an installation's Interservice Support Agreement (ISA). In the case of Fort Benning, AAFES personnel are responsible to perform the duties of system inspection; they must conduct visual and physical inspection and testing as mandated by regulations and/or industry standards. When repairs or maintenance are needed, AAFES reports to the DPW, who then send someone to fix the problem. The DPW is in charge of monitoring the software that is connected to the leak detection equipment in the fuel tanks and fuel lines. The DPW is also in charge of any repairs on this system. After speaking with individuals at Fort Gordon and with experts at ERDC-CERL, it was concluded that this is not a standard agreement. Thus, this report assumes that the DPW is required to conduct all reporting, inspection, monitoring, and maintenance of the fuel storage system after it is installed.

3 Regulatory Review

An in-depth review was done of 40 CFR 112 and 40 CFR 280, of associated USEPA guidance provided in the preamble to these regulations, and of any regulatory guidance documents issued by the USEPA.

The majority of states have received State Program Approval for the operation of their UST programs. All 50 states (and the District of Columbia and Commonwealth of Puerto Rico) have a comprehensive set of UST leak prevention and release detection regulations and a program to implement those regulations; States that have a USEPA-approved program take the lead role in UST program enforcement. In states without an approved program, USEPA will work with state officials to coordinate UST enforcement actions. As of March 2017, 38 states (and the District of Columbia and Puerto Rico) have USEPA-approved programs. For state approval status updates, see the web address provided in Section 2.3.

The regulation of ASTs is more site-specific than that of USTs. The regulation of ASTs is a combination of 40 CFR 112 requirements, state environmental regulations that may adopt wording from 40 CFR 280, and the State Fire Code. The latter is often an adoption of National Fire Protection Association (NFPA) standards. In the states that do regulate ASTs as part of their environmental programs (see Section 2.3), the regulations may mirror the state requirements for USTs, or may contain a combination of regulations for “bulk storage containers” from 40 CFR 112, 40 CFR 280, and other regulatory guides.

Because the regulations for ASTs change depending on the state and county in question, this regulatory review takes a hierarchical approach to present findings on each component of fuel service tank operation. Chapter 4 presents the Federal mandatory minimums for the operation of each tank system. Chapter 5 presents information of importance at a state level. Chapter 6 reviews the recommended Best Management Practices (BMPs) involved in fuel tank operation. Finally, Chapter 6.5 presents some of the site-specific concerns that should be addressed when choosing the correct fuel storage system.

4 Federal Requirements

This chapter outlines the minimum Federal requirements for UST and AST operation, and also contains tables with limited information on the Federal regulations. Appendix A includes a more comprehensive table containing each of the relevant regulations from the Code of Federal Regulations.

4.1 Tank physical requirements

Compatibility requirements for USTs are greater than those for ASTs, to ensure that fuel storage systems are appropriate for the types of stored fuel. USTs also have greater structural requirements than do ASTs.

The 2015 regulatory updates have removed some of the previously existing options for UST structural components. The 1988 UST regulation required new UST systems to be designed, constructed, and installed to prevent releases. This language provided a wide range of flexibility. Today, that flexibility has decreased, and the owner/operator must install a UST that is secondarily contained and that uses interstitial monitoring. Secondary containment is further defined as being

> able to contain regulated substances leaked from the primary containment until they are detected and removed and prevent the release of regulated substances to the environment at any time during the operational life of the UST system (40 CFR 280.20).

The 2015 regulations also extended the secondary containment and interstitial monitoring requirements to the piping associated with the UST system except when certain types of suction piping are used (see 40 CFR 280.41(b)(1)(ii)(A) through (E).

Within these constraints, the owner operator must then make a choice from among the following types of USTs to provide corrosion control and to prevent the release of product to the environment:

- Tanks constructed of fiberglass-reinforced plastic.
- Tanks constructed of steel and cathodically protected in the following manner:
    - The tank is coated with a suitable dielectric material;

    - Field-installed cathodic protection systems are designed by a corrosion expert;
    - Impressed current systems are designed to allow determination of current operating status as required in 40 CFR 280.31(c); and
    - Cathodic protection systems are operated and maintained in accordance with 40 CFR 280.31 or according to guidelines established by the implementing agency.
- Tanks constructed of steel and clad or jacketed with a non-corrodible material.
- Tanks constructed of metal without additional corrosion protection measures provided that:
    - The tank is installed at a site that is determined by a corrosion expert not to be corrosive enough to cause it to have a release due to corrosion during its operating life; and
    - Owners and operators maintain records that demonstrate compliance with the corrosion expert's determination for the remaining life of the tank.
- Tanks for which the construction and corrosion protection are determined by the implementing agency to be designed to prevent the release or threatened release of any stored regulated substance in a manner that is no less protective of human health and the environment

The Federal regulations for structural components of ASTs are very flexible and allow for configurations ranging from single-wall tanks with a secondary containment berm structure to double-wall tanks. The key point of the regulations is that ASTs be constructed to provide a secondary means of containment for the entire capacity of the largest single container, and to provide sufficient freeboard to contain precipitation. In the case of a double-walled AST that will not retain precipitation, freeboard is not a concern.

Requirements for the structure of an AST can be found in 40 CFR 112.8. These requirements include:

- Tanks must be protected from corrosion by coating or cathodic protection compatible with local soil conditions;
- Secondary containment must be provided for the entire capacity of the largest single container, and sufficient freeboard must be provided to contain precipitation;
- The tank must have one of the following overfill protections: high liquid level alarms, high liquid level pump cutoff device, or direct audible

or code signal between the container gauge and the pumping station with a person present to monitor these gauges and the filling of the containers.

4.2 Record retention and notification

Some ongoing labor is associated with record retention and notification for UST operators. These actions vary, depending on the type of tank, on various issues that may occur over the lifetime of operating that tank, and on other factors. Federal regulations do not require that AST system operators retain records, or that they notify an implementing agency of any of the subjects that Federal codes require of UST operators. AST operators are required to include each AST in their SPCC plan, and if their installation stores 42,000 gallons or more of oil, the installation may be required to submit a Facility Response Plan to the USEPA. These plans help to ensure that installations take steps to prevent spills, and that they have the capabilities to address a spill quickly and efficiently.

4.2.1 Record retention

Record retention is very important in the case of environmental compliance auditing. These records help to hold personnel accountable for maintaining the fuel storage systems. They also help to prevent negligence and oversight, especially in the case of employee turnover. Having records that show the maintenance steps that have/have not been taken can help newly responsible personnel pick up where the old personnel left off.

Due to legal requirements, personnel who manage USTs must spend more time on record retention than those who manage ASTs. Table 1 lists Federal regulatory requirements for record retention while operating a UST system. In contrast to the recordkeeping requirements of UST systems, ASTs have only one recordkeeping requirement. Per CFR 112.8(c)(6), AST operators must keep comparison records of their inspections on in-service tanks to track degradation.

Table 1. Record retention requirements for UST operators.

