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NAB LITTLE CREEK
5090.3a

FINAL ABOVEGROUND STORAGE TANK MANAGEMENT PLAN REPORT NAB LITTLE CREEK VA

12/1/1995

ARMOUR, CAPE, AND POND

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Engineers • Architects

FINAL REPORT

ABOVEGROUND STORAGE TANK (AST) MANAGEMENT PLAN

NAVAL AMPHIBIOUS BASE, LITTLE CREEK
NORFOLK, VIRGINIA

A/E CONTRACT NO. N62470-93-D-4033
DELIVERY ORDER NO. 0019

Prepared for:

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
1510 GILBERT STREET
NORFOLK, VIRGINIA 23511

DECEMBER 1995

Armour Cape & Pond Inc
2035 Parkway Parkway
Suite Eight Hundred
Atlanta, Georgia 30345

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Prepared for:

Atlantic Division
Naval Facilities Engineering Command
Norfolk, Virginia

Prepared by:

Armour Cape & Pond
2635 Century Parkway, Suite 800
Atlanta, Georgia 30345

DECEMBER 1995

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SECTION 1.0

INTRODUCTION

1.1 PURPOSE OF PLAN

This plan specifically covers aboveground storage tanks at the Naval Amphibious Base, Little Creek located in Norfolk, Virginia. The primary objective of this Aboveground Storage Tank Management Plan is to delineate a path the Activity can follow to achieve compliance with all requirements of the Commonwealth of Virginia regulations entitled "Aboveground Storage Tanks Pollution Prevention Requirements" (VR 680-14-13) and the U.S. Navy instructions titled "Environmental and Natural Resources Program Manual" (OPNAVINST 5090.1B). As required by VR 680-14-13 and OPNAVINST 5090.1B, this plan also outlines the upgrades required for achieving compliance with both the Environmental Protection Agency (EPA) regulations entitled "Oil Pollution Prevention" (40 CFR 112) and the National Fire Protection Association standard entitled "Flammable and Combustible Liquids Code" (NFPA 30).

1.2 DEFINITIONS

An aboveground storage tank (AST), as defined by VR 680-14-13, means "any one or combination of tanks, including pipes, used to contain an accumulation of oil at atmospheric pressure, and the volume of which, including the volume of the pipes, is more than 90% above the surface of the ground." This term does not include interstate pipelines or associated breakout tanks regulated under the Hazardous Liquid Pipeline Safety Act of 1979. Oil is defined as "oil of any kind and in any form, including, but not limited to, petroleum and petroleum by-products, fuel oil, lubricating oils, sludge, oil refuse, oil mixed with other wastes, crude oils and all other liquid hydrocarbons regardless of specific gravity."

1.3 ORGANIZATION OF PLAN

This report is divided into several sections. Section 2.0, Regulations and Codes, provides an outline of the aforementioned regulations and standards upon which this management plan is based. Included are the purpose of the regulations, the facilities or storage tanks to which they apply and a listing of the topics covered by each regulation or code.

Section 3.0, Compliance Evaluations, contains a general discussion of the current compliance status of the Activity based on the requirements of each regulation or code. This information is based on field observations, the facility's current "Spill Prevention, Control, and Countermeasures (SPCC) Plan," facility as-built and design drawings, and interviews with facility personnel. If a code or regulation contains a provision which is identical to a requirement of a regulation previously discussed in this Section, it is not covered a second time under the later regulation.

Section 4.0, Facility Recommendations, includes a list of specific actions required to achieve compliance with the facility operations requirements of the applicable codes and regulations. These recommendations include the additional operational procedures required as well as any loading rack upgrades necessary for compliance.

Section 5.0, AST Recommendations, outlines the required upgrades to specific AST's and associated piping for compliance with the associated standards. This Section includes an evaluation sheet for each individual tank and piping system. The tank evaluation sheets present the basic inventory information for the particular AST system with an itemized list of the recommended upgrades including estimated construction costs. Inventory information, such as berm and dike floor construction, is based on field observations, facility as-built and design drawings where available, and interviews with facility personnel.

The compliance schedule, located in Section 6.0, presents a proposed plan for completing the recommended upgrades within a 5-year time frame. The possible critical nature of any required upgrades was taken into account during development of this schedule.

Section 7.0 includes sketches of site plans for every AST located at the facility as well as photographs of a few AST systems at NAB Little Creek.

The appendices contain the following supplementary information:

- Virginia AST Pollution Prevention Requirements (VR 680-14-13)
- EPA Regulation, "Oil Pollution Prevention" (40 CFR 112)
- NFPA Standard, "Flammable and Combustible Liquids Code" (NFPA 30)
- U.S. Navy's "Environmental and Natural Resources Program Manual" (OPNAVINST 5090.1B)
- Weekly Facility Inspection Checklist
- Recommended Personnel Training Program

1.4 ASSOCIATED DOCUMENTS

Documents specific to this facility which were referenced during production of this Management Plan include:

- "Oil Spill Prevention, Control and Countermeasures (SPCC) Plan", dated Aug., 1993
- Government furnished as-built drawings
- "Environmental Protection Manual" for NAB Little Creek, Draft version

1.5 REFERENCE PUBLICATIONS

The publications listed below are referenced within this report.

American Petroleum Institute (API) Standards:

API 650 "Welded Steel Tanks for Oil Storage," Eighth Edition, 1988.

API 651 "Cathodic Protection of Aboveground Petroleum Storage Tanks," First Edition, 1991.

API 653 "Tank Inspection, Repair, Alteration and Reconstruction," First Edition, incorporates Supplement 1, 1992.

API 2000 "Venting Atmospheric and Low-Pressure Storage Tanks (Nonrefrigerated and Refrigerated)", Fourth Edition, 1992.

Environmental Protection Agency (EPA) regulations:

40 CFR 112 "Oil Pollution Prevention."

National Association of Corrosion Engineers (NACE) standards:

NACE 0169 "Control of External Corrosion on Underground or Submerged Metallic Piping Systems," 1983.

NACE 0285 "Control of External Corrosion on Metallic Buried, Partially Buried or Submerged Liquid Storage Systems," 1985.

National Fire Protection Association (NFPA) Codes:

NFPA 30 "Flammable and Combustible Liquids Code," 1990.

Occupational Safety and Health Administration (OSHA) Standards:

29 CFR 1910.106 "Flammable and Combustible Liquids."

Commonwealth of Virginia Regulations (VR):

VR 680-14-13 "Aboveground Storage Tanks Pollution Prevention Requirements," 1993.

U.S. Navy Instructions (OPNAVINST):

OPNAVINST 5090.1B "Environmental and Natural Resources Program Manual"

1.6 GENERAL FACILITY INFORMATION

The Naval Amphibious Base, Little Creek (NAB Little Creek) is located in Norfolk, Virginia. The NAB Little Creek Facility is bounded on the north by Chesapeake Bay, the southwest by Norfolk International Airport, the south and east by the city of Virginia Beach, and the west by the city of Norfolk (See Figure 1 for the Vicinity Map).

There is a total of fifty-eight (58) AST's at this facility, forty-two (42) of which are assigned to NAB Little Creek activities. Twelve (12) tanks are located at facilities which are the responsibility of the Navy Public Works Center, Little Creek site. The remaining four (4) tanks are under the responsibility of the U.S. Coast Guard and are not covered within this plan.

Thirty-seven (37) AST's assigned to NAB Little Creek are currently active. These tanks are utilized for purposes such as vehicle/equipment fueling, waste oil storage, test cells, heating oil storage, emergency generators, oily waste storage, bulk storage of fuels, maintenance training facilities, lube oil storage and power generation. An additional tank, Tank #5000, will contain diesel fuel for an emergency generator and is to be installed within the next several months. It is the responsibility of the base civil engineer at NAB Little Creek to perform maintenance and ensure regulatory compliance is achieved on these thirty-nine (39) tanks. Refer to Table 1 on Page 1-13 for an inventory list of these AST's.

Of the ten (10) active PWC/Norfolk tanks, seven (7) are used to store diesel oil for emergency generators, and the remaining tank stores waste oil. The Public Works Center, Norfolk has the responsibility for achieving regulatory compliance and providing maintenance on these tanks. See Table 2 on Page 1-18 for an inventory list of these AST's.

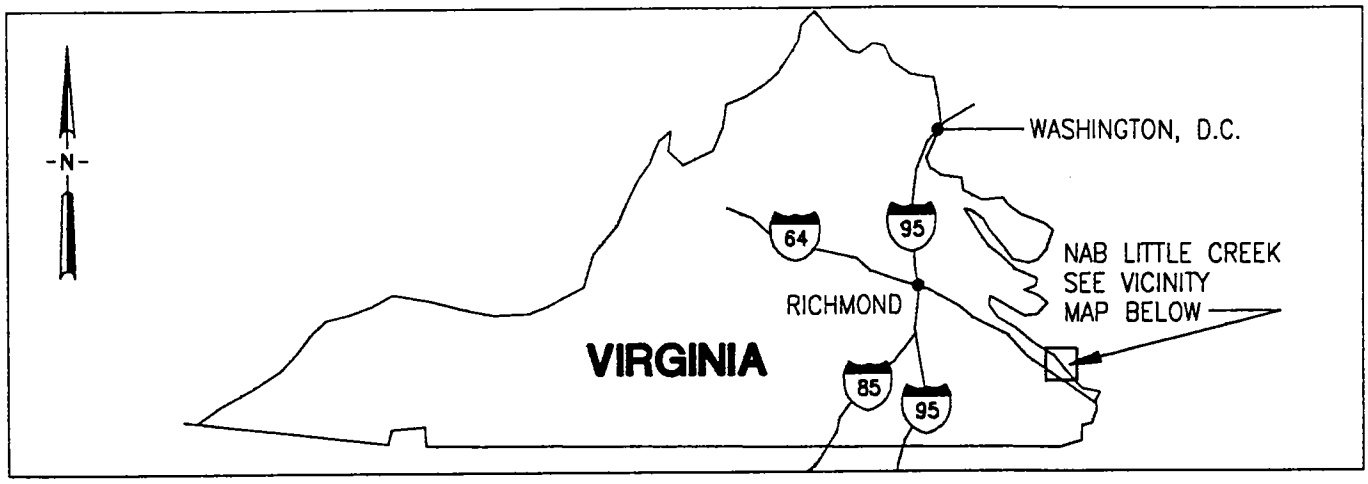
Fourteen (14) of the tanks assigned to NAB Little Creek are considered to be regulated by VR 680-14-13. These AST #'s are as follows: 3105A, 3105B, 3511-2, 3821-3, 3823-2, 3825, 3845, 3846, 3862, 3863, 3864, 3865, 3866 and 3870-1. Also, the U.S. Navy Public Works Center, Little Creek has the responsibility for three (3) regulated ASTs as defined by the Virginia regulations. These AST #'s are as follows: NAB 752-1, NAB 759 and NAB 760.

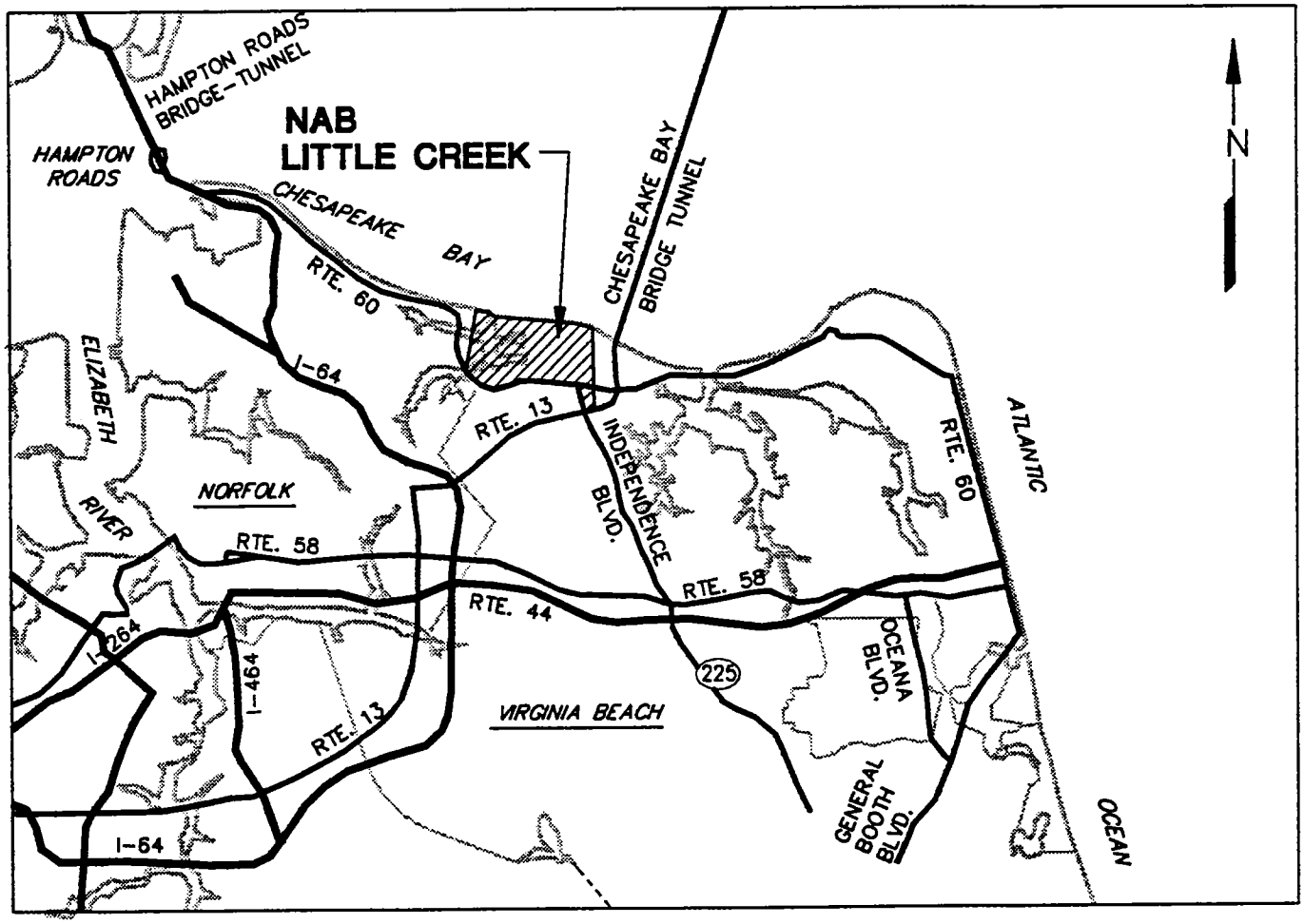
The owner and operator of the NAB Little Creek tanks is:

Deputy Base Civil Engineer (Code N4A)
Naval Amphibious Base Little Creek
1450 Gator Boulevard
Norfolk, Virginia 23521-2616
Phone Number: (804) 464-7287

The owner and operator of the U.S. Navy Public Works Center tanks is:

Public Works Center, Little Creek Site
Site Manager (Code 230)
Naval Amphibious Base Little Creek
1450 Gator Boulevard
Norfolk, Virginia 23521-2616
Phone Number: (804) 464-7302





AST MANAGEMENT PLAN

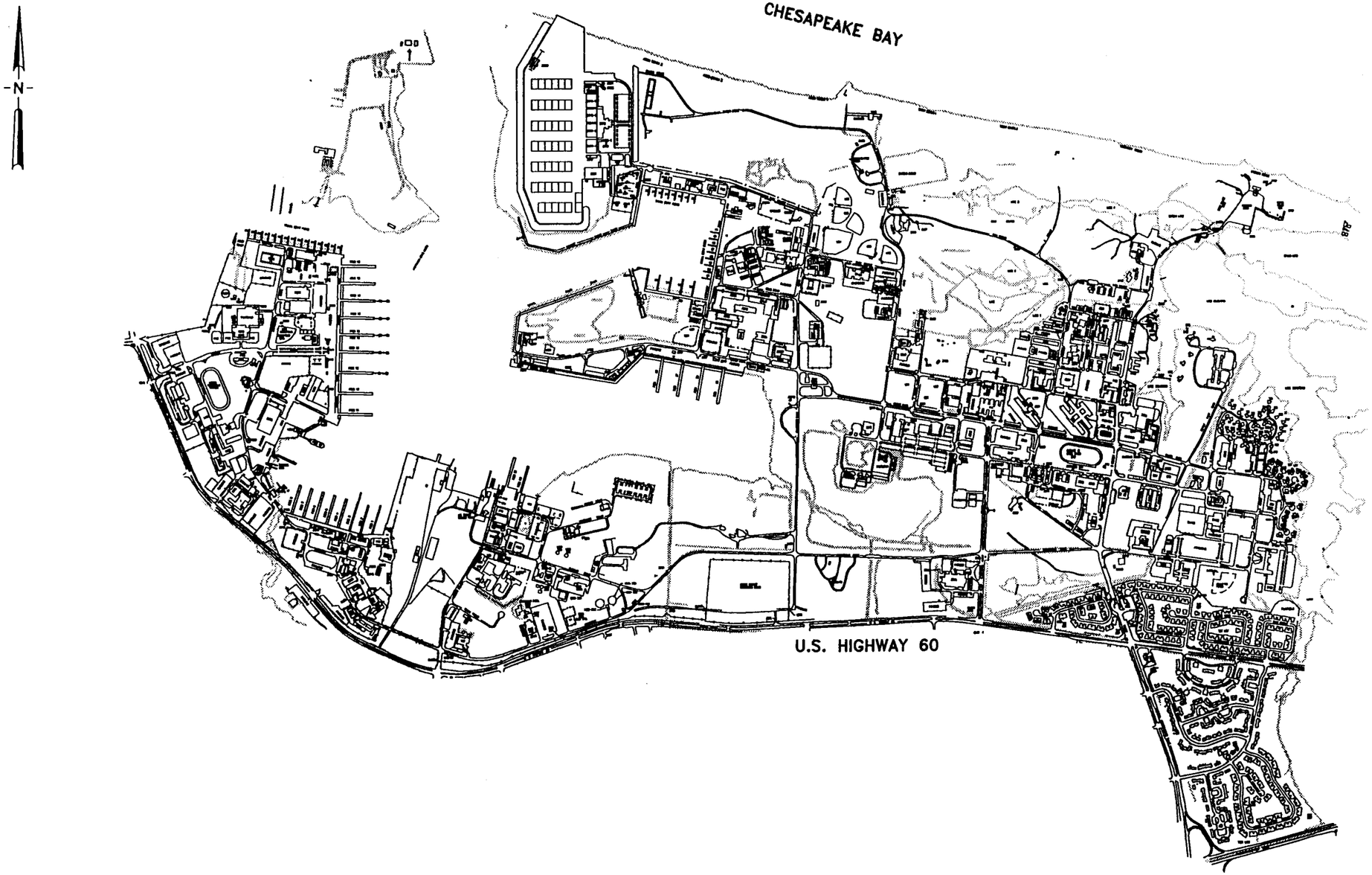
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 1
VICINITY MAP

SCALE:	N.T.S.
FILE:	FIG. 1
DATE:	JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



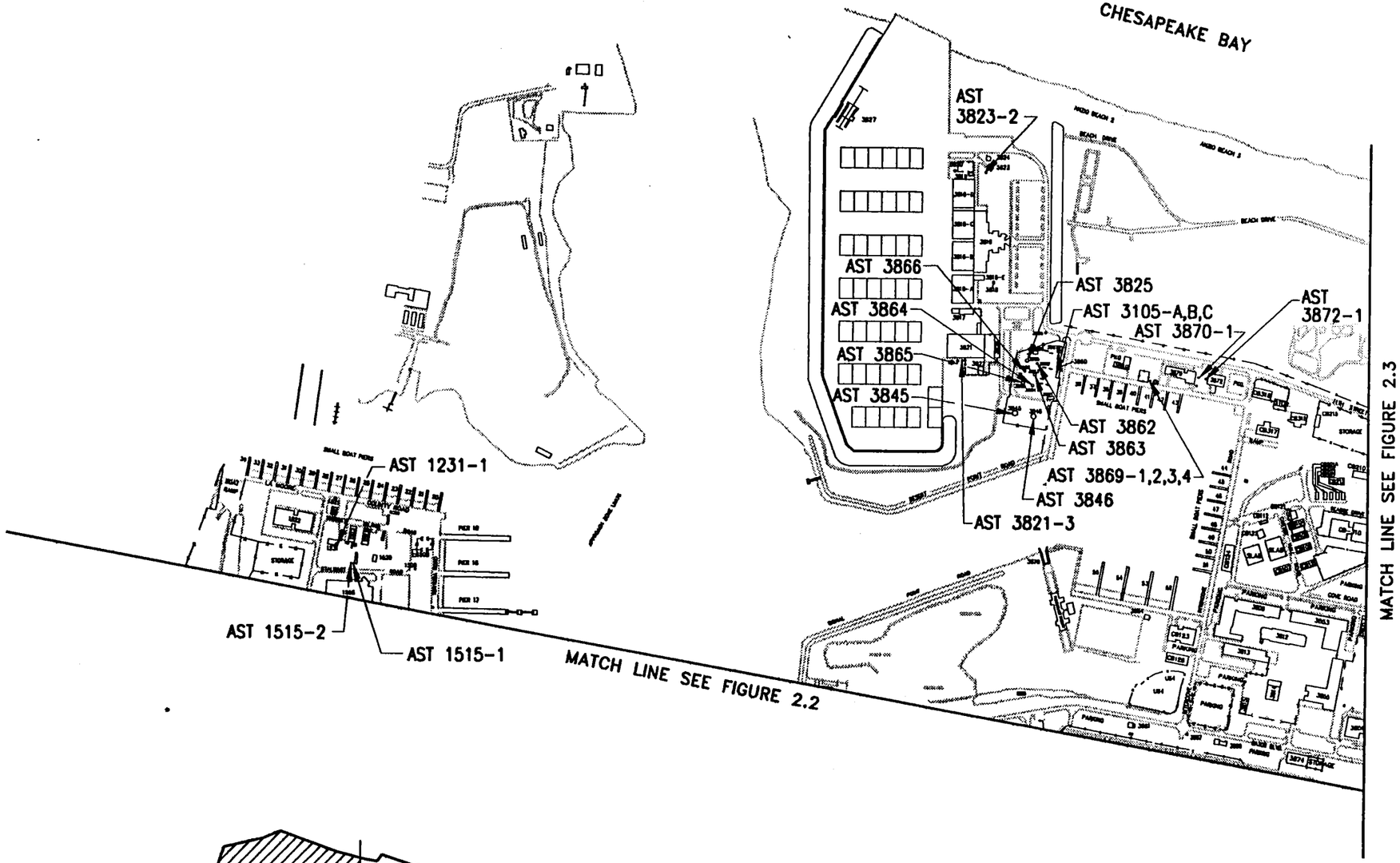
AST MANAGEMENT PLAN

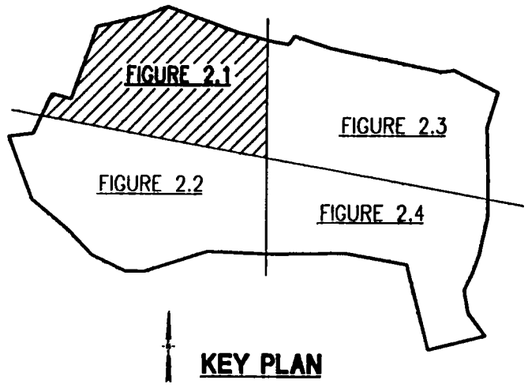
NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 2
INSTALLATION MAP

SCALE: N.T.S.
FILE: FIG. 2
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345





-N-

AST'S THIS AREA

1231-1
1515-1
1515-2
3105-A,B
3821-3
3823-2
3825
3845
3846
3862
3863
3864
3865
3866
3869-1,2,3,4
3870-1
3872-1

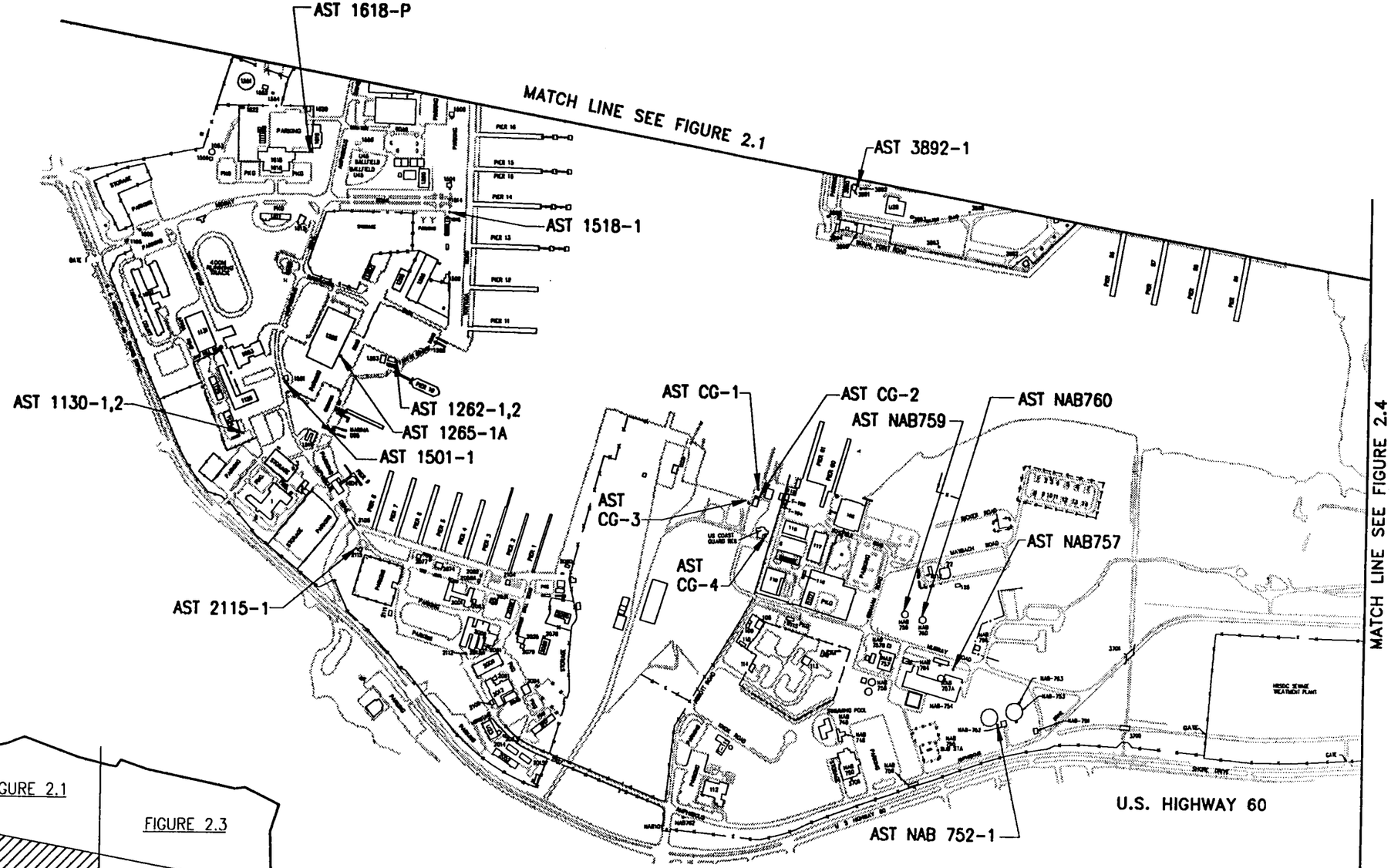
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 3-1
TANK LOCATION MAP

SCALE: N.T.S.
FILE: FIG. 3-1
DATE: JULY 1995

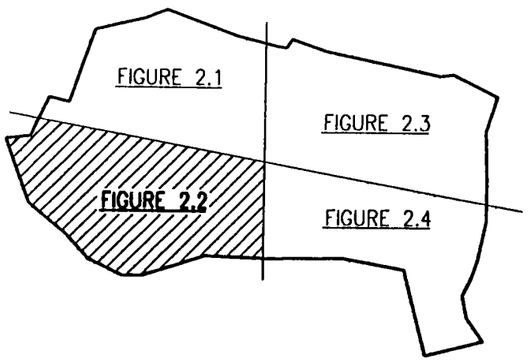
ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345



N

AST'S THIS AREA

1130-1,2
1262-1,2
1265-1A
1501-1 (PWC TK.)
1518-1 (PWC)
1618-P
2115-1 (PWC)
3892-1
NAB752-1 (PWC)
NAB757
NAB759, 760



KEY PLAN

AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 3-2
TANK LOCATION MAP

SCALE: N.T.S.
FILE: FIG. 3-2
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA. 30345

CHESAPEAKE BAY

AST 3699-1,2

AST 3022-2

AST 3661-1

AST 3022-1

AST 3144-3

AST 3661-3

AST 3108-1

AST 3165-3

AST 3165-1

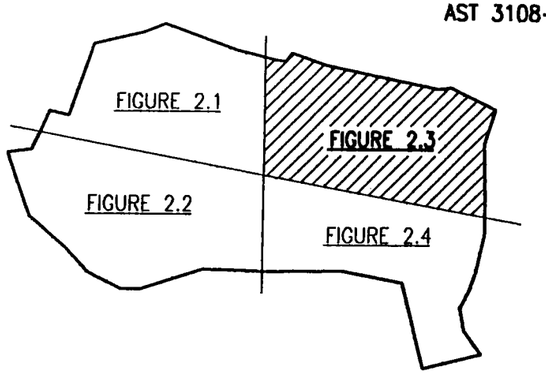
MATCH LINE SEE FIGURE 2.1

MATCH LINE SEE FIGURE 2.4

-N-

AST'S THIS AREA

3022-1,2
3108-1
3144-3 (PWC TK.)
3165-1,3
3661-1,3
3699-1,2



KEY PLAN

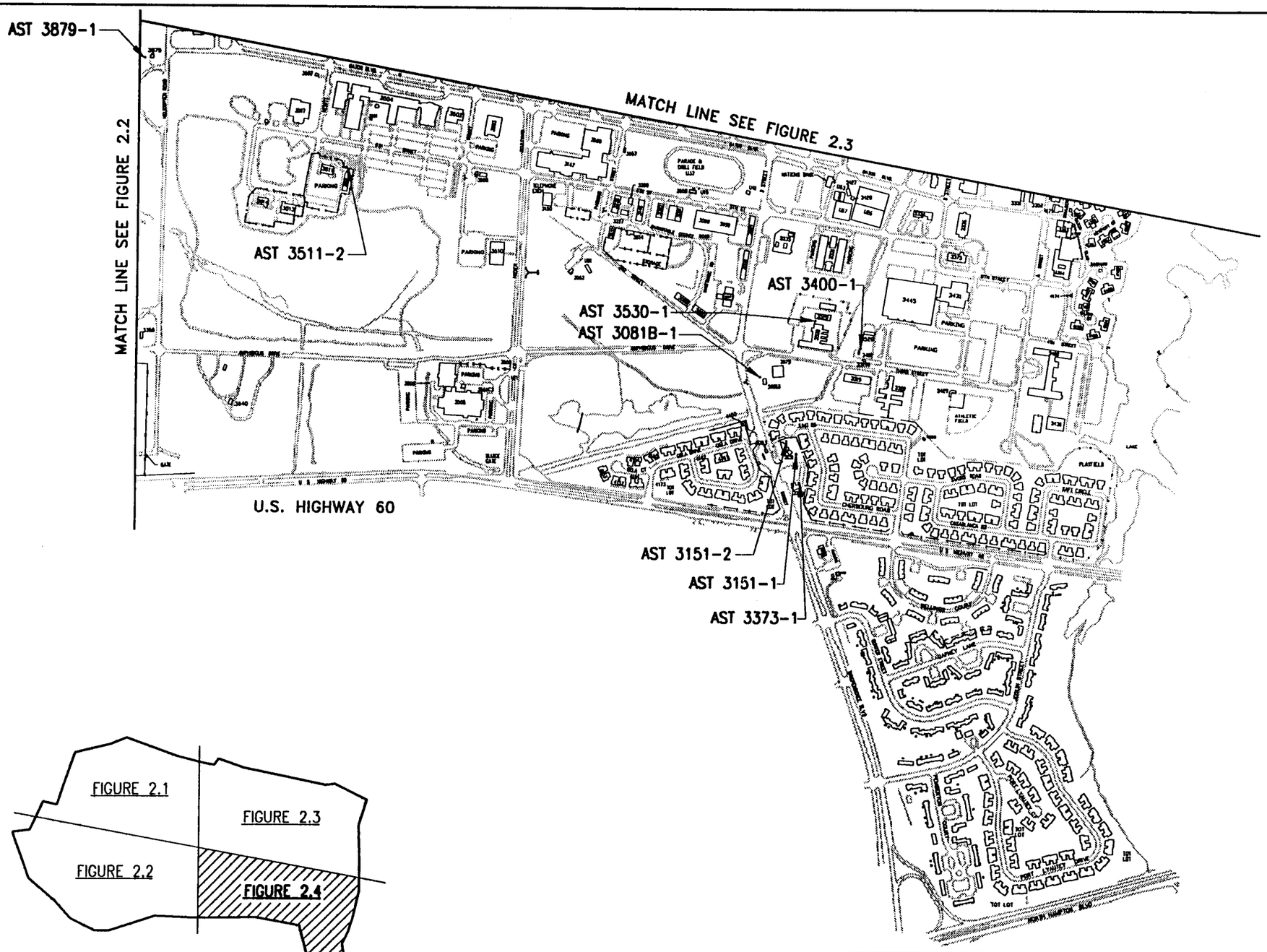
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 3-3
TANK LOCATION MAP

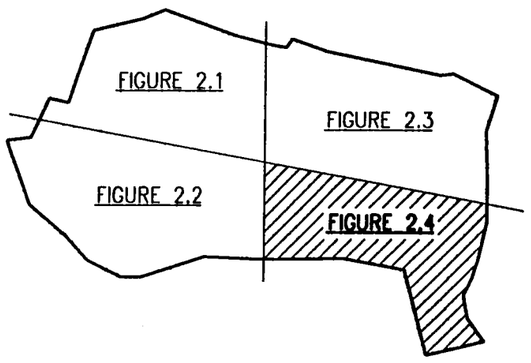
SCALE: N.T.S.
FILE: FIG. 3-3
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345



AST'S THIS AREA

3081B-1 (PWC TK.)
3151-1,2
3373-1
3400-1 (PWC)
3511-2
3530-1
3879-1 (PWC)



KEY PLAN

AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 3-4
TANK LOCATION MAP

SCALE: N.T.S.
FILE: FIG. 3-4
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA 30345

TABLE 1
ABOVEGROUND STORAGE TANKS
AT NAVAL AMPHIBIOUS BASE, LITTLE CREEK
UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

Tank #	Bldg. #	Facility	Capacity (gals.)	Product	Usage	Type	Status	Reg (R)/ Ex (E)*
1130-1	1130	CCWGRULANT	500	Diesel	Vehicle/Equip. Fueling	Horizontal	Active	E
1130-2	1130	CCWGRULANT	275	Waste Oil (WO)	WO Storage	Horizontal	Active	E
1231-1	1231	ACU-2 Maintenance	500	WO	WO Storage	Horizontal	Active	E
1262-1	1262	AFDL6 Storage	275	Diesel	Vehicle/Equip. Fueling	Horizontal	Active	E
1262-2	1262	AFDL6 Storage	275	Unleaded Gasoline	Vehicle/Equip. Fueling	Horizontal	Active	E
1265-1A	1265	SIMA Office/Shop	275	Diesel	Test Cell	Horizontal	Active	E
1515-1	1515	ACU Cold Storage	275	Unleaded Gasoline	Vehicle/Equip. Fueling	Horizontal	Active	E
1515-2	1515	ACU Cold Storage	275	Diesel	Vehicle/Equip. Fueling	Horizontal	Active	E
1618-P	1618	**COMEODGRU-2 Office	400	WO	WO Storage	Horizontal	Active	E
3022-1	3022	Boat Storage	275	Unleaded Gasoline	Equip. Fueling	Horizontal	Active	E

* (R) = Tank is regulated under VR 680-14-13; (E) = Tank is exempt from regulation.
** There are portable tanks in use at this facility.

TABLE 1 (CONT.)
ABOVEGROUND STORAGE TANKS
AT NAVAL AMPHIBIOUS BASE, LITTLE CREEK
UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

Tank #	Bldg. #	Facility	Capacity (gals.)	Product	Usage	Type	Status	Reg (R)/ Ex (E)*
3022-2	3022	Boat Storage	275	Unleaded Gasoline	Equip. Fueling	Horizontal	Active	E
3105A	3860	Fuel Farm	5,000	Diesel	Vehicle Fueling	Horizontal	Active	R
3105B	3860	Fuel Farm	5,000	Diesel	Vehicle Fueling	Horizontal	Active	R
3108-1	3108	Maintenance Shop	275	WO	WO Storage	Horizontal	Active	E
3144-3	3144	BMU-2 OPS Bldg.	500	Waste Oil (WO)	WO Storage	Horizontal	Active	E
3151-1	3151	Housing Office	275	Diesel	Heating Oil	Horizontal	Active	E
3151-2	3151	Housing Office	275	Diesel	Heating Oil	Horizontal	Active	E
3165-3	3165	Office/Shops	275	Diesel	Emergency Generator	Horizontal	Active	E
3373-1	3373	Security Pass Office	275	Diesel	Heating Oil	Horizontal	Active	E
3511-2	3511	LFTC LANT Vehicle Maintenance	1,500	Diesel	Heating Oil	Horizontal	Active	R
3530-1	3530	MWR Hobby Shop	500	WO	WO Storage	Horizontal	Active	E
3615-1	3615	NAVRESALEACT Service Center	275	WO	WO Storage	Horizontal	Active	E

* (R) = Tank is regulated under VR 680-14-13; (E) = Tank is exempt from regulation.

TABLE 1 (CONT.)
ABOVEGROUND STORAGE TANKS
AT NAVAL AMPHIBIOUS BASE, LITTLE CREEK
UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

Tank #	Bldg. #	Facility	Capacity (gals.)	Product	Usage	Type	Status	Reg (R)/ Ex (E)*
3699-1	3699	Golf Course	500	Unleaded Gasoline	Vehicle/Equip. Fueling	Horizontal	Active	E
3699-2	3699	Golf Course	500	Diesel	Vehicle/Equip. Fueling	Horizontal	Active	E
3821-3	3821	**ACU-4 General Warehouse	2,000	OW (Oily Waste)	OW Storage	Horizontal	Active	R
3823-2	3823	ACU4 Fire Pump House	2,000	Diesel	Emergency Generator	Horizontal	Active	R
3825	3860	Fuel Farm	75,000	JP-5	Bulk Storage	Vertical	Active	R
3845	3860	Fuel Farm	250,000	Empty	OOS	Vertical	OOS	R
3846	3860	Fuel Farm	250,000	Empty	OOS	Vertical	OOS	R
3862	3860	Fuel Farm	30,000	Empty	OOS	Vertical	OOS	R
3863	3860	Fuel Farm	50,000	Diesel (F-76)	Bulk Storage	Vertical	Active	R
3864	3860	Fuel Farm	50,000	Diesel (F-76)	Bulk Storage	Vertical	Active	R
3865	3860	Fuel Farm	60,000	Empty	OOS	Vertical	OOS	R
3866	3860	Fuel Farm	30,000	Unleaded Gasoline	Bulk Storage	Vertical	Active	R

* (R) = Tank is regulated under VR 680-14-13; (E) = Tank is exempt from regulation.
** There are portable tanks in use at this facility.

TABLE 1 (CONT.)
ABOVEGROUND STORAGE TANKS
AT NAVAL AMPHIBIOUS BASE, LITTLE CREEK
UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

Tank #	Bldg. #	Facility	Capacity (gals.)	Product	Usage	Type	Status	Reg (R)/ Ex (E)*
3869-1	3869	ACU2 OPS Bldg.	550	WO	WO Storage	Horizontal	Active	E
3869-2	3869	ACU2 OPS Bldg.	275	Lube Oil (LO)	LO Storage	Horizontal	Active	E
3869-3	3869	ACU2 OPS Bldg.	275	LO	LO Storage	Horizontal	Active	E
3869-4	3869	ACU2 OPS Bldg.	275	LO	LO Storage	Horizontal	Active	E
3870-1	3870	COL Office	2,500	Diesel	Storage for Maint.Training	Horizontal	Active	R
3872-1	3872	COL Applied Inst. Building	500	Diesel	Storage for Maint.Training	Horizontal	Active	E
3892-1	3890	FLETRAULANT	275	Diesel	Emergency Generator	Horizontal	Active	E
5000	**	**	500	Diesel	Emergency Generator	Horizontal	**	E

* (R) = Tank is regulated under VR 680-14-13; (E) = Tank is exempt from regulation.
** Tank is to be installed within the next several months.