Citation	Implementation
40 CFR 280.31(d)(1)	For USTs with impressed current cathodic protection systems keep the results of the last three inspections (see 40 CFR 280.31 (c)).
40 CFR 280.31(d)(2)	For USTs equipped with cathodic protection systems keep the results of the last two required inspections (see 40 CFR 280.31(b)).
40 CFR 280.33(g) and 280.34(b)(4)	Maintain records of each repair until the UST system is permanently closed or undergoes a change-in-service.
40 CFR 280.34(a)(4) and 280.62	Maintain records of corrective actions taken or planned including initial abatement measures.
40 CFR 280.34(a)(4) and 280.63	Maintain records of corrective actions taken or planned including initial site characterization.
40 CFR 280.34(a)(4) and 280.64	Maintain records of action taken or planned including free product removal.
40 CFR 280.34(a)(4) and 280.66	Maintain records of corrective actions taken or planned including corrective action plans.
40 CFR 280.20(a)(4), 280.20(b)(3), 280.34(b)(1), 280.34(c)(1), and 280.34(c)(2)	If needed, maintain records of a corrosion expert's analysis of site corrosion potential of corrosion protection equipment not used.
40 CFR 280.31(d), 280.34(b)(2), 280.34(c)(1), and 280.34(c)(2)	If used, maintain documentation of operation of corrosion protection equipment.
40 CFR 280.32(c, 280.34(b)(3), 280.34(c)(1), and 280.34(c)(2)	Documentation of compatibility.
40 CFR 280.35(c, 280.34(b)(5), 280.34(c)(1), and 280.34(c)(2)	Documentation of compliance for spill and overfill prevention equipment and containment sumps used for interstitial monitoring. All records of testing or inspection will be kept for 3 years.
40 CFR 280.34(b)(6), 280.34(c)(1), and 280.34(c)(2), 280.36(b)	Documentation of periodic walk-through inspections. Records must be kept for 1 year. Records must include: a list of each area checked, whether each area checked was acceptable or whether a needed action was taken, a description of actions taken to correct an issue, and delivery records if spill prevention equipment is checked less frequently than every 30 days due to infrequent regulations.
40 CFR 280.34(b)(7), 280.34(c)(1), and 280.34(c)(2), and 280.45	Documentation of compliance with release detection requirements.
40 CFR 280.34(b)(8), 280.34(c, and 280.74	Documentation of site investigation for permanent closure.
40 CFR 280.34(b)(9) and 280.245	Owners and operators must maintain a list of designated Class A, Class B, and Class C operators and records that confirm that training and retraining has been completed.
40 CFR 280.34(a)(4) and 280.65	Maintain records of corrective actions taken or planned including investigation of soil and groundwater cleanup.

4.2.2 Notification

Notification of confirmed spills and leaks is very important. This allows the implementing agency to take the necessary steps to protect public health after a major spill or prolonged leak. AST operators are also encouraged to maintain good notification habits. Table 2 lists Federal regulatory requirements for notification while operating a UST system.

Table 2. Notification requirements for UST operators.

Citation	Implementation
40 CFR 280.22 and 280.34(a)(1)	Submit notification of installation of new UST or change-in-service.
40 CFR 280.32(b) and 280.34(a)(2)	Submit notification of change to biofuels.
40 CFR 280.34(a)(3) and 280.50	Submit notification of suspected releases.
40 CFR 280.34(a)(3) and 280.53	Submit reports of spills and overfills.
40 CFR 280.34(a)(3) and 280.61	Submit reports of confirmed releases.
40 CFR 280.34(a)(5) and 280.71	Submit notifications before permanent closure or change-in-service of a UST.
40 CFR 280.40(b)	Notify the implementing agency when a release detection method operated in accordance with the requirements indicates a release may have occurred.

4.2.3 SPCC Plans

ASTs must be documented in the SPCC Plan. USTs that are compliant with 40 CFR 280 are not required to be included in the SPCC, but it is a BMP to do so.

Depending on the location of the installation, if the facility, specifically the fuel dispensing area, is required to have a Storm Water Pollution Prevention Plan (SWPPP), ASTs in particular must be represented in that plan. Depending on the regulator, USTs may or may not be required to be represented in the SWPPP as well.

From an operations and maintenance (O&M) perspective, it is critical to remember that any inspections, maintenance, testing, or other actions stipulated in any site-specific plan (i.e., SPCC or other management plan) are considered to be regulatory requirements by virtue of their inclusion in the plan; they therefore must be executed even if they are above and beyond the actual regulatory requirements.

4.3 Inspection and testing

The majority of operating costs for both USTs and ASTs can be found in the requirements for inspection and testing of each system. Table 3 lists the inspection and testing requirements for USTs.

Table 3. Inspection and testing requirements for UST operators.

Citation	Description	Implementation
40 CFR 280.31(c) and 280.33(e)	Inspection	Inspect every 60 days any UST system with impressed current cathodic protection to ensure that equipment is running properly.
40 CFR 280.35(a)(2)	Inspection	Overfill prevention equipment must be inspected at least once every 3 years. At a minimum, the inspection will ensure that the overfill prevention equipment is set to activate at the correct level (see 40 CFR 280.20©) and will activate when a regulated substance reaches that level.
40 CFR 280.36(a)(1)(i)	Inspection	Conduct walk-through inspections every 30 days that, at a minimum, check the following equipment: spill prevention equipment and release detection equipment.
40 CFR 280.36(a)(1)(ii)	Inspection	Conduct annual walk-through inspections that, at a minimum check the following equipment: containment sumps and hand held release detection equipment.
40 CFR 280.33(f) and 280.35	Inspection	Repaired spill and overfill prevention equipment must be tested or inspected according to 40 CFR 280.35 as appropriate within 30 days following repair.
40 CFR 280.40(a)(3) and 280.44(a)	Testing	The electronic and mechanical components of the release detection method(s) are tested annually for proper operation. Testing is done in accordance with one of the following: Option 1: Manufacturer's instructions; Option 2: A code of practice developed by a nationally recognized association or independent testing laboratory; or Options 3: Requirements determined by the implementing agency to be no less protective of human health and the environment.
40 CFR 280.31(b) and 280.33(e)	Testing	UST systems equipped with cathodic protection will: (1) Test cathodic protection within 6 mo. of installation (2) Test within 6 months following repair (3) Test cathodic protection at least every 3 years
40 CFR 280.31(c) and 280.33(e)	Testing	UST system with impressed current cathodic protection will be tested within 6 months following repair.
40 CFR 280.33(d)	Testing	Repairs to secondary containment areas of USTs used for interstitial monitoring and containment sumps used for interstitial monitoring of piping are tested for tightness within 30 days after completion of repair according to manufacturer's instructions, a recognized code of practice, or independent testing lab.

Citation	Description	Implementation
40 CFR 280.33(d) and 280.43(c) and 280.44(b)	Testing	All other repairs to tanks (other than repairs to secondary containment areas of USTs used for interstitial monitoring and containment sumps used for interstitial monitoring of piping) must be tightness tested within 30 days after completion of repair
40 CFR 280.35(a)(1)	Testing	Spill prevention equipment and containment sumps used for interstitial monitoring of piping must be monitored/tested to prevent releases Option 1: The equipment is double-walled and the integrity of both walls is monitored as frequently as the required walk-through inspections (40 CFR 280.36). Option 2: The spill prevention equipment is tested at least once every 3 years to ensure that it is liquid tight using vacuum, pressure, or liquid testing according to the manufacturer's requirements, a code of practice developed by a nationally recognized association or independent testing lab, or as required by the implementing agency.
40 CFR 280.33(d) and 280.43(c) and 280.44(b)	Testing	For all repairs to piping other than repairs to secondary containment areas of USTs used for interstitial monitoring and containment sumps used for interstitial monitoring of piping: • Tightness must be tested within 30 days after completion of repair. • A periodic line tightness testing of piping may only be conducted if it can detect a 0.1 gallon per hour leak rate at one and one-half times the operating pressure.
40 CFR 280.33(d)	Testing	For repairs to secondary containment areas of piping related to interstitial monitoring, secondary containment is tested for tightness within 30 days after completion of repair according to manufacturer's instructions, a recognized code of practice, or independent testing lab.