TABLE 2

ABOVEGROUND STORAGE TANKS
AT NAVAL AMPHIBIOUS BASE, LITTLE CREEK
UNDER RESPONSIBILITY OF NAVY PUBLIC WORKS CENTER, LITTLE CREEK SITE

Date: December 1995

Tank #	Bldg. #	Facility	Capacity (gals.)	Product	Usage	Type	Status	Reg (R)/ Ex (E)*
1501-1	1501	Sewage Lift Station	275	Diesel	Emergency Generator	Horizontal	Active	E
1518-1	1518	Sewage Lift Station	275	Diesel	Emergency Generator	Horizontal	Active	E
2115-1	2115	Sewage Lift Station	275	Diesel	Emergency Generator	Horizontal	Active	E
3081B-1	3081B	Freshwater Reservoir	275	Diesel	Emergency Generator	Horizontal	Active	E
3400-1	3400	Sewage Lift Station	275	Diesel	Emergency Generator	Horizontal	Active	E
3661-1	3661	Garage-Heavy Equip.	275	WO	WO Storage	Horizontal	Active	E
3661-3	3661	Garage-Heavy Equip.	275	Unleaded Gasoline	Equip. Fueling	Horizontal	Active	E
3879-1	3879	Sewage Lift Station	275	Diesel	Emergency Generator	Horizontal	Active	E

* (R) = Tank is regulated under VR 680-14-13; (E) = Tank is exempt from regulation.

TABLE 2 (CONT.)

ABOVEGROUND STORAGE TANKS
AT NAVAL AMPHIBIOUS BASE, LITTLE CREEK
UNDER RESPONSIBILITY OF NAVY PUBLIC WORKS CENTER, LITTLE CREEK SITE

Date: December 1995

Tank #	Bldg. #	Facility	Capacity (gals.)	Product	Usage	Type	Status	Reg (R)/ Ex (E)*
NAB 752-1	NAB 752	Pump House	1,000	Diesel	Emergency Generator	Horizontal	Active	R
NAB757-F	757-F	Coal Car Thaw House	500	Fuel Oil	Equip. (Pump) Power Gen.	Horizontal	Active	E
NAB759	NAB757	Steam Plant	500,000	Empty	OOS	Vertical	OOS	R
NAB760	NAB757	Steam Plant	500,000	Empty	OOS	Vertical	OOS	R

* (R) = Tank is regulated under VR 680-14-13; (E) = Tank is exempt from regulation.

SECTION 2.0

REGULATIONS AND CODES

This Section provides an outline of the regulations and standards upon which this Management Plan is based. A summary is presented for the Commonwealth of Virginia regulations entitled "Aboveground Storage Tanks Pollution Prevention Requirements" (VR 680-14-13), the EPA regulations titled "Oil Pollution Prevention" (40 CFR 112) and the NFPA Standard entitled "Flammable and Combustible Liquids Code" (NFPA 30).

2.1 VIRGINIA ABOVEGROUND STORAGE TANKS POLLUTION PREVENTION REQUIREMENTS (VR 680-14-13)

2.1.1 Purpose

This regulation was enacted to develop standards and procedures relating to the prevention of pollution from aboveground storage tanks for operators of facilities with an aggregate aboveground storage capacity of more than 25,000 gallons of oil.

VR 680-14-13 originally became effective on June 30, 1993. However, the Commonwealth of Virginia House Bill #684 changed the effective date for facilities not involved with the resale of oil (i.e., military installations) to July 1, 1995 or a date to be determined in the future. Currently, the Virginia Department of Environmental Quality (VDEQ) is re-writing these regulations. The effective date of VR 680-14-13 for military installations has thus been revised to coincide with the release of the revised regulations. The VDEQ has not set a deadline for completion of the revised regulations, but an estimate would be the summer of 1996.

2.1.2 Applicability

This regulation applies to either:

- A facility located within the Commonwealth of Virginia with an aggregate aboveground storage capacity of more than 25,000 gallons of oil, or
- Any individual AST located within the Commonwealth with a storage capacity of more than 25,000 gallons of oil, unless otherwise specified within this regulation.

2.1.3 Exemptions

With respect to the types of storage tanks utilized at a typical military facility, the requirements of this regulation do not apply to the following:

- Vessels or vehicles
- Any wastewater treatment tank system that is a part of a wastewater treatment facility regulated under the Clean Water Act
- An AST which is used to store hazardous wastes or a mixture of such hazardous wastes and other regulated substances
- An AST which is used to store propane gas
- A surface impoundment, pit, pond or lagoon
- A stormwater or wastewater collection system
- Equipment or machinery that contains oil for operational purposes
- A tank of 1,100 gallons or less capacity used for storing heating oil for consumptive use on the premises where stored
- An AST with a storage capacity of 660 gallons or less of oil, unless otherwise specified within this regulation
- AST(s) used to contain oil for less than 120 days and only in connection with activities related to the containment and clean up of oil, or to any vessel engaged only in activities within state waters related to the containment and clean up of oil, including response related training or drills

2.1.4 Requirements

VR 680-14-13 has requirements which concern both facilities and individual aboveground storage tanks. Appendix "A" consists of a copy of VR 680-14-13. Facility requirements cover issues such as the following:

- Inventory Control
- Monitoring of Transfer Operations
- Safe Fill & Shutdown Procedures in Compliance with NFPA 30
- Provisions at Oil Transfer Areas
- Requirements of Tanker Vehicles
- Weekly Facility Inspections
- Groundwater Monitoring
- Personnel Training
- Record Keeping

Requirements for AST's include:

- Formal Internal and External Tank Inspections
- Containment Dike Certifications
- Cathodic Protection Evaluations
- Tank Gauging and Identification
- High Level Alarms
- Piping Cathodic Protection
- Pressure Testing of Piping
- AST Closure

2.1.5 Notification to Implementing Agency

Operators of facilities that are required to upgrade the existing facility design to comply with this regulation must submit a compliance schedule, such as is included in Section 6.0 of this Plan, to the Virginia Department of Environmental Quality. The mailing address is as follows:

Department of Environmental Quality - Water Division
Office of Spill Response and Remediation
P.O. Box 11143
Richmond, Virginia 23230-1143

2.2 EPA "OIL POLLUTION PREVENTION" REGULATIONS (40 CFR 112)

2.2.1 Purpose

40 CFR 112 was enacted to prevent oil spills from reaching the waters of the United States by establishing requirements for owners or operators of facilities that drill, produce, gather, store, process, refine, transfer or consume oil. The text of the regulation is found in Title 40 of the Code of Federal Regulations, Part 112. The regulation went into effect on January 10, 1974. 40 CFR 112 was updated in 1994 with the Oil Pollution Act of 1990 (OPA 90) revisions which added the requirement for development of "Facility Response Plans." See Appendix B for a copy of 40 CFR 112. (Note that this version does not include the lengthy sections regarding Facility Response Plans.)

2.2.2 Applicability

A facility is subject to this regulation if it is a non-transportation-related facility (either onshore or offshore) engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing or consuming oil and oil products, and which, due to its location, could reasonably be expected to discharge oil into waters of the United States if a spill should occur. To be considered as regulated under 40 CFR 112, a facility must also have the following:

- Total aboveground oil storage capacity in excess of 1,320 gallons or a single container in excess of 660 gallons, and/or
- Total underground oil storage capacity in excess of 42,000 gallons

Non-transportation-related facilities are defined as all fixed facilities, including support equipment, but excluding interstate pipelines, railroad tank cars en route, transport trucks en route and terminals

associated with the transfer of bulk oil to or from a water transportation vessel. The term also includes mobile or portable facilities such as onshore drilling or workover rigs, barge-mounted offshore drilling or workover rigs and portable fueling facilities while they are in fixed, operating mode.

Oil, as defined by 40 CFR 112, means oil of any kind or in any form including, but not limited to, petroleum, fuel oil, sludge, oil refuse and oil mixed with wastes other than dredged spoil.

2.2.3 Exemptions

A facility may be exempt from 40 CFR 112 regulations if due to its location it could not reasonably be expected to discharge oil into or upon the navigable waters of the United States. The exemption determination is based on consideration of such geographical aspects of the facility as proximity to navigable waters, land contour and drainage. The determination excludes consideration of man-made features such as dikes, equipment or other structures that would inhibit a discharge from reaching navigable waters.

Other facilities considered as exempt from regulation under 40 CFR 112 include equipment or operations of vessels or transportation-related onshore and offshore facilities which are subject to authority and control of the Department of Transportation.

2.2.4 Requirements of 40 CFR 112

The vast majority of 40 CFR 112 regulations which pertain to aboveground oil storage facilities and individual AST's, are also contained within VR 680-14-13. The main requirements of 40 CFR 112 are:

- Containment and/or diversionary structures or equipment to control spills
- Facility drainage equipment and procedures
- Bulk storage tank construction procedures
- Facility transfer, pumping and in-plant process equipment and operations

- Facility tanker truck loading/unloading rack provisions
- Facility inspections and records
- Adequate security
- Personnel, training and spill prevention procedures

The regulation outlines requirements for preparation and implementation of a Spill Prevention, Control, and Countermeasures (SPCC) Plan which analyzes a facility's compliance with all of the aforementioned issues. Refer to the current SPCC Plan for this facility for a more in-depth discussion of the requirements of 40 CFR 112.

2.3 NATIONAL FIRE PROTECTION ASSOCIATION "FLAMMABLE AND COMBUSTIBLE LIQUIDS CODE" (NFPA 30)

2.3.1 Purpose

The standards of NFPA 30 are intended to reduce fire hazard to a degree consistent with reasonable public safety without excessive interference with public use of flammable and combustible liquids. As opposed to being a "regulation," NFPA is a "code" and thus its standards must only be met where required by authorities having jurisdiction. Where this code is concerned, however, virtually all federal, state (including VR 680-14-13), and local regulations pertaining to storage of petroleum products require compliance with the provisions of NFPA 30 (refer to Appendix "C" for a copy of this document).

A "flammable" liquid is defined as a liquid having a flash point below 100°F (37.8°C). Motor gasoline (MOGAS) such as commercial unleaded gasoline, aviation gasoline (AVGAS) and the jet fuel type JP-4 are examples of flammable liquids. A liquid defined as "combustible" has a flash point at or above 100°F (37.8°C). Jet fuel types JP-5 and JP-8, kerosene, diesel fuel and burner fuel oils are considered combustible liquids. The "flash point" of a liquid refers to the minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitible mixture with air near the surface of the liquid within the vessel.

2.3.2 Applicability

NFPA 30 applies to all flammable and combustible liquids, including waste liquids.

2.3.3 Exemptions

This code does not apply to the following:

- Liquids that are solid at 100°F (37.8°C) or above
- Liquified gases
- Cryogenic liquids
- Transportation of flammable and combustible liquids
- Storage, handling and use of fuel oil tanks and containers connected with oil burning equipment.
- Storage of flammable and combustible liquids on farms and isolated construction projects
- Liquids without flash points that can be flammable under some conditions
- Storage and handling of aerosol products
- Mists, sprays or foams

2.3.4 Requirements

NFPA 30 standards, pertaining to aboveground storage tanks and facilities, include:

- Location of AST's
- Control of spillage from AST's
- Tank monitoring
- Tank supports, foundation and anchorage
- Fire protection and control
- Overfill prevention
- Inventory records
- Piping systems

- Portable tank storage
- Facility operations
- Tank vehicles and tank cars

2.4 U.S. NAVY "ENVIRONMENTAL AND NATURAL RESOURCES PROGRAM MANUAL" (OPNAVINST 5090.1B)

2.4.1 Applicability

OPNAVINST 5090.1B, as is applies to AST's, provides information and guidance applicable to the regulation of storage tanks containing petroleum products and/or hazardous substances at Navy shore facilities. Refer to Appendix D for a copy of this document which pertains to storage tanks.

2.4.2 Policy

As stated in OPNAVINST 5090.1B, "the Navy's Storage Tank Program policy is to comply with all applicable Federal, State, and local regulations pertaining to the management of fuel storage tanks."

2.4.3 Requirements

As stated previously, OPNAVINST 5090.1B requires all Navy facilities to comply with all applicable Federal, State, and local regulations. Specific requirements address the following issues:

- Monitoring of transfer operations
- Corrosion protection measures
- Recordkeeping
- Release detection systems
- Release reporting
- Out-of-service AST's and closure
- Development of a "Tank Management Plan"

SECTION 3.0

COMPLIANCE EVALUATIONS

The following Section presents a compliance analysis of the facility and individual AST's at NAB Little Creek with respect to the applicable regulations and codes. The requirements evaluated include those contained in the Commonwealth of Virginia regulations entitled "Aboveground Storage Tanks Pollution Prevention Requirements" (VR 680-14-13), the EPA regulations titled "Oil Pollution Prevention" (40 CFR 112), and the NFPA Standard entitled "Flammable and Combustible Liquids Code" (NFPA 30). AST's assigned to NAB Little Creek are evaluated separately from the tanks which are the responsibility of Public Works Center (PWC), Little Creek site.

This Section presents a general compliance overview with respect to each regulatory or code requirement. Refer to the narratives and tables in Sections 4.0 and 5.0 for specific upgrades required and identification of individual tanks and their deficiencies. The information in this Section and the following Sections is based on interviews with facility personnel and field observations performed during the week of March 6th thru 10th, 1995.

3.1 VIRGINIA ABOVEGROUND STORAGE TANKS POLLUTION PREVENTION REQUIREMENTS (VR 680-14-13)

This regulation has separate requirements for facilities based on their aggregate aboveground storage capacity. One set of rules pertains to facilities with a total storage capacity greater than 25,000 gallons and less than 1 million gallons, and a second set of provisions applies to a facility with equal to or greater than 1 million gallons of aggregate storage capacity. The NAB Little Creek facility has an aggregate aboveground storage capacity of approximately 1,830,000 gallons and thus will be evaluated in this plan according to the regulations for a facility equal to or greater than 1 million gallons.

3.1.1 Facility Requirements of NAB Little Creek & PWC Tanks

This subsection provides a general discussion of the NAB Little Creek's compliance with the operational procedures required by VR 680-14-13. The PWC-owned tanks are included in the evaluation in this section because PWC fuels both the NAB Little Creek tanks as well as their own. However, refer to subsection 3.1.2 for a discussion of the operational procedures at the fuel farm. The AST's at the steam plant (NAB 759 & NAB 760) have not been used since prior to 1987, thus the operational aspects of these tanks will not be evaluated in this report. See Section 4.0 for a synopsis of the specific operational deficiencies encountered and associated recommendations on achieving compliance.

3.1.1.1 Inventory Control (Reference VR 680-14-13 Sections 6.A.1.a and 6.A.1.b)

It is the intention of NAB Little Creek to bring all AST's into compliance with inventory control requirements by repairs to existing, or the addition of, level gauges on all regulated tanks. The "environmental coordinator" for each tenant or command will then be required to maintain inventory control records on-site.

3.1.1.2 Monitoring of Transfer Operations (Reference VR 680-14-13 Section 6.A.2.a)

The fuel truck operator manually gauges all tanks to ensure the volume available in the tank is greater than the volume of oil to be transferred to the tank before the fueling operation commences. Transfer operations are monitored continually, by manual means, until complete. The operator ensures that all tank fill valves not in use are secured.

3.1.1.3 Facility Inspections (Reference VR 680-14-13 Section 6.A.4.a & 6.A.4.d)

The "environmental coordinator" for each resident command within NAB Little Creek performs daily visual and weekly written inspections of the AST systems using the NAB Satellite Accumulation, SPCC/AST, & Stormwater Pollution Prevention Checklist. While the current

inspection form may be sufficient, a sample weekly inspection checklist is included in Appendix E. This checklist incorporates all requirements of VR 680-14-13 and may be used for comparison.

3.1.1.4 Personnel Training (Reference VR 680-14-13 Sections 6.A.5)

The Oil Spill Response Coordinator of Base Civil Engineering (BCE) at NAB Little Creek conducts biannual training sessions for all environmental coordinators with each tenant at the installation. This biannual training covers issues addressed in the Spill Prevention, Control, and Countermeasures (SPCC) Plan for NAB Little Creek and AST measures. Spill response training sessions are also conducted on a quarterly basis. Records of this training are maintained at BCE in Bldg. #3165.

3.1.2 Facility Requirements of Fuel Farm

This subsection provides a general discussion of the NAB Little Creek Fuel Farm's compliance with the operational procedures required by VR 680-14-13. The truck loading areas evaluated in this section include the JP-5 loading area located within the ACU-4 compound adjacent to the fuel farm and loading area #3861 within the fuel farm. The gas station area within the fuel farm does not load or unload fuel tanker trucks and is therefore excluded from this evaluation.

3.1.2.1 Inventory Control (Reference VR 680-14-13 Section 6.A.1.a & 6.A.1.b)

All tanks are manually gauged twice daily. They are also gauged both before and after all fuel transfers. Inventory records are sent to the Administrative Offices at Craney Island Fuel Terminal for monthly reconciliations.

3.1.2.2 Monitoring of Transfer Operations (Reference VR 680-14-13 Section 6.A.2.a)

Fuel farm personnel manually gauge the tanks to ensure the volume available in the tank is greater than the volume of oil to be transferred to the tank before the fueling operation commences.

Transfer operations are monitored continually, by manual means, until complete. Operations personnel ensure that all tank fill valves not is use are secured.

3.1.2.3 Tank Vehicles (Reference VR 680-14-13 Section 6.A.2.d)

Oil transfer vehicles which utilize the JP-5 loading area and loading area #3861 are equipped with brake interlock control. The attachment of the hose or loading arm to the trucks's dry-break connection depresses a button which sets the air brakes on the truck.

Pre-set meters at both loading racks provide the capability of loading a predetermined quantity of product.

3.1.2.4 Facility Inspections (Reference VR 680-14-13 Section 6.A.4.a & 6.A.4.b)

Inspections are performed at the fuel farm on a daily basis by use of a written checklist.

3.1.2.5 Groundwater Monitoring (Reference VR 680-14-13 Sections 6.A.4.c, 6.A.4.d and 6.A.4.e)

Groundwater monitoring wells are located throughout the fuel farm facility. These wells are sampled quarterly in accordance with the NAB Little Creek Oil Discharge Contingency Plan.

3.1.2.6 Personnel Training [Reference VR 680-14-13 Section 6.A.5]

Safety training sessions are conducted for fuel farm personnel on a monthly basis by the Fuel Farm Supervisor. Topics covered include hazard recognition, facility operations, procedures for inspections, procedures upon recognition of a hazard, and procedures for evaluating the condition of an AST. Records are kept of these training sessions and are located in Bldg. #3860. In addition to these training sessions, all fuel farm personnel are required to read the operations manual every (6) months and verify this by their signature.

3.1.2.7 Recordkeeping [Reference VR 680-14-13 Section 9]

All books, papers, documents and records relating to the fuel farm facility are located in the fuel farm office in Bldg. #3860. These records include measurements and inventory of oil, records of daily visual inspections and weekly checklists, and other documentation required by statutes or regulations.

3.1.3 AST Requirements

The following subsection analyzes the aboveground storage tank requirements of VR 680-14-13 with respect to the regulated tanks at this facility. Refer to narrative, tables, and evaluation sheets in Section 5.0 for identification of deficiencies observed for specific tanks and recommendations for achieving compliance. See Section 6.0 for a proposed schedule of the required upgrades.

3.1.3.1 NAB Little Creek

This subsection discusses the compliance status of regulated AST's which are assigned to NAB Little Creek activities.

3.1.3.1.1 Formal Tank Inspections [Reference VR 680-14-13 Section 6.A.1. c (1) (2) (3) & (4)]

With the exception of Tanks #3862, 3865, and 3866, no other AST's at NAB Little Creek have had formal integrity inspections performed in accordance with industry accepted methods for nondestructive testing of petroleum storage tanks. American Petroleum Institute Standard 653 (API 653), "Tank Inspection, Repair, Alteration and Reconstruction," applies to vertical steel AST's. Tanks with different configurations or materials of construction must be evaluated with respect to the applicable API or Underwriters Laboratories (UL) standards.

An AST which has greater than 12,000 gallon capacity and has been in operation for more than five (5) years must have an initial external inspection performed within 5 years of the VR 680-14-13

revised effective date and an internal inspection within 3 years. AST's greater than 12,000 gallon capacity that have been in operation for less than five (5) years are required to have an initial external inspection and an internal inspection within 5 years of the regulations' effective date. Typically, an AST with a storage capacity of less than 12,000 gallons only requires a formal external inspection; these tanks are not subject to a formal internal inspection unless the structural integrity of the tank is in question.