In the case of Fort Benning, the tanks are equipped with Veeder-Root 350+ systems that provide for remote monitoring of the ASTs, USTs, and piping on installation through the Insite 350 program. These systems warn DPW personnel of any potential fuel leaks by monitoring the pressure and fuel levels inside the tanks and lines at all times. As so long as the system is properly calibrated and maintained, the DPW has a secondary mechanism for detecting any problems that needs attention. As required by 40 CFR 280, UST operators must submit a notification to the implementing agency in the instance of a known or suspected release due to the monitoring equipment alarms, spills and overfills, tank or line failure, or a need to change or close a UST.

During this research, several complaints surfaced regarding DPW employees who had disabled alarm systems to avoid reporting frequent false alarms to the implementing agency. This is a significant concern because, if a leak had occurred, it would have gone undetected for a prolonged period of time. Note that the need to report suspected leaks due to a sounding alarm is only required by regulations concerning USTs.

In locations where calibration of monitoring equipment is difficult or impossible due to frequent pressure changes, ASTs may have a better chance to be properly monitored. Conversely, Fort Benning personnel report that the monitoring systems are not a problem because it is in the best interest of both AAFES and the DPW to properly maintain the systems. As discussed in the next section, maintenance is the largest cost for the DPW in association with storage tank management. Also, a main factor ensuring that AAFES personnel properly monitor, inspect, and test the station's tanks is the fact that a failure to do so can result in a mandatory closure of the station while repairs or replacement take place. During this time, AAFES is out of business and losing revenue.

Federal regulations require significantly less inspection and testing of ASTs than of USTs in quantity, frequency, and specificity of action. Table 4 lists Federal regulatory requirements for inspection and testing while operating an AST system.

Regardless of the its design, an AST must be tested or inspected for integrity on a "regular" schedule and whenever material repairs are made. The inspections recommended and accepted by both 40 CFR 112 and industry standards are one, or a combination of, the following:

- visual inspection,
- hydrostatic testing,
- radiographic testing,
- ultrasonic testing,
- acoustic emissions testing, or
- other systems of non-destructive testing.

Facility personnel must also inspect the container's supports and foundations, and must frequently inspect the outside of the container for signs of deterioration, discharges, or accumulation of oil inside diked areas. DPW should keep records of all these inspections.

Table 4. Inspection and testing requirements for AST operators.

Citation	Description	Implementation
40 CFR 112.8(c)(3)	Inspection	Inspection of bermed area after rainfall for single wall tanks. Inspect water pooled in containment area for evidence of petroleum, oil, and lubricants (POL). If POL is present, skim it off with spill cleanup materials. Document results of inspections and actions taken.
40 CFR 112.8(c)(6)	Inspection	Routinely inspect the outside of the container for signs of deterioration or discharges as well as the container's supports and foundations. The scope and frequency of the inspection is determined by industry standards or according to a site-specific inspection program developed and certified by the SPCC Plan preparer. The typical industry standard is to perform monthly inspections.
40 CFR 112.8(d)(4) and 112.12(d)(4)	Inspection	Regularly inspect all aboveground valves, piping, and appurtenances. Done according to industry standards.
40 CFR 112.8(d)(1) and 112.12(d)(1)	Inspection	If any portion of buried piping at non-production facilities is exposed, the line must be inspected for deterioration. If corrosion damage is found, provide additional inspection or correction.
40 CFR 112.8(c)(6)	Testing	Test or inspect each aboveground container for integrity on a regular schedule and whenever making material repairs. NOTE: Testing on a "regular schedule" means testing per industry standards (i.e., SP001) or at a frequency sufficient to prevent discharges.
40 CFR 112.8©(8)(v)	Testing	Testing of liquid level sensing devices, if present, is required "routinely."
40 CFR 112.8(d)(4) and 112.12(d)(4)	Testing	Conduct integrity and leak testing of buried piping at the time of installation, modification, construction, relocation, or replacement.

The frequency and the types of inspections and testing are usually defined in the SPCC Plan and should take into consideration container size, configuration, and design (e.g., containers that are: shop-built, field-erected, skid-mounted, elevated, equipped with a liner, double-walled, or partially buried). In lieu of specific SPCC Plan direction, "regular" is defined as: (1) monthly inspections by the tank owner's inspector qualified per paragraph 4.1.2 of the Storage Tank Inspection SP001 Standard, and (2) formal external and internal inspection that is performed by an inspector possessing the necessary qualifications in accordance to industry standards, or on a schedule determined by the facility itself that is sufficient to prevent discharges.

5 State Requirements

At the time of this writing, the states of Georgia, Kansas, Maine, and Nebraska have chosen not to regulate ASTs under CWA authority. Instead, they regulate the installation and management of ASTs as part of their state or local fire code, most often incorporating NFPA30 guidance. Since the state or local fire code is not promulgated under the authority of the CWA, the state fire code is not enforceable by state or Federal environmental regulators at Federal facilities.

Among the states that do regulate ASTs under their CWA authority, there is a trend to adopt the monitoring, testing, and O&M requirements of 40 CFR 280 for USTs, and to apply them to ASTs. In this situation, the state is imposing more requirements for the management of ASTs than are required by the Federal government in 40 CFR 112. According to a quick survey of the states that regulate ASTs under CWA authority, the states have adopted and applied all, or a portion of, 40 CFR 280 to AST management except for the following states: Alaska, Iowa, Indiana, Montana, New Jersey, and Washington.

Lastly, due to the Federal Facilities Compliance Act (FFCA) of 1992, Federal facilities are subject to fees or fines associated with noncompliance with Federal, state, or local UST regulations. Under the CWA there is no such waiver of immunity from civil monetary penalties.

6 Recommended Best Management Practices

6.1 General

BMPs bridge the gap in operations and maintenance requirements included in the Federal regulations. These additional practices and system components are meant to provide extra layers of protection from oil spills and leaks. They are highly recommended to enhance system resiliency. These implementations will increase the life cycle costs of ASTs, making them more expensive than USTs if maintenance of these system components is included in the calculations.

These recommendations come from both industry standards found in the Steel Tank Institute's (STI's) *SP001 Standard* (STI 2018) and NFPA 30A, *Code for Motor Fuel Dispensing Facilities and Repair Garages* (2018). These recommendations are not widely applicable to Army installations, and thus this report relegates them to a lesser position of concern for the life cycle cost analysis.

Some of the most important BMP considerations are found in NFPA 30A (NFPA 2018). NFPA 30A recommends that AST capacity for an individual tank not surpass 12,000 gallons, and a 25-ft radius of protection be maintained around the AST. Buildings, property lines, fuel dispensers, parked vehicles, power lines, and transformers are prohibited within this radius. If followed, this BMP can significantly increase the necessary footprint of a fuel service station.

Furthermore, a number of BMP elements can be added to fuel service systems as capital costs, but their continued maintenance should be a consideration as well.

USTs are increasingly standardized. This reduces the number of recommendations for increasing the tank system's resiliency. Generally, the options available or UST operators are site-specific, including the tank material that is best for the site, and whether to anchor the tank.

Many elements can improve an AST's resiliency, including frequency and types of inspections, the number of tanks, design of tank area, the quality of the anti-corrosion paint used, whether an offloading system or a hose is used, and more. Common recommendations that increase capital costs for AST systems are:

- more tanks with less individual capacity
- fire resistant steel tanks
- transition sump
- fuel offloading system instead of direct fill
- fencing with bollards
- platforms instead of ladders.

6.2 Fuel offloading system

In areas not served by trucks equipped with a fuel pump capable of serving ASTs, AST systems will require an offloading site for trucks delivering fuel to the service station. NFPA suggests that this additional structure be located outside of the 25-ft safety radius. This significantly increases the space needed to operate ASTs at a fuel service station.

6.3 Fencing

Fencing is generally more secure and gives a more aesthetically pleasing appearance than the unobstructed view of storage tanks on service station property. Unfortunately, in comparison with the use of bollards, fencing adds to ASTs' spatial requirements.

6.4 Platforms

Platforms, as an alternative to ladders, are a safer and more convenient working surface for access to and inspection of the tops of ASTs.

6.5 Site specific concerns

When it comes to safety, the most important factors in determining whether to the install a UST in accordance with the design requirement, or to request an exemption to use an AST are the requirements of the specific site location. ASTs and USTs pose different safety risks.

The primary safety risk to consider is the possibility that an AST or UST may sustain catastrophic damage from weather related incidents, fire, or vehicles. Weather-related incidents such as tornadoes, hurricanes, and wild fires pose particular threats to ASTs. Earthquakes and flooding can threaten a UST's storage tank integrity. Regions of the United States that are prone to a particular type of risk may be totally inappropriate for one type of system. For example, earthquake-prone areas may not be good candidates for UST installations; tornado-prone areas may not be good candidates for AST installations. In some cases, steps can be taken to decrease vulnerability to these risk factors, but the additional capital costs and space needed for these risk-avoidance options may make one system an inappropriate choice.

Furthermore, by the nature of the facility, vehicles continually navigate fuel dispensing stations; this adds significantly to the risk that ASTs will be struck and compromised. It is important that access to ASTs be limited as much as possible from vehicle traffic. Limiting vehicle access to ASTs by placing them "out of harm's way" requires that the facility be located on a significantly larger real property area. This can prove very expensive, sometimes impossible for installations to accommodate. Again, this is a site-specific decision. When decision makers determine whether to allow ASTs, it is extremely important that they fully analyze the safety risk from local weather-related factors and vehicle traffic.

ASTs are much more likely to be the targets of terrorist attacks than USTs because of the damage and potential loss of life resulting from such an attack. To limit this potential threat from terror, it is best to place ASTs out of sight from the installation's perimeter, in a shelter that protects the ASTs from aerial view. Installations may find these options difficult to implement since they can involve both space and cost limitations. For example, while personnel at Fort Benning voiced no major concerns with the work required for inspections or reporting, they did express a strong concern with the weather- and terror-related safety risks associated with ASTs.

7 Life Cycle Assessment

7.1 Methodology

7.1.1 Regulation review

The initial step in performing this LCC was to do a detailed review of 40 CFR 112 and 40 CFR 280 to identify requirements applicable to the installation, operation, and management of new ASTs and USTs. To facilitate the assignment of costs, the requirements were categorized by:

- tank structure
- line structure
- tank testing (includes monitoring and inspections)
- line testing (includes monitoring and inspections)
- training
- documentation
- operations.

These initial broad categories were further subdivided as it became obvious that additional granularity was needed to more accurately define costs.

The other challenge has been the variability in regulatory detail for ASTs versus USTs. Due to concerns about contamination of soil and groundwater, as well as lessons learned and technology improvements, USTs are regulated in great detail. On the other hand, the term "aboveground storage tank" does not even appear in 40 CFR 112. Instead the term "Bulk Storage Containers" is used and while basic requirements are provided, the USEPA's expectation is that the facility-specific SPCC Plan will fill in the gaps depending on the potential for release at the facility.

7.1.2 Cost estimation

The next step was to assign monetary costs (dollar amounts) to the actions required by regulation. This was done by creating a 30 year lifetime aggregate of expenses incurred to each system. National averages for construction and maintenance costs of USTs and ASTs were found by using RS Means data (Table 5). This was supplemented with data from a recent AAFES (2017) report that estimated cost comparisons. This analysis follows that analysis in AAFES (2017) in that it compares a service station

with two USTs vs. three ASTs, at a total equivalent volume of 35,000 gallons. The following section summarizes the results of the analysis.

7.2 Results

This analysis found that a UST system is cheaper than an AST system, even when the AST system is designed to meet minimum regulatory requirements. USTs, which are more standardized by regulation, cost an estimated $74,887 annually and have a net present value of $2,333,152 after a 30-year lifetime and includes tank installation and removal cost.

When recommendations are followed to provide for more resilient ASTs, the cost to operate an AST system increases. The annualized cost for an AST following recommendations is $90,570. The net present value for an AST system after a 30-year lifetime is estimated to be $2,807,941. The lifetime cost differential in this case is $474,789. This price includes the cost of increased inspection and testing of the additional structural components of the AST system. By these calculations, the costs of ASTs increase to 20% more than the costs of USTs.

Table 5 lists the annual costs. All costs are annualized over the 30-year lifespan and include maintenance, inspections, and tank removal. Table 6 summarizes these results, including the costs of tank installation and removal. Note that capital costs only include excavation, tanks, and installation labor. It does not include foundations, piping, or other associated construction tasks.

Table 5. Recurring annual cost comparison including AST BMPs.

Implementation	UST	AST
Annual maintenance	$50,000	$50,000
Walk through inspection (monthly)	$720	$720
Recordkeeping/SPCC Plan	$1,080	$1,080
Integrity testing and leak test of underground piping; every 3 years, $1000 + 5 hours DPW labor, annualized	$650	$650
Tank integrity testing; every 3 years, $2000 per each of three tanks, 50% occupied hours (OH), 5 hours DPW time, annualized	$2,150	$3,150
Leak detection system replacement, every 15 years, annualized	$2,000	$2,000
Overfill prevention inspections, every 3 years, annualized	$500	$500
Vapor balance testing, every 3 years, annualized	$1,000	$1,000
Maintenance of leak detection system	$5,000	$5,000
Release detection equipment testing	$5,000	$5,000
Sump/Spill Bucket Test, every 3 years, annualized	$1,667	—
Notification to implementing agency (continuous, call it 1 hour/month)	$1,080	—
Tightness testing; every 3 years or after every repair, $2000 contract per each of two tanks + 5 hours DPW labor. Annualized	$2,150	—
Offload system maintenance	—	$10,000
Liquid level sensing inspection (“routinely,” call it monthly)	—	$360
STI SP001 annual inspection	—	$3,000
Formal STI SP001 Inspection, every 20 years, annualized	—	$1,000
Tank painting, every 10 years, annualized	—	$5,000
Pipe painting, every 10 years, annualized	—	$1,000
Handheld release detection equipment inspection (annually), ½ hour worker rate	—	$30
Inspection of bermed area after rainfall (call it twice per month), 30 min worker time	—	$720
Inspection of fencing, platforms, bollards, berms, monthly, ½ hour labor	—	$360
Annualized tank removal cost (total cost/ 30 years	$1,890	300
TOTALS	$74,887	$90,870

Table 6. Summary of costs.