Each AST must undergo a formal external inspection every five (5) years. Internal AST reinspection are only required every ten (10) years, unless the predetermined corrosion rate requires a reduced inspection interval.

3.1.3.1.2 Containment Dike Certifications (Reference VR 680-14-13 Section 6.A.1.c)

All containment areas at NAB Little Creek are lacking certification in accordance with VR 680-14-13. Each containment dike or berm must be evaluated or certified by a professional engineer with respect to compliance with 40 CFR 112, NFPA 30, and the Occupational Safety and Health Administration's regulation titled, "Flammable and Combustible Liquids" (29 CFR 1910.106). These evaluations must be completed within 5 years of the revised effective date with re-evaluations performed every ten (10) years thereafter. (Note that secondary containment requirements stated in these three (3) regulations are not being evaluated within this AST Management Plan but would be analyzed during the required secondary containment dike certifications.)

3.1.3.1.3 Cathodic Protection Evaluations [Reference VR 680-14-13 Section 6.A.1.c.(6)]

The vertical AST's at NAB Little Creek (Tank #'s 3825, 3845, 3846, 3862, 3863, 3864, 3865, and 3866) have cathodic protection provisions. Cathodic protection evaluations are required by VR 680-14-13 on each AST or associated pipeline on a one-time only basis, therefore no additional evaluations are required.

3.1.3.1.4 Tank Gauging and Identification (Reference VR 680-14-13 Section 6.A.2.f)

Twelve (12) of fourteen (14) AST's at NAB Little Creek are equipped with gauges which indicate the level or quantity of oil in the tank. These gauges are not currently being calibrated at regular intervals.

All AST's have identification numbers clearly marked in a prominent location. However, the majority of tanks lack a marking for tank capacity.

3.1.3.1.5 High Level Alarms (Reference VR 680-14-13 Section 6.A.2.g)

Half (4 of 8) of the bulk storage tanks (tanks with a capacity of 10,000 gallons or greater) at this facility are not equipped with high level alarms.

Five (5) of the sixteen (16) regulated tanks have high level alarms which are operational. The visual and audible alarm signals (horns, lights, etc.) are tested frequently to ensure that the operator will be adequately warned of an impending overfill situation.

Tanks #3862 thru 3866 have "high-high" level sensors which are automated to close the tank's receipt valve. However, the "high-high" level shutoff systems to these tanks are presently not functional and in need of repairs.

3.1.3.1.6 Piping Corrosion Protection [Reference VR 680-14-13 Section 6.A.3]

All aboveground carbon steel piping associated with the NAB Little Creek tanks are painted. However, a large portion of the fuel farm piping shows visible signs of corrosion. Also, two (2) AST's at the fuel farm have underground pipes which need cathodic protection evaluations.

3.1.3.1.7 Pressure Testing of Piping [Reference VR 680-14-13 Section 6.A.3]

The piping associated with ten (10) of the regulated tanks has not been subjected to hydrostatic testing. The use of oil as a test medium is acceptable if the flash point is greater than 120° F. at 14.7 pounds per square inch absolute. This piping is required to be hydrostatically tested within 5 years of the VR 680-14-13 effective date and every five (5) years thereafter.

3.1.3.1.8 Performance Standards for AST's [Reference VR 680-14-13 Section 7]

VR 680-14-13 contains provisions for new AST installations, retrofitted (reconstruction or bottom replacement) tanks and existing AST's which are brought into use after the regulations' effective date. Refer to Appendix "A" for the actual requirements of this regulation.

3.1.3.1.9 AST Closure [Reference VR 680-14-13 Section 8]

VR 680-14-13 includes action requirements for performing temporary and permanent tank closures. Refer to Section 8 of Appendix "A" for the required closure actions.

3.1.3.2 Public Works Center (PWC), Little Creek Site Tanks

This subsection discusses the compliance status of AST's which are under the responsibility of PWC, Little Creek site. The AST's at the steam plant (NAB 759 and NAB 760) are temporarily out-of-service and will thus not be evaluated in this section.

3.1.3.2.1 Formal Tank Inspections [Reference VR 680-14-13 Section 6.A.1.c (1) (2) (3) & (4)]

AST #NAB 752-1 requires a formal external inspection be performed within five (5) years of the VR 680-14-13 effective date. This tank must then be re-inspected every five (5) years.

3.1.3.2.2 Containment Dike Certifications (Reference VR 680-14-13 Section 6.A.1.c)

The containment area at Tank #NAB 752-1 is lacking certification in accordance with VR 680-14-13. The diked area must be evaluated or certified by a professional engineer with respect to compliance with 40 CFR 112, NFPA 30, and the Occupational Safety and Health Administration's regulation titled, "Flammable and Combustible Liquids" (29 CFR 1910.106). This evaluation must be completed within 5 years of the VR 680-14-13 effective date with a re-evaluation performed every ten (10) years thereafter. (Note that secondary containment requirements stated in these three (3) regulations are not being evaluated within this AST Management Plan but would be analyzed during the required secondary containment dike certification.)

3.1.3.2.3 Tank Gauging and Identification (Reference VR 680-14-13 Section 6.A.2.f)

AST #NAB 752-1 is equipped with a gauge which indicates the quantity of oil in the tank. However, the gauge is not currently being calibrated on an annual basis. This tank also has the identification number clearly marked in a prominent location but lacks the tank capacity marking.

3.1.3.2.4 High Level Alarms (Reference VR 680-14-13 Section 6.A.2.g)

Tank #NAB 752-1 is fueled by a truck with an automatic shut-off dispensing system. Thus, a high level alarm is not necessary for this tank.

3.1.3.2.5 Piping Corrosion Protection (Reference VR 680-14-13 Section 6.A.3)

The piping for NAB 752-1 consists of small copper tubing and does not require painting or cathodic protection.

3.1.3.2.6 Pressure Testing of Piping (Reference VR 680-14-13 Section 6.A.3)

The piping associated with AST #NAB 752-1 consists of small copper tubing for which pressure

testing is not necessary.

3.1.3.2.7 Performance Standards of AST's (Reference VR 680-14-13 Section 7)

VR 680-14-13 contains provisions for new AST installations, retrofitted (reconstruction or bottom replacement) tanks and existing AST's which are brought into use after the VR 680-14-13 effective date. Refer to Section 7 of Appendix "A" for the actual requirements of this regulation.

3.1.3.2.8 AST Closure (Reference VR 680-14-13 Section 8)

VR 680-14-13 includes action requirements for performing temporary and permanent closures. Refer to Section 8 of Appendix "A" for the required closure actions.

3.1.4 Loading Rack Requirements

The following subsection discusses the compliance status of the JP-5 loading area and loading rack #3861 with respect to VR 680-14-13 requirements.

3.1.4.1 Spill Containment System (Reference VR 680-14-13 Section 6.A.2.c)

Spills within the loading rack #3861 are directed to drop inlets and conveyed to a 10,000 gallon emergency spill tank. The JP-5 loading area is sloped to a trench grate which drains to a 15,000 gallon oil/water separator. Both drainage systems have enough capacity to contain the largest compartment spilled (5,500 gallons).

3.1.4.2 Automatic Shutdown System (Reference VR 680-14-13 Section 6.A.2.c)

The pump on-off switches are located at the loading racks within reach for automatic shutdown. Fuel farm operations personnel remain at the loading areas during all phases of transfer operations.

3.1.4.3 Collision Barriers (Reference VR 680-14-13 Section 6.A.2.c)

The valves and piping at the truck loading areas are located within an 8" high concrete island to protect the piping from vehicle or equipment impact.

3.2 EPA "OIL POLLUTION PREVENTION" REGULATIONS (40 CFR 112)

The following subsection presents the compliance status of this facility with respect to the AST and loading rack requirements of 40 CFR 112. Refer to the "NAB Little Creek Oil Spill Prevention Control and Countermeasure (SPCC) Plan," dated 1993, for an in-depth evaluation of the facility's compliance with 40 CFR 112. See Appendix "B" for a copy of 40 CFR 112.

3.2.1 NAB Little Creek

This subsection discusses the compliance status of AST's which are assigned to NAB Little Creek. Refer to the narrative and tables in Section 5.0 for identification of specific tanks which require these upgrades.

3.2.1.1 Containment Area Drainage [Reference 40 CFR 112 Section 112.7 (e) (1) (i)]

All tank containment areas at NAB Little Creek have manually operated valves at the drainage outfall. However, the drainage pipe for Tanks #'s 3105A and 3105B has an improper slope and needs to be removed and re-set (Work request no. 50580 has been submitted for design services to correct this problem).

3.2.1.2 Secondary Containment [Reference 40 CFR 112 Section 112.7 (e) (2)]

Ten (10) of the forty-two (42) tanks assigned to NAB Little Creek have inadequate secondary containment volumes. These diked areas must be upgraded to provide containment for the tank capacity plus an allowance for precipitation. Also, the diked areas for six (6) tanks at the fuel farm

are not sufficiently impervious to prevent an oil release from reaching the groundwater table.

3.2.1.3 Integrity Testing [Reference 40 CFR 112 Section 112.7 (e) (2)]

As described previously in Section 3.1.3.1.1, eleven (11) AST's assigned to NAB Little Creek require formal tank testing in accordance with industry standards.

3.2.1.4 Overfill Protection [Reference 40 CFR 112 Section 112.7 (e) (2)]

For the vast majority of tanks at NAB Little Creek, the automatic shut-off feature on the fueling truck dispenser is sufficient for overfill protection. However, high level alarms and/or high-high level switches are required on bulk storage tanks for which fuel is delivered via pipeline from pump stations or unloading racks. Six (6) tanks require installation of high level alarms and three (3) tanks require high-high level switches.

3.2.1.5 Piping Corrosion Protection [Reference 40 CFR 112.7 (e) (3)]

See previous section 3.1.3.1.6 for piping corrosion protection analysis for NAB Little Creek tanks.

3.2.1.6 Pipe Supports [Reference 40 CFR 112 Section 112.7 (e) (3) (iii)]

All pipe supports appear to minimize abrasion and corrosion and allow for pipe expansion and contraction.

3.2.1.7 Pressure Testing of Piping [Reference 40 CFR 112.7 (e) (3)]

See previous section 3.1.3.1.7 for pipe pressure testing requirements of NAB Little Creek tanks.

3.2.1.8 Unloading Area Departure Prevention [Ref. 40 CFR 112 Section 112.7 (e) (4) (iii)]

Fuel farm operations personnel are always at the unloading areas during transfer operations to ensure that premature vehicle departure does not occur.

3.2.1.9 Security Fencing [Reference 40 CFR 112.7 (e) (9)]

It is recommended that security fencing be installed for the three (3) tanks located outside the perimeter fencing surrounding the installation.

3.2.1.10 Security Lighting [Reference 40 CFR 112.7 (e) (9)]

Sixteen (16) tanks at NAB Little Creek have inadequate security lighting to both discover spills and deter vandalism.

3.2.2 PWC, Little Creek site

This subsection discusses the 40 CFR 112 compliance status of all AST's which are assigned to PWC, Little Creek site. Refer to narrative and tables in Section 5.0 for identification of specific tanks which require these upgrades.

3.2.2.1 Containment Area Drainage

All PWC tanks have manual valves for drainage of the diked areas.

3.2.2.2 Secondary Containment

Tank NAB 752-1 has an inadequately sized secondary containment area. This diked area must be upgraded to provide containment for the tank capacity plus an allowance for precipitation. All diked areas are sufficiently impervious to prevent spills from reaching groundwater.

3.2.2.3 Integrity Testing

As described previously in section 3.1.3.2.1, only tank #NAB 752-1 requires a formal external inspection.

3.2.2.4 Overfill Protection

As described previously in section 3.1.3.2.4, most of the PWC tanks are fueled by a truck with an automatic shut-off dispensing system. Thus, overfill protection devices are not necessary for these tanks. However, fuel is delivered via pipeline for the bulk storage tanks, making high level alarms and/or high-high level switches required for these tanks. NAB 759 and NAB 760 require installation of high-high level switches.

3.2.2.5 Piping Corrosion Protection

All piping associated with the PWC tanks is constructed of copper tubing which makes cathodic protection of underground lines and painting of aboveground lines unnecessary.

3.2.2.6 Pipe Supports

There are no pipe supports associated with the PWC, Little Creek site tanks.

3.2.2.7 Pressure Testing of Piping

It is not necessary to pressure test the small copper tubing associated with ten (10) of the twelve (12) tanks. However, NAB 759 and NAB 760 require pressure testing of the associated piping.

3.2.2.8 Security Fencing

All PWC tanks have adequate security fencing.

3.2.2.9 Security Lighting

Ten (10) of the twelve (12) PWC tanks have adequate security lighting for discovery of spills and to deter vandalism. AST #'s NAB 759 and NAB 760 require installation of adequate security lighting.

3.3 NATIONAL FIRE PROTECTION ASSOCIATION "FLAMMABLE AND COMBUSTIBLE LIQUIDS CODE" (NFPA 30)

This subsection does not discuss common requirements of NFPA 30 which have previously been discussed for either VR 680-14-13 or 40 CFR 112.

3.3.1 AST Requirements

It should be noted that the AST evaluations with respect to NFPA 30 do not include the containment requirements which will be covered during performance of the secondary containment dike certifications as required by VR 680-14-13. NFPA 30 containment standards which will be evaluated in the aforementioned certifications include ground slope within diked area, dike capacity, configuration, cross-section and intermediate dike requirements, among others.

3.3.1.1 NAB Little Creek Tanks

The following subsection discusses NFPA 30 compliance status of regulated AST's which are assigned to NAB Little Creek activities.

3.3.1.1.1 Tank Location (Reference NFPA 30 Sections 2-3.1 & 2-3.2)

All regulated tanks assigned to NAB Little Creek satisfy the location requirements of NFPA 30.

3.3.1.1.2 Anchorage of Horizontal Tanks (Reference NFPA 30 Section 2-6.6.2.2)

All regulated horizontal tanks are anchored to both their supports and the support slab as required.

3.3.1.1.3 Unsupervised AST's (Reference NFPA 30 Section 2-9.3)

None of the sixteen (16) tanks assigned to NAB Little Creek activities can be considered as unsupervised; thus, the requirements of this portion of NFPA 30 do not apply.

3.3.1.2 Public Works Center (PWC), Little Creek Site Tanks

This subsection discusses the NFPA 30 compliance status of AST's which are under the responsibility of PWC, Little Creek site.

3.3.1.2.1 Tank Location (Reference NFPA 30 Section 2-3.1 and 2-3.2)

Tank #NAB 752-1's location exceeds the minimum distances from property lines and buildings as required by NFPA 30.

3.3.1.2.2 Anchorage of Horizontal Tanks (Reference NFPA 30 Sections 2-6.6.2.2)

AST #752-1 is anchored to its supports and to the support slab as required.

3.3.1.2.3 Unsupervised AST's (Reference NFPA 30 Section 2-9.3)

Tank #NAB 752-1 is not considered as unsupervised; thus, this section of NFPA 30 is not applicable.

3.3.2 Loading Rack Requirements

The following subsection discusses the compliance status of both the JP-5 loading area and loading area #3861 at the fuel farm with respect to NFPA 30 requirements.

3.3.2.1 Loading Rack Location (Reference NFPA 30 Section 5-4.4.1.1)

Both loading areas meet the separation requirements of NFPA 30.

3.3.2.2 Grounding (Reference NFPA 30 Section 5-4.4.1.2)

Grounding is performed at both loading racks by attaching an alligator clip to the truck frame.

3.4 NAVY "ENVIRONMENTAL AND NATURAL RESOURCES PROGRAM MANUAL" (OPNAVINST 5090.1B)

The following subsection presents the compliance status of this facility with respect to the requirements of OPNAVINST 5090.1B.

3.4.1 Monitoring of Transfer Operations (Reference Section 16.4.1.1)

The current procedures for manually monitoring fueling operations satisfy OPNAVINST 5090.1B (Refer to sections 3.1.1.2 and 3.1.2.2 for an evaluation of this issue). However, the level gauges are in need of calibration on a regular basis (See Section 3.1.3.1.4).

3.4.2 Corrosion Protection Measures (Reference Section 16-4.1.2)

Cathodic protection systems are installed at both the Little Creek fuel farm and steam plant. The fuel farm system is regularly tested to ensure proper protection of tank bottoms while the cathodic protection at the steam plant tanks is inoperable and in need of repair (It should be noted that the

steam plant tanks have been out-of-service since prior to 1987).

3.4.3 Record Keeping (Reference Section 16-4.1.4)

Written records required by all applicable regulations are maintained at each resident command and/or BCE at Building #3165. The only exception are the fuel farm and steam plant which maintain records in their respective offices.

3.4.4 Release Detection Systems (Reference section 16-4.2.2)

The vertical tanks at the fuel farm have groundwater monitoring wells that are sampled quarterly in accordance with the Commonwealth of Virginia Oil Discharge Contingency Plan.

3.4.5 Release Reporting (Reference section 16-4.2.3)

NAB Little Creek reports petroleum releases in accordance with all Navy, Federal, State, and local requirements.

3.4.6 Out-of-Service AST's and Closure (Reference Section 16-4.2.4)

Refer to Sections 3.1.3.1.9 and 3.1.3.2.8 for information on AST Closure actions.

3.4.7 Development of a "Tank Management Plan" (Reference Section 16-5.3)

This report satisfies the "Tank Management Plan" requirements of OPNAVINST 5090.1B.

SECTION 4.0

FACILITY RECOMMENDATIONS

This Section outlines our specific recommendations concerning facility operational procedures and revisions to loading areas to achieve compliance with the applicable regulations and codes.

4.1 BASIS OF RECOMMENDATIONS

The upgrade recommendations are based on interviews with NAB Little Creek and Public Works Center (PWC) personnel as well as field observations made by AC&P. The information obtained has been compared to the operational procedures required by the associated regulations and codes.

4.2 FACILITY OPERATIONS UPGRADES

The following subsection covers the operational upgrades required for fuel storage facilities assigned to both NAB Little Creek activities and PWC, Little Creek site.

4.2.1 Tank Gauging (Reference VR 680-14-13 Section 6.A.2.f and OPNAVINST 5090.1B Section 16-4.1.1)

At the present time, the level gauges on all regulated tanks are not being calibrated on a regular maintenance schedule. The level gauges for all AST's regulated under VR 680-14-13 are required to be calibrated on an annual basis.

4.2.1.1 Groundwater Monitoring (Reference VR 680-14-13 Sections 6.A.4.c, 6.A.4.d & 6.A.4.e)

At the present time, groundwater sampling is being performed on a quarterly basis. VR 680-14-13 requires monthly sampling with a summary submittal to the state on an annual basis.

4.2.1.2 Personnel Training Program [Reference VR 680-14-13 Section 6.A.5]

All NAB Little Creek (including fuel farm operators) and PWC personnel involved in fueling operations or maintenance activities on the AST's should have completed the appropriate training classes for their level of responsibility. See Appendix "E" for the training recommended for different facility personnel. It should be noted that VR 680-14-13 only requires personnel conducting inspections of the fuel facilities to complete training courses specific to the facility as well as a session on the evaluation of aboveground storage tanks. The "Recommended Training Program for Facility Personnel" in Appendix "E" includes training courses mandated by OSHA regulations which would definitely apply to these facility inspectors and may be required for other base personnel depending upon their job responsibilities.

4.3 LOADING/UNLOADING AREA UPGRADES

4.3.1 Spill Containment System [Reference VR 680-14-13 Section 6.A.2.c]

The 10,000-gallon emergency spill tank at fuel farm loading area #3861 fills with stormwater which flows from the recently constructed Tank #'s 3845 and 3846. It is recommended to install a concrete rollover curb around the perimeter of this loading area to prevent the stormwater from reducing the available capacity of the containment system. It should be noted that Work Request No. 40992 has been submitted to alleviate this problem.

4.3.2 Traffic Flow at JP-5 Loading Area

Vehicles within the ACU-4 compound frequently pass through the JP-5 loading area when entering or exiting the facility. It is recommended that a fence be constructed around the loading area to prevent vehicles from either damaging the fuel piping/valves or colliding with a fuel tanker truck within the loading area.

SECTION 5.0

AST RECOMMENDATIONS

The recommendations concerning upgrades for individual AST's are based on deficiencies observed by Armour Cape & Pond during the week of March 6th thru 10th, 1995. See the tank-by-tank evaluation sheets in this section for an itemized list of upgrades required for each individual tank at this facility.