Cost	UST	AST
Installation Cost (including excavation, tanks, and installation)	$133,215	$138,000
Removal Cost (current $)	$56,700	$9,000
Annual Cost (incl. maintenance and inspections)	$72,997	$90,570
30 year, Net Present Value (NPV) (incl. annual cost, installation, and removal)	$2,333,152	$2,807,941

8 Summary, Conclusions, and Recommendations

8.1 Summary

A detailed regulatory review revealed that the requirements of USTs are more defined and straightforward than those of ASTs. UST requirements, which are found in 40 CFR 280, are applied to systems on government property in each of the states holding approved UST management plans with the USEPA. AST regulations are more difficult to define in that they change significantly from state to state. AST regulations can be found in 40 CFR 112, and (depending on with what authority the state regulates the ASTs) in parts of 40 CFR 280, in the state fire code, and in NFPA30A. This report focused primarily on the Federal requirements listed in 40 CFR 280 and 40 CFR 112. Determining the state, county, and local regulations that also apply to the management of ASTs at fuel service stations on government property must be done a case-by-case basis.

8.2 Conclusions

Taking into account installation, annual costs, and tank removal, this work has estimated that AST systems are, at a minimum, 4% more expensive than USTs over their 30-year lifetime (assuming bare minimums). If recommended AST practices and purchases are made, it is likely that the life cycle cost of an AST will be ~20% more expensive than the cost of a UST system, over 30 years. Note that the estimated 20% annual cost differential between USTs and ASTs does not account for state, local, and site specific factors that must also be considered when choosing the correct fuel storage system.

8.3 Recommendations

The life cycle costs of USTs do not differ significantly enough from the costs of ASTs to clearly recommend one system over the other based solely on cost. It is recommended that the installation consider the benefits and weaknesses of USTs and ASTs to determine the type of system that is more resilient and that best meets its needs. When neither system is clearly suitable, then issues of space, aesthetics, and local preference should be taken into account.

This work does not recommend that the standard design for service stations should mandate one fuel storage system over the other. Installations should be allowed to select storage tank type on a case-by-case basis. Nevertheless, since a clear UST standard does currently exist, it is recommended that waiver requests not be given out freely. The UST standard requires that fuel storage systems be systematically maintained, inspected, and tested, regardless of the state or area. Over the course of this work, it was found that some locations prefer ASTs to USTs because ASTs are currently subject to fewer legal requirements governing operation than are USTs. This fact should make authorities especially wary of the risks of negligence. Even though ASTs and USTs are considered to be equally resilient systems against leaks and failures, this is only true when the systems are properly maintained. Formal regulation provides a powerful tool to minimize negligence by requiring proper maintenance.

It is recommended that waiver requests be granted in situations where USTs can be proven to be at higher risk for leaks and failures than ASTs. The best indication of which system to choose is the amount of risk mitigated at the site. Each system is vulnerable to different extents to catastrophic failure from weather related incidents, fire, flooding, automobile collision, and terror. For instance, sites at high risk of earthquakes may wish to install ASTs over USTs, but sites where wild fires are common place may be better off with a UST. It is up to site designers to take these concerns into consideration.

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Acronyms and Abbreviations

Term	Definition
AAFES	Army and Air Force Exchange Service
AST	Aboveground Storage Tank
BMP	Best Management Practice
CERL	Construction Engineering Research Laboratory
CFR	Code of the Federal Regulations
CWA	Clean Water Act
DoD	U.S. Department of Defense
DPW	Directorate of Public Works
ERDC	U.S. Army Engineer Research and Development Center
ERDC-CERL	Engineer Research and Development Center, Construction Engineering Research Laboratory
FFCA	Federal Facilities Compliance Act (of 1992)
FFEP	Fuels Facilities Engineering Panel
IMCOM	U.S. Army Installation Management Command
JBSA	Joint Base San Antonio
HQIMCOM	Headquarters, Installation Management Command
ISA	Interservice Support Agreement
LCCA	Life-Cycle Cost Analysis
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
NPV	Net Present Value
O&M	Operations and Maintenance
OH	Occupied Hours
POL	Petroleum, Oil, and Lubricants
RCRA-I	Resource Conservation and Recovery Act, Subtitle I
SPCC	Spill Prevention, Control and Countermeasure
STI	Steel Tank Institute
SWPPP	Storm Water Pollution Prevention Plan
TR	Technical Report
USEPA	U.S. Environmental Protection Agency
UST	Underground Storage Tank

Glossary

Aboveground Release
: In relation to USTs, this is any release to the surface of the land or to surface water. This includes, but is not limited to, releases from the aboveground portion of a UST system and aboveground releases associated with overfills and transfer operations as the regulated substance moves to or from a UST system (40 CFR 280.12).

Adjacent
: Means bordering, contiguous, or neighboring [see definition of *Neighboring*] a water identified in paragraphs (1) through (5) of the definition for "Waters of the United States," including waters separated by constructed dikes or barriers, natural river berms, beach dunes, and the like. For purposes of adjacency, an open water such as a pond or lake includes any wetlands within or abutting its ordinary high water mark. Adjacency is not limited to waters located laterally to a water identified in paragraphs (1) through (5) of the definition for "Waters of the United States." Adjacent waters also include all waters that connect segments of a water identified in paragraphs (1) through (5) or are located at the head of a water identified in paragraphs (1) through (5) of the definition for "Waters of the United States," and are bordering, contiguous, or neighboring such water. Waters being used for established normal farming, ranching, and silviculture activities (33 U.S.C. 1344(f)) are not adjacent (40 CFR 112.2).

Accidental Release
: Any sudden or non-sudden release of petroleum from an underground storage tank that results in a need for corrective action and/or compensation for bodily injury or property damage neither expected nor intended by the tank owner or operator (40 CFR 280.92).

Ancillary Equipment
: Any device including, but not limited to, such devices as piping, fittings, flanges, valves, and pumps used to distribute, meter, or control the flow of regulated substances to and from the UST (40 CFR 280.12).

Belowground Release

Any release to the subsurface of the land and to groundwater. This includes, but is not limited to, releases from the below ground portion of a UST system and belowground releases associated with overfills and transfer operations as the regulated substance moves to or from an UST (40 CFR 280.12).

Bulk Gasoline Plant

Any gasoline storage and distribution facility that receives gasoline by pipeline, ship or barge, or cargo tank, and subsequently loads the gasoline into gasoline cargo tanks for transport to gasoline dispensing facilities, and has a gasoline throughput of less than 20,000 gallons per day. Gasoline throughput shall be the maximum calculated design throughput as may be limited by compliance with an enforceable condition under Federal, State, or local law, and discoverable by the Administrator and any other person (40 CFR 63.11100).

Bulk Gasoline Terminal

Any gasoline facility that receives gasoline by pipeline, ship or barge, and has a gasoline throughput greater than 75,700 liters per day. Gasoline throughput shall be the maximum calculated design throughput as may be limited by compliance with an enforceable condition under Federal, State or local law and discoverable by the Administrator and any other person (40 CFR 63.421).

Bulk Gasoline Terminal

Any gasoline storage and distribution facility that receives gasoline by pipeline, ship or barge, or cargo tank and has a gasoline throughput of 20,000 gallons per day or greater. Gasoline throughput shall be the maximum calculated design throughput as may be limited by compliance with an enforceable condition under Federal, State, or local law and discoverable by the Administrator and any other person (40 CFR 63.11100).

Bulk Storage Container

Any container used to store oil. These containers are used for purposes including, but not limited to, the storage of oil prior to use, while being used, or prior to further distribution in commerce. Oil-filled electrical, operating, or manufacturing equipment is not a bulk storage container (40 CFR 112.2).

Bunkered Tank

A container constructed or placed in the ground by cutting the earth and re-covering the container in a manner that breaks the surrounding natural grade, or that lies above grade, and is covered with earth, sand, gravel, asphalt, or other material. A bunkered tank is considered an aboveground storage container for purposes of 40 CFR 112 (40 CFR 112.2).