5.1 BASIS OF RECOMMENDATIONS

5.1.1 Secondary Containment Evaluations (Reference VR 680-14-13 Section 6.A.1.d)

The tank-by-tank evaluations in this section include only the recommendations and costs for performance of the containment dike certifications as required by VR 680-14-13. This report does not include identification of deficiencies to containment provisions that will be evaluated in these certifications. Future secondary containment evaluations will include analysis of features such as proper ground surface slopes within diked areas, adequate containment volume, configuration of berm or dike, and intermediate dike requirements.

5.1.2 High Level Alarms (Reference VR 680-14-13 Section 6.A.2.g)

Although they are not mandated by the regulations, it is recommended to install high level alarms and high-high level switches at bulk storage tanks which do not currently have these components due to their size and potential hazard to the environment. "Bulk storage tank," as defined in this report, includes AST's 10,000 gallons or greater in size which are filled by pumping operations (i.e., does not include waste oil tanks).

5.1.3 Piping Cathodic Protection and Pressure Testing of Piping (Reference VR 680-14-13 Section 6.A.3.b)

Where pressure testing evaluations of piping are required by VR 680-14-13, they apply to the portion of the AST receipt and issue lines from the tank to the point where the connection is made to the main fueling lines.

5.1.4 AST Closures (Reference VR 680-14-13 Section 8)

AST #'s 3845, 3846, 3862, 3865, NAB 759 and NAB 760, located at the Fuel Farm and Steam Plant, are temporarily out-of-service. It is recommended that plans for use of these tanks be determined by the end of the 1995 calendar year. If these AST's will not be placed back into service, temporary or permanent closure actions must be performed as outlined in the following subsections. The upgrade requirements listed in the tank evaluation sheets for these AST's are based on the assumption that these tanks will be placed back into service in the future and must therefore conform to VR 680-14-13 regulations.

5.1.4.1 Permanent AST Closure (Reference VR 680-14-13 Section 8)

Permanent closure actions, as outlined in VR 680-14-13, require the operator of an AST to do the following:

i. Obtain a permit according to the Uniform Statewide Building Code requirements.

ii. Perform an inspection as outlined in the Uniform Statewide Building Code.

iii. Notify the Virginia Department of Environmental Quality (VDEQ) within thirty (30) days after the AST has been permanently closed. This notification is performed by submission of an updated "Aboveground Storage Tank Registration Form" with the tank closure information indicated as required under VR 680-14-12. If the tank closure is in response to containment and cleanup actions that necessitate AST removal, the local building official and the VDEQ must be immediately notified of this utilizing an updated AST registration form as mentioned previously.

iv. Perform an assessment of the AST site in accordance with Section 8.C. of VR 680-14-13. This assessment shall be conducted after notifying the VDEQ and the local building official, and must be performed prior to completion of all permanent closure actions.

v. Records of all permanent closure actions performed must be maintained at the facility for a minimum of five (5) years from the date the VDEQ receives notice of tank closure.

5.1.4.2 Temporary AST Closure (Reference VR 680-14-13 Section 8)

Temporary closure, should it be necessary in the future for compliance with VR 680-14-13, requires the operator of the AST to perform the following actions:

i. Obtain a permit according to the Uniform Statewide Building Code requirements.

ii. Perform an inspection as outlined in the Uniform Statewide Building Code.

iii. Notify the Virginia Department of Environmental Quality (VDEQ) within thirty (30) days after the AST has been temporarily closed. This notification is performed by submission of an updated "Aboveground Storage Tank Registration Form" with the tank closure information indicated as required under VR 680-14-12.

iv. Records of all temporary closure actions performed must be maintained at the facility for a minimum of five (5) years from the date the VDEQ receives notice of tank closure.

If an AST remains temporarily closed for more than twelve (12) months, the operator of the AST must choose one of the following options:

i. Perform permanent closure actions, unless the tank meets all requirements of a new AST as defined by VR 680-14-13.

ii. Request that the local building official permit an extension of the twelve (12) month temporary closure period. Prior to requesting this time extension, a site assessment must be performed following the requirements outlined in Section 8.c of VR 680-14-13.

5.1.5 Lighting of Diked Areas [Reference 40 CFR 112 Section 112.7 (e) (9) (v)]

It appears that a number of tanks at this facility have inadequate lighting for "discovery of spills during hours of darkness" as required by 40 CFR 112. Thus, it is recommended to install additional site lighting for illumination of the containment areas at the tanks for which the lighting is inadequate. See Sections 5.3.1.9 and 5.3.2.9, as well as the Tank Evaluation Sheets, for identification of the AST's which require additional lighting.

5.1.6 Painting of Tanks

Although the regulations and codes upon which this report is based do not specifically address the painting requirements for existing regulated AST's, we have evaluated and made upgrade recommendations regarding the condition of a tank's exterior coating system. It should be noted that air quality provisions show the lowest evaporative loss from fuel storage tanks which have a white exterior coating. See Sections 5.3.1.11 and 5.3.2.11 and the Tank Evaluation Sheets for additional reference.

5.1.7 Tanks Exempt from VR 680-14-13 Regulations

Tanks at NAB Little Creek that are exempt from regulation by VR 680-14-13 were evaluated based on 40 CFR 112 requirements, NFPA 30 provisions (if applicable), and other obvious maintenance requirements (i.e., painting, inadequate support structure, leaking pipe joints, etc.). Tank Evaluation Sheets are included in this section for all tanks which either require or do not require upgrades.

5.2 COST ASSUMPTIONS

5.2.1 General Cost Assumptions

All costs include labor, equipment and material costs as well as labor tax and insurance and state sales tax on material. Costs shown also include applicable subcontractor's and prime contractor's overhead and profit markups, as well as an escalation allowance of four (4) percent per year. Engineering design costs for required upgrades are estimated at fifteen (15) percent of the construction costs.

5.2.2 Labor Costs for Facility Personnel

Costs are not included for labor-intensive items that are assumed will be performed by facility maintenance personnel (i.e., pressure testing of piping, painting of smaller tanks, etc.). Also, the assumption is made that maintenance personnel will paint the required identification markings on each AST, thus costs shown for this are for paint materials only.

5.2.3 Specific AST Assumptions

It is assumed that magnetic flux exclusion (MFE) scanning of floors will be included in the performance of API 653 internal inspections for AST #'s 3825, 3845, 3846, 3863 and 3864.

In addition, API 653 only applies to vertical steel AST's. For other tanks at this facility to which API 653 does not apply, costs are included for performing integrity evaluations of these AST's with respect to the applicable API and/or UL standards.

5.2.4 Engineering Evaluation Fees

The engineering costs shown for performing secondary containment dike certifications include labor costs for field and office evaluations, travel expenses, project management fees, costs for two (2) submittals, reproduction expenses, and allowances for overhead and profit. Engineering fees include separate mobilizations for inspection of each vertical storage tank (one site visit to perform both internal and external inspections). It was assumed that engineering evaluations could be performed on all tanks with less than a 12,000 gallon capacity in one (1) mobilization (external inspection

only). The assumption was also made that the field information for all secondary containment dike certifications could be performed in one (1) site visit. It is presumed that a reputable engineering firm with experience in the petroleum industry will be utilized for performance of these evaluations.

Where cathodic protection does not exist for underground piping associated with a specific AST and the piping is currently in contact with earthen material (i.e., no outer casing pipe), the costs include a cathodic protection evaluation of the pipe as well as an allowance for the upgrades required.

Containment dike certifications will evaluate each AST location based on the specific containment requirements of 40 CFR 112, NFPA 30 and OSHA 29 CFR 1910.106. The containment volume of each diked area will be determined from topographic surveys furnished strictly for performance of these certifications. A survey is not required for determination of containment volumes for horizontal tanks within smaller diked areas with containment walls. Engineering fees will include taking measurements of these areas and calculating volumes directly from these dimensions.

5.2.5 Formal Tank Inspections

The costs given for internal and external tank inspections include performance of an AST integrity evaluation in accordance with the inspection requirements stated within the applicable API or UL publications. Inspection fees do not include costs for cleaning the tanks. However, these costs include certification of the cleaned tank as a "gas-free" environment. Inspections of all vertical steel tanks will be performed by a "certified tank inspector" as defined by API 653.

5.3 AST UPGRADES

The following subsection contains a narrative discussion of the required upgrades to the AST's at this facility. Refer to the Tank Evaluation Sheets within this section for an itemized list of tank upgrades required for each individual AST.

5.3.1 NAB Little Creek

This subsection covers required upgrades for the AST's which are assigned to NAB Little Creek activities. Refer to Tables 3 and 4 following this section for a summary of the information outlined in this subsection.

5.3.1.1 Formal Tank Inspections [Reference VR 680-14-13 Section 6.A.1.c and 40 CFR 112.7 (e)(2)(vi)]

Eleven (11) regulated AST's at NAB Little Creek require performance of integrity inspections in accordance with industry accepted methods for nondestructive testing of petroleum storage tanks. Six (6) of these (Tank #'s 3105A, 3105B, 3511-2, 3821-3, 3823-2, and 3870-1) are horizontal AST's which require only external inspections. The remaining five (5) tanks (AST #'s 3825, 3845, 3846, 3863, and 3864) require formal internal and external testing and inspections. See previous Section 3.1.2.1.1 for more information.

5.3.1.2 Containment Dike Certifications (Reference VR 680-14-13 Section 6.A.1.c)

Thirteen (13) of the fourteen (14) tanks regulated by VR 680-14-13 require performance of secondary containment dike certifications. These tank #'s are as follows: 3105A, 3105B, 3511-2, 3821-3, 3825, 3845, 3846, 3862, 3863, 3684, 3865, 3866, and 3870-1. See previous Section 3.1.2.1.2 for more information.

5.3.1.3 AST Cathodic Protection Evaluations (Reference VR 680-14-13 Section 6.A.1.d)

All vertical tanks satisfy the cathodic protection requirements of VR 680-14-13. Thus, no additional evaluations are required.

5.3.1.4 Tank Level Gauges (Reference VR 680-14-13 Section 6.A.2.f)

A level gauge must be installed on AST #'s 3511-2 and 3821-3. All remaining AST's regulated by VR 680-14-13 and assigned to NAB Little Creek have the required level sensing devices. In addition, the level gauges must be calibrated on an annual basis.

5.3.1.5 Tank Identification (Reference VR 680-14-13 Section 6.A.2.f)

Tank identification numbers are marked in a prominent location on all of the AST's regulated by VR 680-14-13. However, the identification number is required to be at the gauge location for Tank #'s 3511-2 and 3821-3. Also, the tank capacity must be painted at a prominent location and/or in the vicinity of the level gauge for fourteen (14) AST's. These tank #'s are as follows: 3105A, 3105B, 3511-2, 3821-3, 3823-2, 3825, 3845, 3846, 3862, 3863, 3864, 3865, 3866, and 3870-1.

5.3.1.6 Overfill Protection [Reference VR 680-14-13 Section 6.A.2.g and 40 CFR 112.7 (e)(2)(viii)]

Six (6) tanks require installation of high level alarms. Two (2) of these, Tank #'s 3105A and 3105B, are horizontal AST's for which a whistle-type vent fitting may be installed for alarm purposes. Tank #'s 3825, 3845, 3846, and 3865 are vertical and require both visual and audible alarm devices. Also, Tank #'s 3825, 3845, and 3846 require high-high level switches with valve actuators.

5.3.1.7 Pressure Testing of Piping [Reference VR 680-14-13 Section 6.A.3, NFPA Section 3-8, and 40 CFR 112.7(e)(3)(iv)]

The piping associated with all of the required AST's must be hydrostatically tested. However, it is not necessary to pressure test the small tubing associated with many of the horizontal tanks. Thus, ten (10) AST's require pressure testing of the associated piping. These tank #'s are as follows: 3105A, 3105B, 3825, 3845, 3846, 3862, 3863, 3864, 3865, and 3866. Refer to previous Section 3.1.2.1.7 for additional information.

5.3.1.8 Piping Corrosion Protection [Reference VR 680-14-13 Section 6.A.3, NFPA Section 3-6, and 40 CFR 112.7 (e)(3)]

AST #'s 3105A and 3105B have underground pipes conveying fuel to the gas station. These underground lines are not currently protected and require cathodic protection evaluations to be performed in accordance with VR 680-14-13.

All aboveground carbon steel piping associated with the NAB Little Creek tanks are painted except for the piping at Tank #3615-1 at which rusting is evident. Also, much of the piping at the fuel farm has visible signs of corrosion and thus costs are itemized with AST #'s 3862 thru 3866 to cover sandblasting and re-coating these aboveground lines.

5.3.1.9 Secondary Containment [Reference 40 CFR 112 Section 112.7 (e)(2)]

Ten (10) tanks have diked areas which are inadequate for containment of the tank plus an allowance for precipitation. These tanks are numbered as follows: 1231-1, 3144-3, 3151-2, 3165-3, 3530-1, 3699-1, 3699-2, 3821-3, 3870-1, and 3872-1. Also, the diked areas for Tank #'s 3825, 3862, 3863, 3864, 3865, and 3866 are not sufficiently impervious that an oil release would be prevented from infiltrating to the groundwater. It is recommended to install impervious liners in these diked area.

5.3.1.10 Facility Lighting [Reference 40 CFR 112 Section 112.7 (e)(9)(v)]

Installation of adequate overhead lighting is required at sixteen (16) AST's to allow for discovery of spills during hours of darkness and to deter acts of vandalism. These tanks include: 3105A, 3105B, 3151-1, 3699-1, 3699-2, 3825, 3845, 3846, 3862, 3863, 3864, 3865, 3866, 3870-1, 3872-1, and 3892-1.

5.3.1.11 Tank Location (Reference NFPA 30 Sections 2-3.1 and 2-3.2)

All tanks assigned to NAB Little Creek satisfy the location requirements of NFPA 30.

5.3.1.12 Tank Painting [Reference 40 CFR 112.7 (e)(2)]

Sixteen (16) of the AST's assigned to NAB Little Creek have visible signs of corrosion and need to be painted. These tank #'s are as follows: 1130-1, 1130-2, 1262-1, 1262-2, 1618-P, 3022-1, 3022-2, 3144-3, 3151-2, 3373-1, 3615-1, 3862, 3863, 3864, 3865, and 3866.

5.3.1.13 Manual Dike Drainage Valves [Reference 40 CFR 112.7 (e)(1)]

Three (3) tank containment areas require installation of manual dike drainage valves with locking devices. The containment areas at Tank #'s 1231-1, 1515-1, and 1515-2 are in need of this upgrade.

5.3.1.14 Security Fencing [Reference 40 CFR 112.7 (e)(9)]

Three (3) AST's are located outside the main gate of the installation. It is recommended that additional security fencing be required for these tanks (AST #'s 3151-1, 3151-2, and 3373-1).

5.3.2 Public Works Center (PWC), Little Creek Site Tanks

The following subsection covers the upgrades required for AST's which are under the responsibility of PWC, Little Creek site. It should be noted that Tank #'s NAB 752-1, NAB 759 and NAB 760 are the only PWC tanks regulated by VR 680-14-13; thus upgrades will only be listed for the remaining PWC tanks when required by other applicable regulations. Refer to Tables 5 and 6 following this section for a summary of the information given in this subsection.

5.3.2.1 Formal Tank Inspections [Reference VR 680-14-13 Section 6.A.1.c and 40 CFR 112.7 (e)(2)(vi)]

AST #NAB 752-1 is in need of a formal external inspection by industry accepted methods.

5.3.2.2 Containment Dike Certification (Reference VR 680-14-13 Section 6.A.1.c)

A secondary containment dike evaluation must be performed for Tank #'s NAB 752-1, NAB 759 and NAB 760.

5.3.2.3 Cathodic Protection Evaluation (Reference VR 680-14-13 Section 6.A.1.d)

None of the AST's assigned to PWC Little Creek require a cathodic protection evaluation.

5.3.2.4 Level Gauges (Reference VR 680-14-13 Section 6.A.2.f)

The level gauge for Tank #NAB 752-1 must be calibrated on an annual basis as required by VR 680-14-13.

5.3.2.5 Tank Identification (Reference VR 680-14-13 Section 6.A.2.f)

AST #NAB 752-1 currently has its identification number and storage capacity marked in a prominent location on both the tank and gauge which is easily visible from the tank's gauge location.

5.3.2.6 High Level Alarms [Reference VR 680-14-13 Section 6.A.2.g and 40 CFR 112.7 (e)(2)(viii)]

High level alarms are not required for ten (10) of the twelve (12) PWC tanks because they are fueled by a truck which has an automatic shut-off dispensing system. However, NAB 759 and NAB 760 are vertical tanks. These AST's require both visual and audible high level alarms in addition to a high-high level switch with valve actuators.

5.3.2.7 Pressure Testing of Piping [Reference VR 680-14-13 Section 6.A.3, NFPA 30 Section 3-8, and 40 CFR 112.7(e)(3)(iv)]

The piping associated with most of the PWC tanks consists of small copper tubing for which hydrostatic testing is not necessary. NAB 759 and NAB 760, however, require pressure testing of the associated piping.

5.3.2.8 Piping Corrosion Protection [Reference VR 680-14-13 Section 6.A.3, NFPA 30 Section 3-6, and 40 CFR 112.7 (e)(3)]

The copper tubing at the PWC tanks does not require painting or cathodic protection.

5.3.2.9 Secondary Containment [Reference 40 CFR 112 Section 112.7 (e)(2)]

The diked areas for Tank # NAB 752-1 is inadequate for containment of the tank plus an allowance for precipitation.

5.3.2.10 Facility Lighting [Reference 40 CFR 112 Section 112.7 (e)(3)(iii)]

Adequate overhead lighting currently exists at ten (10) of the twelve (12) PWC tanks to allow for discovery of spills during hours of darkness and to deter acts of vandalism, thus no upgrade is necessary. NAB 759 and NAB 760 require installation of adequate overhead lighting.

5.3.2.11 Tank Location (Reference NFPA 30 Sections 2-3.1 and 2-3.2)

All PWC tanks satisfy the location requirements of NFPA 30.

5.3.2.12 Tank Painting [Reference 40 CFR 112.7 (e)(2)]

Five (5) of the AST's assigned to PWC Little Creek have visible signs of corrosion and need to be painted. These tank #'s are as follows: 3081B-1, 3400-1, 3661-1, 3879-1, and NAB 757-F.

5.3.2.13 Manual Dike Drainage Valves [Reference 40 CFR 112.7 (e)(1)]

All PWC tanks satisfy the requirement for having a manual dike drainage valve.

5.3.2.14 Security Fencing [Reference 40 CFR 112.7 (e)(9)]

All PWC tanks have adequate security fencing provided by either the installation or the resident command.

5.4 MAINTENANCE ISSUES

Tanks were evaluated on maintenance issues such as adequate support structure, adequate support slab, and visible signs of leakage.

5.4.1 Tanks Assigned to NAB Little Creek

Seven (7) AST's require anchoring to support slabs and/or frames: 1130-1, 1262-1, 1262-2, 1618-P, 3151-1, 3151-2, and 3165-3. Tank #1618-P has a bent support leg which needs repair. Two (2) tank support structures, those at AST's #1515-1 and 1515-2, require painting. The containment areas for Tank #'s 1262-1, 1262-2, and 3530-1 are coated with an oily residue and need cleaning. Refer to Table 7 following this section for a summary of the information outlined in this subsection.

5.4.2 Tanks Assigned to PWC, Little Creek Site

Tank #'s 3081B-1, 3400-1 and 3661-3 need to be anchored to their support slab. Refer to Table 8 following this section for a summary of the information given in this subsection.

TABLE 3

OPERATIONS REQUIREMENTS IN COMPLIANCE FOR TANKS UNDER RESPONSIBILITY OF NAVAL AMPHIBIOUS BASE, LITTLE CREEK

Date: December 1995

Regulated Under			Applicable Regulations		VR EPA	VR EPA	VR	VR	VR	VR	VR	VR NFPA EPA	VR NFPA EPA	EPA
VR	NFPA	EPA	AST ID #	Bldg. #	Formal Internal Inspctn	Formal External Inspctn	Containment Dike Cert.	I.D. at Prominent Location	Cap. at Prominent Location	I.D. at Gauge	Capacity at Gauge	Piping Pressure Tested	AG Piping Painted	Adequate Tank Painting
		X	1130-1	1130	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	No
		X	1130-2	1130	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	No
		X	1231-1	1231	N/A	N/A	N/R	Yes	N/R	Yes	N/R	N/A	Yes	Yes
		X	1262-1	1262	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	No
		X	1262-2	1262	N/A	N/A	N/R	Yes	N/R	N/R	N/R	N/A	N/A	No
		X	1265-1A	1265	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	Yes
		X	1515-1	1515	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	Yes
		X	1515-2	1515	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	Yes
		X	1618-P	1618	N/A	N/A	N/R	Yes	N/R	N/R	N/R	N/A	N/A	No
		X	3022-1	3022	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	No
		X	3022-2	3022	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	No
X	X	X	3105A	3860	N/A	No	No	Yes	No	Yes	No	No	Yes	Yes
X	X	X	3105B	3860	N/A	No	No	Yes	No	Yes	No	No	Yes	Yes
		X	3108-1	3108	N/A	N/A	N/R	Yes	N/R	N/R	N/R	N/A	N/A	Yes
		X	3144-3	3144	N/A	N/A	N/R	Yes	N/R	N/R	N/R	N/A	N/A	No
		X	3151-1	3151	N/A	N/A	N/R	Yes	N/R	N/R	N/R	N/A	N/A	Yes
		X	3151-2	3151	N/A	N/A	N/R	Yes	N/R	N/R	N/R	N/A	N/A	No
		X	3165-3	3165	N/A	N/A	N/R	Yes	N/R	Yes	N/R	N/A	N/A	Yes

N/R = Not required; tank is not governed by the referenced regulation(s).
N/A = Not applicable; tank construction is such that item is not required.

TABLE 5 (CONT.)

OPERATIONS REQUIREMENTS IN COMPLIANCE FOR TANKS UNDER RESPONSIBILITY OF NAVAL AMPHIBIOUS BASE, LITTLE CREEK

Date: December 1995

Regulated Under			Applicable Regulations		VR EPA	VR EPA	VR	VR	VR	VR	VR	VR NFPA EPA	VR NFPA EPA	EPA
VR	NFPA	EPA	AST ID #	Bldg. #	Formal Internal Inspctn	Formal External Inspctn	Containment Dike Cert.	I.D. at Prominent Location	Cap. at Prominent Location	I.D. at Gauge	Capacity at Gauge	Piping Pressure Tested	AG Piping Painted	Adequate Tank Painting
		X	3373-1	3373	N/A	N/A	N/R	Yes	N/R	Yes	N/R	N/A	N/A	No
X	X	X	3511-2	3511	N/A	No	No	Yes	No	No	No	N/A	N/A	Yes
		X	3530-1	3530	N/A	N/A	N/R	Yes	N/R	Yes	N/R	N/A	N/A	Yes
		X	3615-1	3615	N/A	N/A	N/R	Yes	N/R	N/R	N/R	N/A	No	No
		X	3699-1	3699	N/A	N/A	N/R	Yes	N/R	Yes	N/R	N/A	N/A	Yes
		X	3699-2	3699	N/A	N/A	N/R	Yes	N/R	Yes	N/R	N/A	N/A	Yes
X	X	X	3821-3	3821	N/A	No	No	Yes	No	No	No	N/A	N/A	Yes
X	X	X	3823-2	3823	N/A	No	*N/A	Yes	No	Yes	Yes	N/A	N/A	Yes
X	X	X	3825	3860	No	No	No	Yes	No	Yes	No	No	Yes	Yes
X	X	X	3845	3860	No	No	No	Yes	No	Yes	No	No	Yes	Yes
X	X	X	3846	3860	No	No	No	Yes	No	Yes	No	No	Yes	Yes
X	X	X	3862	3860	Yes	Yes	No	Yes	No	Yes	No	No	Yes	No
X	X	X	3863	3860	No	No	No	Yes	No	Yes	No	No	Yes	No
X	X	X	3864	3860	No	No	No	Yes	No	Yes	No	No	Yes	No
X	X	X	3865	3860	Yes	Yes	No	Yes	No	Yes	No	No	Yes	No
X	X	X	3866	3860	Yes	Yes	No	Yes	No	Yes	No	No	Yes	No
		X	3869-1	3869	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	Yes

* Double-wall tank with interstitial containment.

TABLE 5 (CONT.)

OPERATIONS REQUIREMENTS IN COMPLIANCE FOR TANKS UNDER RESPONSIBILITY OF NAVAL AMPHIBIOUS BASE, LITTLE CREEK

Date: December 1995

Applicable Regulations					VR EPA	VR EPA	VR	VR	VR	VR	VR	VR NFPA EPA	VR NFPA EPA	EPA
Regulated Under			AST ID #	Bldg. #	Formal Internal Inspctn	Formal External Inspctn	Containment Dike Cert.	I.D. at Prominent Location	Cap. at Prominent Location	I.D. at Gauge	Capacity at Gauge	Piping Pressure Tested	AG Piping Painted	Adequate Tank Painting
VR	NFPA	EPA												
		X	3869-2	3869	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	Yes
		X	3869-3	3869	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	Yes
		X	3869-4	3869	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	N/A	Yes
X	X	X	3870-1	3870	N/A	No	No	Yes	No	Yes	No	N/A	Yes	Yes
		X	3872-1	3872	N/A	N/A	N/R	Yes	N/R	Yes	N/R	N/A	Yes	Yes
		X	3892-1	3890	N/A	N/A	N/R	Yes	N/R	N/R	N/R	N/A	N/A	Yes
		X	5000	**	N/A	N/A	N/R	N/R	N/R	N/R	N/R	N/A	**	**

** Tank is to be installed within the next several months.

TAbLE 4

FACILITIES REQUIREMENTS IN COMPLIANCE FOR TANKS UNDER RESPONSIBILITY OF NAVAL AMPHIBIOUS BASE, LITTLE CREEK

Date: December 1995

Applicable Regulations					VR	VR EPA(Optl)	VR(Optl) EPA(Optl)	EPA	VR NFPA EPA	EPA	EPA	EPA
Regulated Under			AST ID #	Building #	Tank Cathodic Protection	Level Gauge	High Level Alarm	UG Piping Wrapped and Coated	UG Piping Cathodically Protected	Manual Drain Valve	Adequate Dike Lighting	Adequate Security Fencing
VR	NFPA	EPA										
		X	1130-1	1130	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	1130-2	1130	N/R	Yes	N/A	N/A	N/A	Yes	Yes	Yes
		X	1231-1	1231	N/R	Yes	N/A	N/A	N/A	No	Yes	Yes
		X	1262-1	1262	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	1262-2	1262	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	1265-1A	1265	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	1515-1	1515	N/R	Yes	Yes	N/A	N/A	No	Yes	Yes
		X	1515-2	1515	N/R	Yes	Yes	N/A	N/A	No	Yes	Yes
		X	1618-P	1618	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	3022-1	3022	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	3022-2	3022	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
X	X	X	3105A	3860	N/A	Yes	No	Yes	No	Yes	No	Yes
X	X	X	3105B	3860	N/A	Yes	No	Yes	No	Yes	No	Yes
		X	3108-1	3108	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	3144-3	3144	N/R	Yes	N/A	N/A	N/A	Yes	Yes	Yes
		X	3151-1	3151	N/R	N/A	N/A	N/A	N/A	Yes	No	No
		X	3151-2	3151	N/R	N/A	N/A	N/A	N/A	Yes	Yes	No

N/R = Not required; tank is not governed by the referenced regulation(s).
N/A = Not applicable; tank construction is such that item is not required, or optional equipment (i.e., gauges, HLA's) is being covered adequately by existing fueling operations.

TABLE 4 (CONT.)

FACILITIES REQUIREMENTS IN COMPLIANCE FOR TANKS UNDER RESPONSIBILITY OF NAVAL AMPHIBIOUS BASE, LITTLE CREEK

Date: December 1995

Applicable Regulations					VR	VR EPA(Optl)	VR(Optl) EPA(Optl)	EPA	VR NFPA EPA	EPA	EPA	EPA
Regulated Under			AST ID #	Building #	Tank Cathodic Protection	Level Gauge	High Level Alarm	UG Piping Wrapped and Coated	UG Piping Cathodically Protected	Manual Drain Valve	Adequate Dike Lighting	Adequate Security Fencing
VR	NFPA	EPA										
		X	3165-3	3165	N/R	Yes	N/A	N/A	N/A	Yes	Yes	Yes
		X	3373-1	3373	N/R	Yes	N/A	N/A	N/A	Yes	Yes	No
X	X	X	3511-2	3511	N/A	No	N/A	N/A	N/A	Yes	Yes	Yes
		X	3530-1	3530	N/R	Yes	N/A	N/A	N/A	Yes	Yes	Yes
		X	3615-1	3615	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	3699-1	3699	N/R	Yes	N/A	N/A	N/A	Yes	No	Yes
		X	3699-2	3699	N/R	Yes	N/A	N/A	N/A	Yes	No	Yes
X	X	X	3821-3	3821	N/A	No	N/A	N/A	N/A	N/A	Yes	Yes
X	X	X	3823-2	3823	N/A	Yes	Yes	N/A	N/A	N/A	Yes	Yes
X	X	X	3825	3860	Yes	Yes	No	N/A	N/A	Yes	No	Yes
X	X	X	3845	3860	Yes	Yes	No	N/A	N/A	Yes	No	Yes
X	X	X	3846	3860	Yes	Yes	No	N/A	N/A	Yes	No	Yes
X	X	X	3862	3860	Yes	Yes	Yes	N/A	N/A	Yes	No	Yes
X	X	X	3863	3860	Yes	Yes	Yes	N/A	N/A	Yes	No	Yes
X	X	X	3864	3860	Yes	Yes	Yes	N/A	N/A	Yes	No	Yes
X	X	X	3865	3860	Yes	Yes	No	N/A	N/A	Yes	No	Yes
X	X	X	3866	3860	Yes	Yes	Yes	N/A	N/A	Yes	No	Yes

N/R = Not required; tank is not governed by the referenced regulation(s).
N/A = Not applicable; tank construction is such that item is not required, or optional equipment (i.e., gauges, HLA's) is being covered adequately by existing fueling operations.

TABLE 4 (CONT.)

FACILITIES REQUIREMENTS IN COMPLIANCE FOR TANKS UNDER RESPONSIBILITY OF NAVAL AMPHIBIOUS BASE, LITTLE CREEK

Date: December 1995

Applicable Regulations					VR	VR EPA(Optl)	VR(Optl) EPA(Optl)	EPA	VR NFPA EPA	EPA	EPA	EPA
Regulated Under			AST ID #	Building #	Tank Cathodic Protection	Level Gauge	High Level Alarm	UG Piping Wrapped and Coated	UG Piping Cathodically Protected	Manual Drain Valve	Adequate Dike Lighting	Adequate Security Fencing
VR	NFPA	EPA										
		X	3869-1	3869	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	3869-2	3869	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	3869-3	3869	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	3869-4	3869	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
X	X	X	3870-1	3870	N/A	Yes	N/A	N/A	N/A	Yes	No	Yes
		X	3872-1	3872	N/R	Yes	N/A	N/A	N/A	Yes	No	Yes
		X	3892-1	3890	N/R	N/A	N/A	N/A	N/A	Yes	No	Yes
		X	5000	*	N/R	*	*	*	*	*	*	*

* Tank is to be installed within the next several months.

TABLE 5

OPERATIONS REQUIREMENTS IN COMPLIANCE FOR TANKS UNDER RESPONSIBILITY OF PUBLIC WORKS CENTER, LITTLE CREEK SITE

Date: December 1995

Applicable Regulations					VR EPA	VR EPA	VR	VR	VR	VR	VR	VR NFPA EPA	VR NFPA EPA	EPA
Regulated Under			AST ID #	Bldg. #	Formal Internal Inspctn	Formal External Inspctn	Containment Dike Cert.	I.D. at Prominent Location	Cap. at Prominent Location	I.D. at Gauge	Capacity at Gauge	Piping Pressure Tested	AG Piping Painted	Adequate Tank Painting
VR	NFPA	EPA												
		X	1501-1	1501	N/A	N/A	N/R	Yes	Yes	Yes	Yes	N/A	N/A	Yes
		X	1518-1	1518	N/A	N/A	N/R	Yes	Yes	Yes	Yes	N/A	N/A	Yes
		X	2115-1	2115	N/A	N/A	N/R	Yes	Yes	Yes	Yes	N/A	N/A	Yes
		X	3081B-1	3081B	N/A	N/A	N/R	Yes	N/R	N/R	N/R	N/A	N/A	No
		X	3400-1	3400	N/A	N/A	N/R	Yes	Yes	Yes	Yes	N/A	N/A	No
		X	3661-1	3661	N/A	N/A	N/R	Yes	Yes	N/R	N/R	N/A	N/A	No
		X	3661-3	3661	N/A	N/A	N/R	Yes	Yes	N/R	N/R	N/A	N/A	Yes
		X	3879-1	3879	N/A	N/A	N/R	Yes	Yes	Yes	Yes	N/A	N/A	No
X	X	X	NAB752-1	NAB752	N/A	No	No	Yes	Yes	Yes	Yes	N/A	N/A	Yes
		X	NAB757-F	NAB757-F	N/A	N/A	N/R	Yes	Yes	Yes	Yes	N/A	Yes	No
X	X	X	NAB759	NAB757	Yes	Yes	No	Yes	Yes	Yes	Yes	No	N/A	Yes
X	X	X	NAB760	NAB757	Yes	Yes	No	Yes	Yes	Yes	Yes	No	N/A	Yes

N/R = Not required; tank is not governed by the referenced regulation(s).
N/A = Not applicable; tank construction is such that item is not required.

TABLE 6

FACILITIES REQUIREMENTS IN COMPLIANCE FOR TANKS UNDER RESPONSIBILITY OF PUBLIC WORKS CENTER, LITTLE CREEK SITE

Date: December 1995

Applicable Regulations			VR	VR EPA(Optl)	VR(Optl) EPA(Optl)	EPA	VR NFPA EPA	EPA	EPA	EPA
Regulated Under			AST ID #	Building #	Tank Cathodic Protection	Level Gauge	High Level Alarm	UG Piping Wrapped and Coated	UG Piping Cathodically Protected	Manual Drain Valve	Adequate Dike Lighting	Adequate Security Fencing
VR	NFPA	EPA										
		X	1501-1	1501	N/R	Yes	N/A	N/A	N/A	Yes	Yes	Yes
		X	1518-1	1518	N/R	Yes	N/A	N/A	N/A	Yes	Yes	Yes
		X	2115-1	2115	N/R	Yes	N/A	N/A	N/A	Yes	Yes	Yes
		X	3081B-1	3081B	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	3400-1	3400	N/R	Yes	N/A	N/A	N/A	Yes	Yes	Yes
		X	3661-1	3661	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
		X	3661-3	3661	N/R	N/A	Yes	N/A	N/A	Yes	Yes	Yes
		X	3879-1	3879	N/R	N/A	N/A	N/A	N/A	Yes	Yes	Yes
X	X	X	NAB752-1	NAB752	N/A	Yes	N/A	N/A	N/A	Yes	Yes	Yes
		X	NAB757-F	NAB757-F	N/R	Yes	N/A	N/A	N/A	Yes	Yes	Yes
X	X	X	NAB759	NAB757	Yes	Yes	No	Yes	N/A	Yes	No	Yes
X	X	X	NAB760	NAB757	Yes	Yes	No	Yes	N/A	Yes	No	Yes

N/R = Not required; tank is not governed by the referenced regulation(s).
N/A = Not applicable; tank construction is such that item is not required, or optional equipment (i.e., gauges, HLA's) is being covered by existing fueling operations.

TABLE 7

MAINTENANCE ISSUES FOR TANKS UNDER RESPONSIBILITY OF NAVAL AMPHIBIOUS BASE, LITTLE CREEK

Date: December 1995

Tank #	Bldg. #	Adequate Support Structure	Support Slab	Leaking Pipe Fittings	Leaking Tank Fittings
1130-1	1130	No-needs anchoring	Yes	N/A	No
1130-2	1130	Yes	Yes	N/A	No
1231-1	1231	Yes	Yes	No	No
1262-1	1262	No-needs anchoring	Yes	N/A	No
1262-2	1262	No-needs anchoring	Yes	No	No
1265-1A	1265	Yes	Yes	No	No
1515-1	1515	Yes-needs painting	Yes	No	No
1515-2	1515	Yes-needs painting	Yes	No	No
1618-P	1618	No-leg is bent & frame needs anchoring to slab	Yes	N/A	No
3022-1	3022	Yes	Yes	N/A	No
3022-2	3022	Yes	Yes	N/A	No
3105A	3860	Yes	Yes	No	No
3105B	3860	Yes	Yes	No	No
3108-1	3108	Yes	Yes	No	No
3144-3	3144	Yes	Yes	No	No
3151-1	3151	No-needs anchoring	Yes	No	No
3151-2	3151	No-needs anchoring	Yes	No	No
3165-3	3165	No-needs anchoring	Yes	No	No
3373-1	3373	Yes	Yes	No	No
3511-2	3511	Yes	Yes	No	No

TABLE 7 (CONT.)

MAINTENANCE ISSUES FOR TANKS
UNDER RESPONSBILITY OF NAVAL AMPHIBIOUS BASE, LITTLE CREEK

Date: December 1995

Tank #	Bldg. #	Adequate Support Structure	Support Slab	Leaking Pipe Fittings	Leaking Tank Fittings
3530-1	3530	Yes	Yes	No	No
3615-1	3615	Yes	Yes	No	No
3699-1	3699	Yes	Yes	N/A	No
3699-2	3699	Yes	Yes	No	No
3821-3	3821	Yes	Yes	N/A	No
3823-2	3823	Yes	Yes	No	No
3825	3860	Yes	*	No	No
3845	3860	Yes	*	No	No
3846	3860	Yes	*	No	No
3862	3860	Yes	*	No	No
3863	3860	Yes	*	No	No
3864	3860	Yes	*	No	No
3865	3860	Yes	*	No	No
3866	3860	Yes	*	No	No
3869-1	3869	Yes	Yes	N/A	No
3869-2	3869	Yes	Yes	N/A	No
3869-3	3869	Yes	Yes	N/A	No
3869-4	3869	Yes	Yes	N/A	No
3870-1	3870	Yes	Yes	No	No
3872-1	3872	Yes	Yes	No	N/A

TABLE 7 (CONT.)

MAINTENANCE ISSUES FOR TANKS
UNDER RESPONSBILITY OF NAVAL AMPHIBIOUS BASE, LITTLE CREEK

Date: December 1995

Tank #	Bldg. #	Adequate Support Structure	Support Slab	Leaking Pipe Fittings	Leaking Tank Fittings
3892-1	3890	Yes	Yes	No	No
5000	**	**	**	**	**

* Vertical tank with foundation.
** Tank is to be installed within the next several months.

TABLE 8

MAINTENANCE ISSUES FOR TANKS UNDER RESPONSIBILITY OF NAVY PUBLIC WORKS CENTER, LITTLE CREEK SITE

Date: December 1995

Tank #	Bldg. #	Adequate Support Structure	Support Slab	Leaking Pipe Fittings	Leaking Tank Fittings
1501-1	1501	Yes	Yes	No	No
1518-1	1518	Yes	Yes	No	No
2115-1	2115	Yes	Yes	No	No
3081B-1	3081B	No-needs anchoring to slab	Yes	No	No
3400-1	3400	No-needs anchoring to slab	Yes	No	No
3661-1	3661	Yes	Yes	No	No
3661-3	3661	No-needs anchoring	Yes	N/A	No
3879-1	3879	Yes	Yes	No	No
NAB752-1	NAB752	Yes	Yes	No	No
NAB757-F	NAB757-F	Yes	Yes	No	No
NAB759	NAB757	Yes	*	No	No
NAB760	NAB757	Yes	*	No	No

* Vertical tank with foundation.

Key for Tank Evaluation Sheets

N/R = Not required; tank is not governed by the referenced regulation(s).

N/A = Not applicable; tank construction is such that item is not required.

N = Item is required; upgrade is necessary.

Y = Item is acceptable, although not necessarily required.