Cathodic Protection

A technique to prevent corrosion of a metal surface by making that surface the cathode of an electrochemical cell. For example, a tank system can be cathodically protected through the application of either galvanic anodes or impressed current (40 CFR 280.12).

Class A Operator

The individual who has primary responsibility to operate and maintain the UST system in accordance with applicable requirements established by the implementing agency. The Class A operator typically manages resources and personnel, such as establishing work assignments, to achieve and maintain compliance with regulatory requirements (40 CFR 280.12).

Class B Operator

The individual who has day-to-day responsibility for implementing applicable regulatory requirements established by the implementing agency. The Class B operator typically implements in-field aspects of operation, maintenance, and associated recordkeeping for the UST system (40 CFR 280.12).

Class C Operator

The individual responsible for initially addressing emergencies presented by a spill or release from an UST system. The Class C operator typically controls or monitors the dispensing or sale of regulated substances (40 CFR 280.12).

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 UST (40 CFR 280.12).

Completely Buried Tank

Any container completely below grade and covered with earth, sand, gravel, asphalt, or other material. Containers in vaults, bunkered tanks, or partially buried tanks are considered aboveground storage containers for purposes of 40 CFR 112 (40 CFR 112.2).

Connected Piping

All underground piping including valves, elbows, joints, flanges, and flexible connectors attached to a tank system through which regulated substances flow. For the purpose of determining how much piping is connected to any individual UST system, the piping that joins two UST systems should be allocated equally between them (40 CFR 280.12).

Consumptive Use

With respect to heating oil, means consumed on the premises (40 CFR 280.12)

Containment Sump

A liquid-tight container that protects the environment by containing leaks and spills of regulated substances from piping, dispensers, pumps and related components in the containment area. Containment sumps may be single walled or secondarily contained and located at the top of tank (tank top or submersible turbine pump sump), underneath the dispenser (under-dispenser containment sump), or at other points in the piping run (transition or intermediate sump) (40 CFR 280.12).

Corrosion Expert

A person who, by reason of thorough 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 accredited or certified as being qualified by the National Association of Corrosion Engineers or be a registered professional engineer who has certification or licensing that includes education and experience in corrosion control of buried or submerged metal piping systems and metal tanks (40 CFR 280.12).

Discharge This term includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying, or dumping of oil, but excludes discharges in compliance with a permit under Section 402 of the CWA; discharges resulting from circumstances identified, reviewed, and made a part of the public record with respect to a permit issued or modified under Section 402 of the CWA, and subject to a condition in such permit; or continuous or anticipated intermittent discharges from a point source, identified in a permit or permit application under Section 402 of the CWA, that are caused by events occurring within the scope of relevant operating or treatment systems. For purposes of 40 CFR 112, the term discharge shall not include any discharge of oil that is authorized by a permit issued under Section 13 of the River and Harbor Act of 1899 (33 U.S.C. 407) (40 CFR 112.2).

Dispenser Equipment located aboveground that dispenses regulated substances from the UST system (40 CFR 280.12).

Dispenser System
The dispenser and the equipment necessary to connect the dispenser to the underground storage tank system (40 CFR 280.12).

Electrical Equipment
Underground equipment that contains dielectric fluid that is necessary for the operation of equipment such as transformers and buried electric cable (40 CFR 280.12)

Excavation Zone
The volume containing the tank system and backfill material bounded by the ground surface, walls, and floor of the pit and trenches into which the UST system is placed at the time of installation (40 CFR 280.12).

Excluded USTs
These are USTs that are not required to meet the requirements found in 40 CFR 280 and include (40 CFR 280.10(b)):

1. Any UST system holding hazardous wastes listed or identified under Subtitle C of the Solid Waste Disposal Act, or a mixture of such hazardous waste and other regulated substances
2. Any wastewater treatment tank system that is part of a wastewater treatment facility regulated under Section 402 or 307(b) of the Clean Water Act (CWA)

3. Equipment or machinery that contains regulated substances for operational purposes such as hydraulic lift tanks and electrical equipment tanks
4. Any UST system with a capacity of 110 gal or less
5. Any UST system that contains a de minimis concentration of regulated substance
6. Any emergency spill or overflow containment UST system that is expeditiously emptied after use.

NOTE: See also the definitions for Underground Storage Tank and Partially Excluded USTs.

Facility Any mobile or fixed, onshore or offshore building, property, parcel, lease, structure, installation, equipment, pipe, or pipeline (other than a vessel or a public vessel) used in oil well drilling operations, oil production, oil refining, oil storage, oil gathering, oil processing, oil transfer, oil distribution, and oil waste treatment, or in which oil is used, as described in Appendix A to 40 CFR 112. The boundaries of a facility depend on several site-specific factors, including but not limited to, the ownership or operation of buildings, structures, and equipment on the same site and types of activity at the site. Contiguous or non-contiguous buildings, properties, parcels, leases, structures, installations, pipes, or pipelines under the ownership or operation of the same person may be considered separate facilities. Only this definition governs whether a facility is subject to 40 CFR 112 (40 CFR 112.2).

Field-Constructed Tank
A tank constructed in the field. For example, a tank constructed of concrete that is poured in the field, or a steel or fiberglass tank primarily fabricated in the field is considered field-constructed (40 CFR 280.250).

Flow-Through Process Tank
A tank that forms an integral part of a production process through which there is a steady, variable, recurring, or intermittent flow of materials during the operation of the process. Flow-through process tanks do not include tanks used for the storage of material prior to their introduction into the production process or for the storage of finished products or byproducts from the production process (40 CFR 280.12).

Free-Product

A regulated substance that is present as a non-aqueous phase liquid (e.g., liquid not dissolved in water).

Heating Oil Petroleum that is No. 1, No. 2, No. 4–light, No. 4–heavy, No. 5–light, No. 5–heavy, and No. 6–technical grades of fuel oil; other residual fuel oils (including Navy Special Fuel Oil and Bunker C); and other fuels when used as substitutes for one of these fuel oils. Heating oil is typically used in the operation of heating equipment, boilers, or furnaces (40 CFR 280.12).

Implementing Agency

For 40 CFR 112 this is the U.S. Regional Administrator. For 40 CFR 280, the USEPA Regional Administrator, or, in the case of a state with a program approved under Section 9004, the Director of the designated state or local agency responsible for carrying out an approved UST program.

Liquid Trap Sumps, well cellars, and other traps used in association with oil and gas production, gathering, and extracting operations (including gas production plants), for the purpose of collecting oil, water, and other liquids. These liquid traps may temporarily collect liquids for subsequent disposition or reinjection into a production or pipeline stream, or may collect and separate liquids from a gas stream (40 CFR 280.12).

Maintenance

The normal operational upkeep to prevent a UST system from releasing product (40 CFR 280.12).

Mobile Refueler

A bulk storage container onboard a vehicle or towed, that is designed or used solely to store and transport fuel for transfer into or from an aircraft, motor vehicle, locomotive, vessel, ground service equipment, or other oil storage container (40 CFR 112.2).

Motive Power Container

Any onboard bulk storage container used primarily to power the movement of a motor vehicle, or ancillary onboard oil-filled operational equipment. An onboard bulk storage container that is used to store or transfer oil for further distribution is not a motive power container. The definition of motive power container does not include oil drilling or workover equipment, including rigs (40 CFR 112.2).