SECTION 5.5

Tank-by-Tank Evaluation Sheets for Tanks Under Responsibility of NAB Little Creek

Tank Evaluation Sheet

AST ID#: 1130-1
Product: Diesel
Capacity (gal): 500
Year Installed: Unkwn

Facility: CCWGRULANT
Usage: Veh/Equip Fuel
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: N/R
AST ID marked @ gauge: N/R
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Aboveground piping: N
Type: N/A
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **1130-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.
- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1996	Anchor tank to supports and supports to slab.	150		
	Total:	300		
	Grand Total:			**$300**

Tank Evaluation Sheet

AST ID#: 1130-2
Product: Waste Oil
Capacity (gal): 275
Year Installed: Unkwn

Facility: CCWGRULANT
Usage: WO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: N/R
AST ID marked @ gauge: N/R
High Level Alarm: N/A
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: N
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **1130-2**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
	Total:	150		
	Grand Total:			**$150**

Tank Evaluation Sheet

AST ID#: 1231-1
Product: Waste Oil
Capacity (gal): 500
Year Installed: Unkwn

Facility: ACU-2 Maintenance
Usage: WO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Type: N/R
Cathodic Protection Survey: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
Tank capacity clearly marked: N/R
AST ID marked @ gauge: Y
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: N
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Wrapped and Coated: N/A
Cathodic Protection: N/A
Type: N/A
Aboveground piping: Y
Painted: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: N
Lockable: N/A
Security fencing: Y
Security lighting: Y

AST ID#: **1231-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Adequate secondary containment.
- Manual dike drain valve with locking device.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1997	Construct concrete walls for secondary containment.			250/1000
1997	Install manual dike drain valve with lockable device.			0/100
	Total:			1350
	Grand Total:			**$1,350**

Tank Evaluation Sheet

AST ID#: 1262-1
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: AFDL6 Storage
Usage: Veh/Equip Fuel
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
AST ID marked @ gauge: N/R
High Level Alarm: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
(V)isual/(A)udible/(B)oth: N/A

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Aboveground piping: N
Piping through berms or under roads: N
Cathodic Protection: N/A
Hydrostatically tested: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Casing: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **1262-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.
- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1996	Anchor tank to frame and frame to support slab.	150		
1996	Clean containment area.	100		
	Total:	400		
	Grand Total:			**$400**

Tank Evaluation Sheet

AST ID#: 1262-2
Product: Gasoline
Capacity (gal): 275
Year Installed: Unkwn

Facility: AFDL6 Storage
Usage: Veh/Equip Fuel
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Type: N/R
Cathodic Protection Survey: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
Tank capacity clearly marked: N/R
AST ID marked @ gauge: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Wrapped and Coated: N/A
Cathodic Protection: N/A
Type: N/A
Aboveground piping: N
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **1262-2**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.
- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1996	Anchor tank to frame and frame to support slab.	150		
1996	Clean containment area.	100		
	Total:	400		
	Grand Total:			**$400**

Tank Evaluation Sheet

AST ID#: 1265-1A
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: SIMA Office/Shop
Usage: Test Cell
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Type: N/R
Cathodic Protection Survey: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: N/R
Tank capacity clearly marked: N/R
AST ID marked @ gauge: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Metal
Floor Construction: Metal

Piping:

Buried piping: N
Wrapped and Coated: N/A
Cathodic Protection: N/A
Type: N/A
Aboveground piping: Y
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: N
Security fencing: Y
Security lighting: Y

AST ID#: **1265-1A**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: In Compliance

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
	None			
	Total:			
	Grand Total:			**$0**

Tank Evaluation Sheet

AST ID#: 1515-1
Product: Unleaded Gas
Capacity (gal): 275
Year Installed: Unkwn

Facility: ACU Cold Storage
Usage: Veh/Equip Fuel
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: N/R
AST ID marked @ gauge: N/R
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: Y
(V)isual/(A)udible/(B)oth: A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: N
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: N
Lockable: N/A
Security fencing: Y
Security lighting: Y

AST ID#: **1515-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Manual dike drain valve with locking device.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint support structure.	100		
1996	Install manual dike drain valve with locking device.			0/75
	Total:	100		75
	Grand Total:			**$175**

Tank Evaluation Sheet

AST ID#: 1515-2
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: ACU Cold Storage
Usage: Veh/Equip Fuel
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Type: N/R
Cathodic Protection Survey: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: N/R
Tank capacity clearly marked: N/R
AST ID marked @ gauge: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: Y
(V)isual/(A)udible/(B)oth: A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Wrapped and Coated: N/A
Cathodic Protection: N/A
Type: N/A
Aboveground piping: N
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: N
Lockable: N
Security fencing: Y
Security lighting: Y

AST ID#: **1515-2**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Manual dike drain valve with locking device.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint support structure.	100		
1996	Install manual dike drain valve with locking device.			0/75
	Total:	100		75
	Grand Total:			**$175**

Tank Evaluation Sheet

AST ID#: 1618-P
Product: Waste Oil
Capacity (gal): 400
Year Installed: Unkwn

Facility: COMEODGRU-2 Office
Usage: WO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Type: N/R
Cathodic Protection Survey: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
Tank capacity clearly marked: N/R
AST ID marked @ gauge: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Wrapped and Coated: N/A
Cathodic Protection: N/A
Type: N/A
Aboveground piping: N
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **1618-P**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.
- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1996	Repair bent support leg.	100		
1996	Anchor tank frame to support slab.	100		
	Total:	350		
	Grand Total:			**$350**

Tank Evaluation Sheet

AST ID#: 3022-1
Product: Unleaded Gas
Capacity (gal): 275
Year Installed: Unkwn

Facility: Boat Storage
Usage: Equip. Fueling
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R — Type: N/R
Cathodic Protection Survey: N/R — Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: N/R — Tank capacity clearly marked: N/R
AST ID marked @ gauge: N/R — Tank capacity marked @ gauge: N/R
High Level Alarm: N/A — (V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N — Wrapped and Coated: N/A
Cathodic Protection: N/A — Type: N/A
Aboveground piping: N — Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A — Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y — Lockable: N
Security fencing: Y
Security lighting: Y

AST ID#: **3022-1**

Regulated by
VR 680-14-13: N
NFPA 30: N
40 CFR 112: **Y**

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.
- Locking device on dike drain valve.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1996	Install locking device on dike drain valve.			0/50
	Total:	150		50
	Grand Total:			**$200**

Tank Evaluation Sheet

AST ID#: 3022-2
Product: Unleaded Gas
Capacity (gal): 275
Year Installed: Unkwn

Facility: Boat Storage
Usage: Equip. Fueling
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R — Type: N/R
Cathodic Protection Survey: N/R — Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: N/R — Tank capacity clearly marked: N/R
AST ID marked @ gauge: N/R — Tank capacity marked @ gauge: N/R
High Level Alarm: N/A — (V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N — Wrapped and Coated: N/A
Cathodic Protection: N/A — Type: N/A
Aboveground piping: N — Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A — Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y — Lockable: N
Security fencing: Y
Security lighting: Y

AST ID#: **3022-2**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.
- Locking device on dike drain valve.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1996	Install locking device on dike drain valve.			0/50
	Total:	150		50
	Grand Total:			**$200**

Tank Evaluation Sheet

AST ID#: 3105A
Product: Diesel
Capacity (gal): 5000
Year Installed: 1942

Facility: Fuel Farm
Usage: Vehicle Fueling
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N
Cathodic Protection: N/A — Type: N/A
Cathodic Protection Survey: N/A — Date: N/A
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y — Tank capacity clearly marked: N
AST ID marked @ gauge: Y — Tank capacity marked @ gauge: N
High Level Alarm: N — (V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Earth
Floor Construction: Earth

Piping:

Buried piping: Y — Wrapped and Coated: Y
Cathodic Protection: N — Type: N/A
Aboveground piping: Y — Painted: Y
Piping through berms or under roads: N
Cathodic Protection: N/A — Casing: N/A
Hydrostatically tested: N

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y — Lockable: N
Security fencing: Y
Security lighting: N

AST ID#: **3105A**

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Initial external inspection.
- Tank markings.
- Cathodically protect underground piping.
- Pressure testing of piping.
- Secondary containment evaluation/certification.
- Install drain locking device.
- Install new drainage pipe with proper slope.
- Lighting of tank and surrounding area.
- High level alarm.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Evaluate and implement cathodic protection for buried piping.		250	0/1250
1996	Install drain locking device.	100		
1996	Install high level alarm (whistle vent).			50/200
1996	Install new drainage pipe with proper slope. (WR #50580 has been submitted to design this upgrade.)			275/1750
1996	Perform formal external inspection.		750	
1996	Pressure test piping (by govt. personnel).	0		
1997	Perform secondary containment evaluation.		375	
1998	Install diked area lighting.			300/2000
	Total:	200	1375	5825
	Grand Total:			**$7400**

Tank Evaluation Sheet

AST ID#: 3105B
Product: Diesel
Capacity (gal): 5000
Year Installed: 1942

Facility: Fuel Farm
Usage: Vehicle Fueling
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N
Cathodic Protection: N/A — Type: N/A
Cathodic Protection Survey: N/A — Date: N/A
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y — Tank capacity clearly marked: N
AST ID marked @ gauge: Y — Tank capacity marked @ gauge: N
High Level Alarm: N — (V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Earth
Floor Construction: Earth

Piping:

Buried piping: Y — Wrapped and Coated: Y
Cathodic Protection: N — Type: N/A
Aboveground piping: Y — Painted: Y
Piping through berms or under roads: N
Cathodic Protection: N/A — Casing: N/A
Hydrostatically tested: N

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y — Lockable: N
Security fencing: Y
Security lighting: N

AST ID#: **3105B**

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Initial external inspection.
- Tank markings.
- Cathodically protect underground piping.
- Pressure testing of piping.
- Secondary containment evaluation/certification.
- Install drain locking device.
- Install new drainage pipe with proper slope.
- Lighting of tank and surrounding area.
- High level alarm.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Install drain locking device.	100		
1996	Evaluate and implement cathodic protection for buried piping.		250	0/1250
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Install new drainage pipe with proper slope. (WR #50580 has been submitted to design this upgrade.)			275/1750
1996	Install high level alarm (whistle vent).			50/200
1996	Perform formal external inspection.		750	
1996	Pressure test piping (by govt. personnel).	0		
1997	Perform secondary containment evaluation.		375	
1998	Install diked area lighting.			300/2000
	Total:	200	1375	5825
	Grand Total:			**$7400**

Tank Evaluation Sheet

AST ID#: 3108-1
Product: Waste Oil
Capacity (gal): 275
Year Installed: Unkwn

Facility: Maintenance Shop
Usage: WO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Type: N/R
Cathodic Protection Survey: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
Tank capacity clearly marked: N/R
AST ID marked @ gauge: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Wrapped and Coated: N/A
Cathodic Protection: N/A
Type: N/A
Aboveground piping: Y
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: 3108-1

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: In Compliance

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
	None			
	Total:	—	—	—
	Grand Total:			**$0**

Tank Evaluation Sheet

AST ID#: 3144-3
Product: Waste Oil
Capacity (gal): 500
Year Installed: Unkwn

Facility: BMU-2 OPS Building
Usage: WO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: N/R
High Level Alarm: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
(V)isual/(A)udible/(B)oth: N/A

Secondary Containment:

Volume Adequate: N
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Hydrostatically tested: N/A

Wrapped and Coated: N/A
Type: N/A
Painted: N/A

Casing: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: 3144-3

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Inadequate tank painting.
- Inadequate secondary containment capacity.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1997	Upgrade secondary containment volume.			225/1500
	Total:	150		1725
	Grand Total:			**$1875**

Tank Evaluation Sheet

AST ID#: 3151-1
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: Housing Office
Usage: Heating Oil
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Type: N/R
Cathodic Protection Survey: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
Tank capacity clearly marked: N/R
AST ID marked @ gauge: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Wrapped and Coated: N/A
Cathodic Protection: N/A
Type: N/A
Aboveground piping: Y
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: N
Security lighting: N

AST ID#: **3151-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Anchorage of tank.
- Impervious containment area.
- Security fencing.
- Security lighting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Anchor tank supports to slab.	100		
1996	Check containment area for leakage, seal cracks if found.	150		
1997	Install security fencing.			0/750
1997	Install diked area lighting.			225/1500
	Total:	250		2475
	Grand Total:			**$2725**

Tank Evaluation Sheet

AST ID#: 3151-2
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: Housing Office
Usage: Heating Oil
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Type: N/R
Cathodic Protection Survey: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
Tank capacity clearly marked: N/R
AST ID marked @ gauge: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: N
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: Y
Wrapped and Coated: N/A
Cathodic Protection: N/A
Type: N/A
Aboveground piping: Y
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: N
Security lighting: Y

AST ID#: 3151-2

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.
- Anchorage of tank.
- Adequate containment volume.
- Security fencing.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint bottom of tank.	25		
1996	Weld support legs to tank and anchor to slab.	150		
1997	Construct additional containment curbing/walls.			150/750
1997	Install security fencing.			0/750
	Total:	175		1650
	Grand Total:			**$1825**

Tank Evaluation Sheet

AST ID#: 3165-3
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: Office/Shops
Usage: Emergency Gen.
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: N
Berm Construction: CMU
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **3165-3**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Anchorage of tank.
- Adequate containment volume.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Anchor tank supports to slab.	100		
1997	Construct additional containment curbing/walls.			150/750
	Total:	100		900
	Grand Total:			**$1000**

Tank Evaluation Sheet

AST ID#: 3373-1
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: Security Pass Office
Usage: Heating Oil
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: Y
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: Y
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: N
Security lighting: Y

AST ID#: **3373-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.
- Security fencing.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1997	Install security fencing.			0/750
	Total:	150		750
	Grand Total:			**$900**

Tank Evaluation Sheet

AST ID#: 3511-2
Product: Diesel
Capacity (gal): 1500
Year Installed: Unkwn

Facility: LFTC Veh. Maint.
Usage: Boiler
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N
Cathodic Protection: N/A
Type: N/A
Cathodic Protection Survey: N/A
Date: N/A
Automatic Shutdown System: N/A
Gauge: N
AST ID clearly marked: Y
Tank capacity clearly marked: N
AST ID marked @ gauge: N/A
Tank capacity marked @ gauge: N
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: Y
Wrapped and Coated: N/A
Cathodic Protection: N/A
Type: Copper
Aboveground piping: Y
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: 3511-2

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Initial external inspection.
- Level gauge.
- Tank markings.
- Secondary containment evaluation.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Install level gauge.			225/1500
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Perform formal external inspection.		500	
1997	Perform secondary containment evaluation.		450	
	Total:	100	950	1725
	Grand Total:			**$2775**

Tank Evaluation Sheet

AST ID#: 3530-1
Product: Waste Oil
Capacity (gal): 500
Year Installed: Unkwn

Facility: MWR Hobby Shop
Usage: WO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
High Level Alarm: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
(V)isual/(A)udible/(B)oth: N/A

Secondary Containment:

Volume Adequate: N
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Hydrostatically tested: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Casing: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **3530-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Adequate containment volume.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Clean tank, containment area, and building wall.	100		
1997	Construct additional containment curbing/walls.			250/1000
	Total:	100		1250
	Grand Total:			**$1350**

Tank Evaluation Sheet

AST ID#: 3615-1
Product: Waste Oil
Capacity (gal): 275
Year Installed: Unkwn

Facility: NAVRESALEACT Service
Usage: WO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
AST ID marked @ gauge: N/R
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **3615-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.
- Aboveground pipe painting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and piping.	200		
	Total:	200		
	Grand Total:			**$200**

Tank Evaluation Sheet

AST ID#: 3699-1
Product: Gasoline
Capacity (gal): 500
Year Installed: Unkwn

Facility: Golf Course
Usage: Veh/Equip Fuel
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: N
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: N
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: **3699-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Vent height for gasoline tank in public access way.
- Operable level gauge.
- Adequate containment volume.
- Security lighting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Repair level gauge.	150		
1996	Extend vent to 12' off of ground (tank located in public access area).	250		
1997	Construct additional containment curbing/walls.			250/650
1997	Install lighting for tank and diked area.			225/1500
	Total:	400		2625
	Grand Total:			**$3025**

Tank Evaluation Sheet

AST ID#: 3699-2
Product: Gasoline
Capacity (gal): 500
Year Installed: Unkwn

Facility: Golf Course
Usage: Veh/Equip Fuel
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: N
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: N
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: **3699-2**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Adequate containment volume.
- Security lighting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1997	Construct additional containment curbing/walls.			250/1000
1997	Install lighting for tank and diked area.			225/1500
	Total:	—	——	2975
	Grand Total:			**$ 2975**

Tank Evaluation Sheet

AST ID#: 3821-3
Product: Oily Waste
Capacity (gal): 2000
Year Installed: Unkwn

Facility: ACU-4
Usage: OW Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N
Cathodic Protection: N/A
Cathodic Protection Survey: N/A
Type: N/A
Date: N/A
Automatic Shutdown System: N/A
Gauge: N
AST ID clearly marked: Y
AST ID marked @ gauge: N
High Level Alarm: N
Sec. Containment Certification: N
Monitoring wells present: N
Previous tank upgrades: None
Tank capacity clearly marked: N
Tank capacity marked @ gauge: N
(V)isual/(A)udible/(B)oth: N/A

Secondary Containment:

Volume Adequate: N
Berm Construction: None
Floor Construction: Concrete

Piping:

Buried piping: N
Cathodic Protection: N/A
Aboveground piping: N
Piping through berms or under roads: N
Cathodic Protection: N/A
Hydrostatically tested: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Casing: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/A
Tank separation distance adequate: N/A
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: N/A
Lockable: N/A
Security fencing: Y
Security lighting: Y

AST ID#: 3821-3

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Initial external inspection.
- Level gauge.
- Tank markings.
- Secondary containment.
- Secondary containment certification.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Install level gauge.			225/1500
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Perform formal external inspection.		500	
1997	*Install secondary containment.			750/5000
1997	Certify containment area.		450	
	Total:	100	950	7475
	Grand Total:			**$8525**

* Note: Recommend constructing a concrete slab and walls for containment of this permanent tank with an adjacent curbed area for storage of the portable tanks utilized at this facility.

Tank Evaluation Sheet

AST ID#: 3823-2
Product: Diesel
Capacity (gal): 2000
Year Installed: 1994

Facility: ACU-4 Fire Pumphouse
Usage: Emergency Gen.
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N
Cathodic Protection: N/A
Cathodic Protection Survey: N/A
Type: N/A
Date: N/A
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N
Tank capacity marked @ gauge: Y
High Level Alarm: Y
(V)isual/(A)udible/(B)oth: B
Sec. Containment Certification: N/A
Monitoring wells present: Y
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: N/A
Floor Construction: N/A

Piping:

Buried piping: Y
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: Fiberglass
Aboveground piping: Y
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/A
Tank separation distance adequate: N/A
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: N/A
Lockable: N/A
Security fencing: Y
Security lighting: Y

AST ID#: **3823-2**

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Initial external inspection.
- Tank markings.

Note: Tank has interstitial containment.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint markings on tank (capacity at a prominent location).	100		
1996	Perform formal external inspection.		500	
	Total:	100	500	
	Grand Total:			**$600**

Tank Evaluation Sheet

AST ID#: 3825
Product: JP-5
Capacity (gal): 75000
Year Installed: 1986

Facility: Fuel Farm
Usage: Bulk Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: V
Formal Internal Inspection: N
Formal External Inspection: N
Cathodic Protection: Y
Cathodic Protection Survey: N/A
Type: Sac. Anode
Date: N/A
Automatic Shutdown System: N
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N
Tank capacity marked @ gauge: N
High Level Alarm: N
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N
Monitoring wells present: Y
Previous tank upgrades: Int Coating

Secondary Containment:

Volume Adequate: Y
Berm Construction: Earth
Floor Construction: Earth

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: Y
Painted: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: 3825

Regulated by

VR 680-14-13:	Y
NFPA 30:	Y
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Initial internal inspection.
- Initial external inspection.
- Tank markings.
- Pressure testing of piping.
- Secondary containment evaluation/certification.
- Lighting of tank and surrounding area.
- Impervious containment area.
- Automatic shutdown system (high-high level switch).
- High level alarm.
- Aboveground pipe painting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Pressure test piping (by govt. personnel).	0		
1996	Perform formal API 653 (with floor MFE) internal and external inspection.		15000	
1997	Perform secondary containment evaluation.		750	
1997	Install high level alarm.			675/4500
1997	Install high-high level switch.			1875/12500
1998	Install diked area lighting.			900/6000
1998	Install containment area liner.			3375/22500
2000	*Re-paint piping (sandblast and paint).			1875/12500
	Total:	100	15750	66700
	Grand Total:			**$82550**

* Does not include lead or asbestos abatement costs.

Tank Evaluation Sheet

AST ID#: 3845
Product: Empty
Capacity (gal): 250000
Year Installed: 1993

Facility: Fuel Farm
Usage: Bulk Storage
Status: OOS

AST Information

(H)orizontal or (V)ertical: V
Formal Internal Inspection: N
Formal External Inspection: N
Cathodic Protection: Y
Cathodic Protection Survey: N/A
Type: Sac. Anode
Date: N/A
Automatic Shutdown System: N
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N
Tank capacity marked @ gauge: N
(V)isual/(A)udible/(B)oth: N/A
High Level Alarm: N
Sec. Containment Certification: N
Monitoring wells present: Y
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Clay-imp
Floor Construction: Clay-imp

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: Y
Painted: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N
Secondary containment has manual drainage valve: Y
Lockable: N
Security fencing: Y
Security lighting: N

AST ID#: 3845

Regulated by

VR 680-14-13:	Y
NFPA 30:	Y
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Initial internal inspection.
- Initial external inspection.
- Tank markings.
- Pressure testing of piping.
- Secondary containment evaluation/certification.
- Drain locking device.
- Lighting of tank and surrounding area.
- High level alarm.
- Automatic shutdown system (high-high level switch).