Motor Fuel A complex blend of hydrocarbons typically used in the operation of a motor engine, such as motor gasoline, aviation gasoline, No. 1 or No. 2 diesel fuel, or any blend containing one or more of these substances (for example: motor gasoline blended with alcohol). (40 CFR 280.12).

Neighboring This term means (40 CFR 110.1 and 112.2):

1. All waters located within 100 ft of the ordinary high water mark of a water identified in paragraphs (1) through (5) of the definition for "Waters of the United States." The entire water is neighboring if a portion is located within 100 ft of the ordinary high water mark;
2. All waters located within the 100-year floodplain of a water identified in paragraphs (1) through (5) of the definition for "Waters of the United States" and not more than 1,500 ft from the ordinary high water mark of such water. The entire water is neighboring if a portion is located within 1,500 ft of the ordinary high water mark and within the 100-year floodplain;
3. All waters located within 1,500 ft of the high tide line of a water identified in paragraphs (1) or (3) of the definition for "Waters of the United States," and all waters within 1,500 ft of the ordinary high water mark of the Great Lakes. The entire water is neighboring if a portion is located within 1,500 ft of the high tide line or within 1,500 ft of the ordinary high water mark of the Great Lakes.

New Tank System
For USTs, a tank system that will be used to contain an accumulation of regulated substances and for which installation has commenced after 22 December 1988 (40 CFR 280.12).

Occurrence An accident, including continuous or repeated exposure to conditions, which results in a release from an underground storage tank. NOTE: This definition is intended to assist in the understanding of these regulations and is not intended either to limit the meaning of "occurrence" in a way that conflicts with standard insurance usage or to prevent the use of other standard insurance terms in place of "occurrence" (40 CFR 280.92).

Oil Oil of any kind or in any form, including, but not limited to: fats, oils, or greases of animal, fish, or marine mammal origin; vegetable oils, including oils from seeds, nuts, fruits, or kernels; and, other oils and greases, including petroleum, fuel oil, sludge, synthetic oils, mineral oils, oil refuse, or oil mixed with wastes other than dredged spoil (40 CFR 112.2).

Oil-filled Operational Equipment
Equipment that includes an oil storage container (or multiple containers) in which the oil is present solely to support the function of the apparatus or the device. Oil-filled operational equipment is not considered a bulk storage container, and does not include oil-filled manufacturing equipment (flow-through process). Examples of oil-filled operational equipment include, but are not limited to, hydraulic systems, lubricating systems (e.g., those for pumps, compressors and other rotating equipment, including pumpjack lubrication systems), gear boxes, machining coolant systems, heat transfer systems, transformers, circuit breakers, electrical switches, and other systems containing oil solely to enable the operation of the device (40 CFR 112.2).

On the Premises Where Stored
With respect to heating oil, means UST systems located on the same property where the stored heating oil is used (40 CFR 280.12).

Operational Life
The period beginning when installation of the tank system has commenced until the time the tank system is properly closed under Subpart G of 40 CFR 280 (40 CFR 280.12).

Operator Any person in control of or having responsibility for the daily operation of the UST system (40 CFR 280.12).

Overfill Release
A release that occurs when a tank is filled beyond its capacity, resulting in a discharge of the regulated substance to the environment (40 CFR 280.12).

Owner or Operator
Any person owning or operating an onshore facility or an offshore facility, and in the case of any abandoned offshore facility, the person who owned or operated or maintained the facility immediately prior to such abandonment (40 CFR 112.2).

Owner:

1. In the case of an UST system in use on November 8, 1984, or brought into use after that date, any person who owns an UST system used for storage, use, or dispensing of regulated substances; and
2. In the case of any UST system in use before November 8, 1984, but no longer in use on that date, any person who owned such UST immediately before the discontinuation of its use (40 CFR 280.12).

Owner or Operator

When the owner or operator are separate parties, refers to the party that is obtaining or has obtained financial assurances (40 CFR 280.92).

Partially Buried Tank

A storage container that is partially inserted or constructed in the ground, but not entirely below grade, and not completely covered with earth, sand, gravel, asphalt, or other material. A partially buried tank is considered an aboveground storage container for purposes of 40 CFR 112 (40 CFR 112.2).

Partially Excluded Underground Storage Tanks (USTs)

For the purposes of 40 CFR 280, the following USTs are exempt from Subparts B, C, D, E, G, J, and K (40 CFR 280.10(c)):

1. Wastewater treatment tank systems not covered in the definition of *Excluded USTs*;
2. Aboveground storage tanks associated with:
3. Airport hydrant fuel distribution systems regulated under 40 CFR 280, Subpart K; and
4. UST systems with field constructed tanks regulated under 40 CFR 280, Subpart K;
5. Any UST systems containing radioactive material that are regulated under the Atomic Energy Act of 1954 (42 U.S.C. 2011 and following); and
6. Any UST system that is part of an emergency generator system at nuclear power generation facilities licensed by the Nuclear Regulatory Commission and subject to Nuclear Regulatory Commission requirements regarding design and quality criteria, including but not limited to 10 CFR 50.

Person An individual, trust, firm, joint stock company, Federal agency, corporation, state, municipality, commission, political subdivision of a state, or any interstate body. Person also includes a consortium, a joint venture, a commercial entity, and the U.S. Government (40 CFR 280.12).

Person Includes an individual, firm, corporation, association, or partnership (40 CFR 112.2).

Petroleum Oil
Petroleum in any form, including but not limited to crude oil, fuel oil, mineral oil, sludge, oil refuse, and refined products (40 CFR 112.2).

Petroleum UST System
A UST system that contains petroleum or a mixture of petroleum with de minimis quantities of other regulated substances. Such systems include those containing motor fuels, jet fuels, distillate fuel oils, residual fuel oils, lubricants, petroleum solvents, and used oils (40 CFR 280.12).

Pipe or Piping
A hollow cylinder or tubular conduit that is constructed of nonearthen materials (40 CFR 280.12).

Release Any spilling, leaking, emitting, discharging, escaping, leaching, or disposing from a UST into groundwater, surface water, or subsurface soils (40 CFR 280.12).

Release Detection
Determining whether a release of a regulated substance has occurred from the UST system into the environment or into the interstitial space between the UST system and its secondary barrier or secondary containment around it (40 CFR 280.12).

Release Detection
Determining whether a release of a regulated substance has occurred from the UST system into the environment or a leak has occurred into the interstitial space between the UST system and its secondary barrier or secondary containment around it (40 CFR 280.12).

Repair (Noun) Any work necessary to maintain or restore a container to a condition suitable for safe operation, other than that necessary for ordinary, day-to-day maintenance to maintain the functional integrity of the container and that does not weaken the container (40 CFR 112.2).

Repair (Verb) To restore to proper operating condition a tank, pipe, spill prevention equipment, overfill prevention equipment, corrosion protection equipment, release detection equipment or other UST system component that has caused a release of product from the UST system or has failed to function properly (40 CFR 280.12).

Replaced For a tank, this is to remove a tank and install another tank. For piping, this is to remove 50% or more of piping and install other piping, excluding connectors, connected to a single tank. For tanks with multiple piping runs, this definition applies independently to each piping run (40 CFR 280.12).

Secondary Containment or Secondarily Contained
A release prevention and release detection system for a tank or piping. This system has an inner and outer barrier with an interstitial space that is monitored for leaks. This term includes containment sumps when used for interstitial monitoring of piping (40 CFR 280.12).

Spill Prevention, Control, and Countermeasure Plan; SPCC Plan, or Plan
The document required by 40 CFR 112.3 that details the equipment, workforce, procedures, and steps to prevent, control, and provide adequate countermeasures to a discharge (40 CFR 112.2).

Storage Capacity of a Container
The shell capacity of the container (40 CFR 112.2).

Stormwater or Wastewater Collection System
Piping, pumps, conduits, and any other equipment necessary to collect and transport the flow of surface water runoff resulting from precipitation, or domestic, commercial, or industrial wastewater to and from retention areas or any areas where treatment is designated to occur. The collection of stormwater and wastewater does not include treatment except where incidental to conveyance (40 CFR 280.12).

Tank In relation to USTs, a stationary device designed to contain an accumulation of regulated substances and constructed of non-earthen materials (e.g., concrete, steel, plastic) that provide structural support (40 CFR 280.12).

Training Program

Any program that provides information to and evaluates the knowledge of a Class A, Class B, or Class C operator through testing, practical demonstration, or another approach acceptable to the implementing agency regarding requirements for UST systems that meet the requirements of subpart J of 40 CFR 280 (40 CFR 280.12).

Underground Storage Tank (UST)

Any one or a combination of tanks (including underground pipes connected thereto) that is used to contain an accumulation of regulated substances, and the volume of which (including the volume of underground pipes connected thereto) is 10% or more beneath the surface of the ground. This term does not include any (40 CFR 280.12):

1. Farm or residential tank with a capacity of 1100 gal or less that is used for storing motor fuel for noncommercial purposes
2. Tank used for storing heating oil for consumptive use on the premises where stored
3. Septic tanks
4. Pipeline facility (including gathering lines):
5. which is regulated under 49 U.S.C. chapter 601; or
6. which is an intrastate pipeline facility regulated under state laws as provided in 49 U.S.C. chapter 601, and which is determined by the Secretary of Transportation to be connected to a pipeline, or to be operated or intended to be capable of operating at pipeline pressure or as an integral part of a pipeline;
7. Surface impoundment, pit, pond, or lagoon
8. Stormwater or waste water collection system
9. Flow-through process tank
10. Liquid trap or associated gathering lines directly related to oil or gas production and gathering operations
11. Storage tank situated in an underground area (such as a basement, cellar, mineworking, drift, shaft, or tunnel) if the storage tank is situated upon or above the surface of the floor

NOTE: The definition of UST does not include any pipes connected to any tank that is described in para (1) through (9) of this definition.

NOTE: See also the definitions for Excluded USTs and Partially Excluded USTs.

Upgrade The addition or retrofit of some systems such as cathodic protection, lining, or spill and overfill controls to improve the ability of a UST system to prevent the release of product (40 CFR 280.12).

UST System *or Tank System*
An UST, connected underground piping, underground ancillary equipment, and containment system, if any (40 CFR 280.12).

Wastewater Treatment Tank
A tank that is designed to receive and treat influent wastewater through physical, chemical, or biological methods (40 CFR 280.12).

Waters of the United States
This phrase includes the following (40 CFR 112.2):

1. All waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide;
2. All interstate waters, including interstate wetlands [see definition of *Wetlands*];
3. The territorial seas;
4. All impoundments of waters otherwise identified as waters of the United States under 40 CFR 110.1;
5. All tributaries, [see definition of *Tributary*], of waters identified in paragraphs (1) through (3);
6. All waters adjacent [see definition of *Adjacent*] to a water identified in paragraphs (1) through (5) of this definition, including wetlands, ponds, lakes, oxbows, impoundments, and similar waters;
7. All waters in paragraphs (a) through (e) of this paragraph (7) where they are determined, on a case-specific basis, to have a significant nexus to a water identified in paragraphs (1) through (3) of this definition. The waters identified in

each of paragraphs (a) through (e) of this paragraph (7) are similarly situated and shall be combined, for purposes of a significant nexus analysis, in the watershed that drains to the nearest water identified in paragraphs (1) through (3) of this definition. Waters identified in this paragraph (7) shall not be combined with waters identified in paragraph (6) when performing a significant nexus analysis. If waters identified in this paragraph are also an adjacent water under paragraph (6), they are an adjacent water and no case-specific significant nexus analysis is required.

8. *Prairie potholes*. Prairie potholes are a complex of glacially formed wetlands, usually occurring in depressions that lack permanent natural outlets, located in the upper Midwest.
9. *Carolina bays and Delmarva bays*. Carolina bays and Delmarva bays are ponded, depressional wetlands that occur along the Atlantic coastal plain.
10. *Pocosins*. Pocosins are evergreen shrub and tree dominated wetlands found predominantly along the Central Atlantic coastal plain.
11. *Western vernal pools*. Western vernal pools are seasonal wetlands located in parts of California and associated with topographic depression, soils with poor drainage, mild, wet winters and hot, dry summers.
12. *Texas coastal prairie wetlands*. Texas coastal prairie wetlands are freshwater wetlands that occur as a mosaic of depressions, ridges, intermound flats, and mima mound wetlands located along the Texas Gulf Coast.
13. All waters located within the 100-year floodplain of a water identified in paragraphs (1) through (3) of this definition and all waters located within 4,000 ft of the high tide line or ordinary high water mark [see definition of *High Tide Line* and *Ordinary High Water Mark*] of a water identified in paragraphs (1) through (5) of this definition where they are determined on a case-specific basis to have a significant nexus to a water identified in paragraphs (1) through (3) of this definition. For waters determined to have a significant nexus, the entire water is a water of the United States if a portion is located within the 100-year

floodplain of a water identified in paragraphs (1) through (3) of this definition or within 4,000 ft of the high tide line or ordinary high water mark. Waters identified in this paragraph (8) shall not be combined with waters identified in paragraph (6) of this definition when performing a significant nexus analysis. If waters identified in this paragraph (8) are also an adjacent water under paragraph (6), they are an adjacent water and no case-specific significant nexus analysis is required.

The following are not "waters of the United States" even where they otherwise meet the terms of paragraphs (4) through (8) above in this definition:

1. Prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other Federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with EPA.
2. The following ditches:
    a. Ditches with ephemeral flow that are not a relocated tributary or excavated in a tributary.
    b. Ditches with intermittent flow that are not a relocated tributary, excavated in a tributary, or drain wetlands
    c. Ditches that do not flow, either directly or through another water, into a water identified in paragraphs (1) through (3) of the above definition of waters that are "waters of the United States."
3. The following features:
    a. Artificially irrigated areas that would revert to dry land should application of water to that area cease;
    b. Artificial, constructed lakes and ponds created in dry land such as farm and stock watering ponds, irrigation ponds, settling basins, fields flooded for rice growing, log cleaning ponds, or cooling ponds;
    c. Artificial reflecting pools or swimming pools created in dry land;
    d. Small ornamental waters created in dry land;

e. Water-filled depressions created in dry land incidental to mining or construction activity, including pits excavated for obtaining fill, sand, or gravel that fill with water;
f. Erosional features, including gullies, rills, and other ephemeral features that do not meet the definition of tributary, non-wetland swales, and lawfully constructed grassed waterways; and
g. Puddles.

4. Groundwater, including groundwater drained through subsurface drainage systems.
5. Stormwater control features constructed to convey, treat, or store stormwater that are created in dry land.
6. Wastewater recycling structures constructed in dry land; detention and retention basins built for wastewater recycling; groundwater recharge basins; percolation ponds built for wastewater recycling; and water distributary structures built for wastewater recycling.

Wetlands Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (40 CFR 112.2).