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Install drain locking device.	100		
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Pressure test piping (by govt. personnel).	0		
1996	Perform formal API 653 (with floor MFE) internal and external inspection (does not include cleaning).		17500	
1997	Perform secondary containment evaluation.		750	
1997	Install automatic shutdown system (high-high level switch).			1875/12500
1997	Install high level alarm.			825/5500
1998	Install diked area lighting.			900/6000
	Total:	200	18250	27600
	Grand Total:			**$46050**

Tank Evaluation Sheet

AST ID#: 3846
Product: Empty
Capacity (gal): 250000
Year Installed: 1993

Facility: Fuel Farm
Usage: Bulk Storage
Status: OOS

AST Information

(H)orizontal or (V)ertical: V
Formal Internal Inspection: N
Formal External Inspection: N
Cathodic Protection: Y
Cathodic Protection Survey: N/A
Type: Sac. Anode
Date: N/A
Automatic Shutdown System: N
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
High Level Alarm: N
Sec. Containment Certification: N
Monitoring wells present: Y
Previous tank upgrades: None

Tank capacity clearly marked: N
Tank capacity marked @ gauge: N
(V)isual/(A)udible/(B)oth: N/A

Secondary Containment:

Volume Adequate: Y
Berm Construction: Clay-imp
Floor Construction: Clay-imp

Piping:

Buried piping: N
Cathodic Protection: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Hydrostatically tested: N

Wrapped and Coated: N/A
Type: N/A
Painted: Y

Casing: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N
Secondary containment has manual drainage valve: Y
Lockable: N
Security fencing: Y
Security lighting: N

AST ID#: **3846**

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Initial internal inspection.
- Initial external inspection.
- Tank markings.
- Pressure testing of piping.
- Secondary containment evaluation/certification.
- Drain locking device.
- Lighting of tank and surrounding area.
- Automatic shutdown system.
- High level alarm.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Install drain locking device.	100		
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Pressure test piping (by govt. personnel).	0		
1996	Perform formal API 653 (with floor MFE) internal and external inspection (does not include cleaning).		17500	
1997	Perform secondary containment evaluation.		750	
1997	Install automatic shutdown system (high-high level switch).			1875/12500
1997	Install high level alarm.			825/5500
1998	Install diked area lighting.			900/6000
	Total:	200	18250	27600
	Grand Total:			**$46050**

Tank Evaluation Sheet

AST ID#: 3862
Product: Empty
Capacity (gal): 30000
Year Installed: 1942

Facility: Fuel Farm
Usage: Bulk Storage
Status: OOS

AST Information

(H)orizontal or (V)ertical: V
Formal Internal Inspection: Y
Formal External Inspection: Y
Cathodic Protection: Y
Cathodic Protection Survey: N/A
Type: Sac. Anode
Date: N/A
Automatic Shutdown System: Y
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N
Tank capacity marked @ gauge: N
High Level Alarm: Y
(V)isual/(A)udible/(B)oth: B
Sec. Containment Certification: N
Monitoring wells present: Y
Previous tank upgrades: Int Coating

Secondary Containment:

Volume Adequate: Y
Berm Construction: Earth
Floor Construction: Earth

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: Y
Painted: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: Y
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: 3862

Regulated by

VR 680-14-13:	Y
NFPA 30:	Y
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Tank markings.
- Pressure testing of piping.
- Secondary containment evaluation/certification.
- Lighting of tank and surrounding area.
- Impervious containment area.
- Adequate tank painting.
- Aboveground pipe painting.
- Inoperable high-high level switch.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Calibrate gauge and high level alarm (by govt. personnel).	0		
1996	Pressure test piping (by govt. personnel).	0		
1997	Repair high-high level switch.	2500		
1997	Perform secondary containment evaluation.		750	
1998	Install diked area lighting.			900/6000
1998	Install containment area liner.			3375/22500
1999	*Paint tank.			9750/65000
2000	*Paint piping.			1875/12500
	Total:	2600	750	121900
	Grand Total:			**$125250**

* Does not include lead or asbestos abatement costs.

Tank Evaluation Sheet

AST ID#: 3863
Product: F-76 Diesel
Capacity (gal): 50000
Year Installed: 1953

Facility: Fuel Farm
Usage: Bulk Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: V
Formal Internal Inspection: N
Formal External Inspection: N
Cathodic Protection: Y
Cathodic Protection Survey: N/A
Type: Sac. Anode
Date: N/A
Automatic Shutdown System: Y
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N
Tank capacity marked @ gauge: N
High Level Alarm: Y
(V)isual/(A)udible/(B)oth: B
Sec. Containment Certification: N
Monitoring wells present: Y
Previous tank upgrades: Int Coating

Secondary Containment:

Volume Adequate: Y
Berm Construction: Earth
Floor Construction: Earth

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: Y
Painted: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: Y
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: 3863

Regulated by
VR 680-14-13: **Y**
NFPA 30: **Y**
40 CFR 112: **Y**

Compliance Status: Out of Compliance

Deficiencies:

- Initial internal inspection.
- Initial external inspection.
- Tank markings.
- Pressure testing of piping.
- Secondary containment evaluation/certification.
- Lighting of tank and surrounding area.
- Impervious containment area.
- Tank painting.
- Aboveground pipe painting.
- Inoperable high-high level switch.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Calibrate gauge and high level alarm (by govt. personnel).	0		
1996	Perform formal API 653 (with floor MFE) internal and external inspection (does not include cleaning).		15000	
1996	Pressure test piping (by govt. personnel).	0		
1997	Repair high-high level switch.	2500		
1997	Perform secondary containment evaluation.		750	
1998	Install diked area lighting.			900/6000
1998	Install containment area liner.			3750/25000
1999	*Paint tank.			9750/65000
2000	*Paint piping.			1875/12500
	Total:	2600	15750	124775
	Grand Total:			**$143125**

* Does not include lead or asbestos abatement costs.

Tank Evaluation Sheet

AST ID#: 3864
Product: F-76 Diesel
Capacity (gal): 50000
Year Installed: 1953

Facility: Fuel Farm
Usage: Bulk Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: V
Formal Internal Inspection: N
Formal External Inspection: N
Cathodic Protection: Y
Cathodic Protection Survey: N/A
Type: Sac Anode
Date: N/A
Automatic Shutdown System: Y
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
High Level Alarm: Y
Sec. Containment Certification: N
Monitoring wells present: Y
Previous tank upgrades: Int Coating
Tank capacity clearly marked: N
Tank capacity marked @ gauge: N
(V)isual/(A)udible/(B)oth: B

Secondary Containment:

Volume Adequate: Y
Berm Construction: Earth
Floor Construction: Earth

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: Y
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: Y
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: 3864

Regulated by
VR 680-14-13: **Y**
NFPA 30: **Y**
40 CFR 112: **Y**

Compliance Status: Out of Compliance

Deficiencies:

- Initial internal inspection.
- Initial external inspection.
- Tank markings.
- Pressure testing of piping.
- Secondary containment evaluation/certification.
- Lighting of tank and surrounding area.
- Impervious containment area.
- Tank painting.
- Aboveground pipe painting.
- Inoperable high-high level switch.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Calibrate gauge and high level alarm (by govt. personnel).	0		
1996	Perform formal API 653 (with floor MFE) internal and external inspection (does not include cleaning).		15000	
1996	Pressure test piping (by govt. personnel).	0		
1997	Repair high-high level switch.	2500		
1997	Perform secondary containment evaluation.		750	
1998	Install diked area lighting.			900/6000
1998	Install containment area liner.			3375/22500
1999	*Paint tank.			9750/65000
2000	*Paint piping.			1875/12500
	Total:	2600	15750	121900
	Grand Total:			**$140250**

* Does not include lead or asbestos abatement costs.

Tank Evaluation Sheet

AST ID#: 3865
Product: Empty
Capacity (gal): 60000
Year Installed: 1953

Facility: Fuel Farm
Usage: Bulk Storage
Status: OOS

AST Information

(H)orizontal or (V)ertical: V
Formal Internal Inspection: Y
Formal External Inspection: Y
Cathodic Protection: Y
Cathodic Protection Survey: N/A
Type: Sac Anode
Date: N/A
Automatic Shutdown System: Y
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N
Tank capacity marked @ gauge: N
(V)isual/(A)udible/(B)oth: N/A
High Level Alarm: N
Sec. Containment Certification: N
Monitoring wells present: Y
Previous tank upgrades: Float Roof

Secondary Containment:

Volume Adequate: Y
Berm Construction: Earth
Floor Construction: Earth

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: Y
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: Y
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: 3865

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Tank markings.
- Pressure testing of piping.
- Secondary containment evaluation/certification.
- Lighting of tank and surrounding area.
- Impervious containment area.
- High level alarm.
- Inoperable high-high level switch.
- Adequate tank painting.
- Adequate pipe painting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Calibrate gauge (by govt. personnel).	0		
1996	Pressure test piping (by govt. personnel).	0		
1997	Repair high-high level switch.	2500		
1997	Perform secondary containment evaluation.		750	
1997	Install high level alarm.			675/4500
1998	Install diked area lighting.			900/6000
1998	Install containment area liner.			3750/25000
1999	*Paint tank.			9750/65000
2000	*Paint piping.			1875/12500
	Total:	2600	750	129950
	Grand Total:			**$133300**

* Does not include lead or asbestos abatement costs.

Tank Evaluation Sheet

AST ID#: 3866
Product: Unleaded Gas
Capacity (gal): 30000
Year Installed: 1953

Facility: Fuel Farm
Usage: Bulk Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: V
Formal Internal Inspection: Y
Formal External Inspection: Y
Cathodic Protection: Y
Cathodic Protection Survey: N/A
Type: Sac. Anode
Date: N/A
Automatic Shutdown System: Y
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
High Level Alarm: Y
Sec. Containment Certification: N
Monitoring wells present: Y
Previous tank upgrades: Int Coating

Tank capacity clearly marked: N
Tank capacity marked @ gauge: N
(V)isual/(A)udible/(B)oth: B

Secondary Containment:

Volume Adequate: Y
Berm Construction: Earth
Floor Construction: Earth

Piping:

Buried piping: N
Cathodic Protection: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Hydrostatically tested: N

Wrapped and Coated: N/A
Type: N/A
Painted: Y

Casing: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: Y
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: 3866

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Tank markings.
- Pressure testing of piping.
- Secondary containment evaluation/certification.
- Lighting of tank and surrounding area.
- Impervious containment area.
- Inoperable high-high level switch.
- Adequate tank painting.
- Adequate pipe painting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Calibrate gauge and high level alarm (by govt. personnel).	0		
1996	Pressure test piping (by govt. personnel).	0		
1997	Repair high-high level switch.	2500		
1997	Perform secondary containment evaluation.		750	
1998	Install diked area lighting.			900/6000
1998	Install containment area liner.			3375/22500
1999	*Paint tank.			9750/65000
2000	*Paint piping.			1875/12500
	Total:	2600	750	121900
	Grand Total:			**$125250**

Tank Evaluation Sheet

AST ID#: 3869-1
Product: Waste Oil
Capacity (gal): 550
Year Installed: Unkwn

Facility: ACU2 OPS Building
Usage: WO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: N/R
AST ID marked @ gauge: N/R
High Level Alarm: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
(V)isual/(A)udible/(B)oth: N/A

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Aboveground piping: N
Piping through berms or under roads: N
Cathodic Protection: N/A
Hydrostatically tested: N/A

Wrapped and Coated: N/A
Type: N/A
Painted: N/A

Casing: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **3869-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Anchor support frame to slab.	100		
	Total:	100		
	Grand Total:			**$100**

Tank Evaluation Sheet

AST ID#: 3869-2
Product: Lube Oil
Capacity (gal): 275
Year Installed: Unkwn

Facility: ACU2 OPS Building
Usage: LO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: N/R
AST ID marked @ gauge: N/R
High Level Alarm: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
(V)isual/(A)udible/(B)oth: N/A

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Aboveground piping: N
Piping through berms or under roads: N
Cathodic Protection: N/A
Hydrostatically tested: N/A

Wrapped and Coated: N/A
Type: N/A
Painted: N/A

Casing: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **3869-2**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Anchor support frame to slab.	100		
	Total:	100		
	Grand Total:			**$100**

Tank Evaluation Sheet

AST ID#: 3869-3
Product: Lube Oil
Capacity (gal): 275
Year Installed: Unkwn

Facility: ACU2 OPS Building
Usage: LO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: N/R
AST ID marked @ gauge: N/R
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Aboveground piping: N
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: 3869-3

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Anchor support frame to slab.	100		
	Total:	100		
	Grand Total:			**$100**

Tank Evaluation Sheet

AST ID#: 3869-4
Product: Lube Oil
Capacity (gal): 275
Year Installed: Unkwn

Facility: ACU2 OPS Building
Usage: LO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R — Type: N/R
Cathodic Protection Survey: N/R — Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: N/R — Tank capacity clearly marked: N/R
AST ID marked @ gauge: N/R — Tank capacity marked @ gauge: N/R
High Level Alarm: N/A — (V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N — Wrapped and Coated: N/A
Cathodic Protection: N/A — Type: N/A
Aboveground piping: N — Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A — Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y — Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **3869-4**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Anchor support frame to slab.	100		
	Total:	100		
	Grand Total:			**$100**

Tank Evaluation Sheet

AST ID#: 3870-1
Product: Diesel Fuel
Capacity (gal): 2500
Year Installed: Unkwn

Facility: COL Office
Usage: Maint. Training
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N
Cathodic Protection: N/A
Type: N/A
Cathodic Protection Survey: N/A
Date: N/A
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
Tank capacity clearly marked: N
AST ID marked @ gauge: Y
Tank capacity marked @ gauge: N
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: N
Berm Construction: Concrete
Floor Construction: Concrete

Piping:

Buried piping: N
Wrapped and Coated: N/A
Cathodic Protection: N/A
Type: N/A
Aboveground piping: Y
Painted: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: **3870-1**

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Initial external inspection.
- Tank markings.
- Lighting of tank and surrounding area.
- Adequate secondary containment capacity.
- Secondary containment evaluation.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Paint markings on tank (capacity at a prominent location and at gauge).	100		
1996	Perform formal external inspection.		500	
1997	Upgrade secondary containment capacity.			300/2000
1997	Perform secondary containment evaluation.		450	
1997	Install diked area lighting.			225/1500
	Total:	100	950	4025
	Grand Total:			**$5075**

Tank Evaluation Sheet

AST ID#: 3872-1
Product: Diesel
Capacity (gal): 500
Year Installed: Unkwn

Facility: COL Applied Inst.
Usage: Maint. Training
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: N
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: Y
Painted: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: 3872-1

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Adequate secondary containment volume.
- Security lighting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1997	Upgrade secondary containment volume.			150/1000
1997	Install dike area lighting.			225/1500
	Total:	—	——	2875
	Grand Total:			**$2875**

Tank Evaluation Sheet

AST ID#: 3892-1
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: FLETRAULANT
Usage: Emerg Generator
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
AST ID marked @ gauge: N/R
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: **3892-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Security lighting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1997	Install dike area lighting.			225/1500
	Total:	—	—	1725
	Grand Total:			**$1725**

Tank Evaluation Sheet

AST ID#: 5000
Product: Diesel
Capacity (gal): 500
Year Installed: 1995

Facility:
Usage: Emerg Generator
Status:

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
AST ID marked @ gauge: Y
High Level Alarm: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
(V)isual/(A)udible/(B)oth: N/A

Secondary Containment:

Volume Adequate: N/A
Berm Construction: N/A
Floor Construction: N/A

Piping:

Buried piping: N
Cathodic Protection: N/A
Aboveground piping: N
Piping through berms or under roads: N
Cathodic Protection: N/A
Hydrostatically tested: N/A

Wrapped and Coated: N/A
Type: N/A
Painted: N/A

Casing: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: N/A
Lockable: N/A
Security fencing: N/A
Security lighting: N/A

AST ID#: **5000**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Not Available

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
** Tank will be installed in near future. **				
	Total:			
	Grand Total:			**$0**

SECTION 5.6

Tank-by-Tank Evaluation Sheets for Tanks Under Responsibility of PWC

Tank Evaluation Sheet

AST ID#: 1501-1
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: Sewage Lift Station
Usage: Emerg Generator
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: Y
Tank capacity marked @ gauge: Y
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: 1501-1

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: In Compliance

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
	None			
	Total:	—	—	—
	Grand Total:			**$0**

Tank Evaluation Sheet

AST ID#: 1518-1
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: Sewage Lift Station
Usage: Emerg Generator
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: Y
Tank capacity marked @ gauge: Y
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: N
Security fencing: Y
Security lighting: Y

AST ID#: **1518-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Dike drain locking device.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Install dike drain locking device.			0/50
	Total:	—	——	50
	Grand Total:			**$50**

Tank Evaluation Sheet

AST ID#: 2115-1
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: Sewage Lift Station
Usage: Emerg Generator
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: Y
Tank capacity marked @ gauge: Y
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: N
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: N
Security fencing: Y
Security lighting: Y

AST ID#: **2115-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Dike drain locking device.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Install dike drain locking device.			0/50
	Total:			50
	Grand Total:			**$50**

Tank Evaluation Sheet

AST ID#: 3081B-1
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: Freshwater Reservoir
Usage: Emerg Generator
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
AST ID marked @ gauge: N/R
Tank capacity clearly marked: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Aboveground piping: Y
Type: N/A
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **3081B-1**

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Inadequate tank painting.
- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1996	Anchor tank to slab.	100		
	Total:	250		
	Grand Total:			**$250**

Tank Evaluation Sheet

AST ID#: 3400-1
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: Sewage Lift Station
Usage: Emerg Generator
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: Y
Tank capacity marked @ gauge: Y
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: 3400-1

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Inadequate tank painting.
- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1996	Anchor tank to slab.	100		
	Total:	250		
	Grand Total:			**$250**

Tank Evaluation Sheet

AST ID#: 3661-1
Product: Waste Oil
Capacity (gal): 275
Year Installed: Unkwn

Facility: Garage-Heavy Equip.
Usage: WO Storage
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
Tank capacity clearly marked: Y
AST ID marked @ gauge: N/R
Tank capacity marked @ gauge: N/R
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Aboveground piping: N
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: 3661-1

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Tank painting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank.	150		
	Total:	150		
	Grand Total:			**$150**

Tank Evaluation Sheet

AST ID#: 3661-3
Product: Gasoline
Capacity (gal): 275
Year Installed: Unkwn

Facility: Garage-Heavy Equip.
Usage: Equip. Fueling
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
AST ID marked @ gauge: N/R
Tank capacity clearly marked: Y
Tank capacity marked @ gauge: N/R
High Level Alarm: Y
(V)isual/(A)udible/(B)oth: A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: CMU
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Aboveground piping: N
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: 3661-3

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Anchorage of tank.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Anchor support legs to slab.	100		
	Total:	100		
	Grand Total:			**$100**

Tank Evaluation Sheet

AST ID#: 3879-1
Product: Diesel
Capacity (gal): 275
Year Installed: Unkwn

Facility: Sewage Lift Station
Usage: Emerg Generator
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: N/A
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: Y
Tank capacity marked @ gauge: Y
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: 3879-1

Regulated by

VR 680-14-13:	N
NFPA 30:	N
40 CFR 112:	Y

Compliance Status: Out of Compliance

Deficiencies:

- Inadequate tank painting.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
	Total:	150		
	Grand Total:			**$150**

Tank Evaluation Sheet

AST ID#: 752-1
Product: Diesel
Capacity (gal): 1000
Year Installed: Unkwn

Facility: Pump House
Usage: Emergency Gen.
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N
Cathodic Protection: N/A
Cathodic Protection Survey: N/A
Type: N/A
Date: N/A
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: Y
Tank capacity marked @ gauge: Y
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: N
Berm Construction: Concrete
Floor Construction: Concrete

Piping:

Buried piping: Y
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: Copper
Painted: N/A
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: N/A
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: Y

AST ID#: **NAB 752-1**

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Initial external inspection.
- Secondary containment evaluation.
- Inadequate secondary containment capacity.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Perform formal external inspection.		500	
1997	Perform secondary containment evaluation.		450	
1997	Upgrade secondary containment volume.			300/2000
	Total:	—	950	2300
	Grand Total:			**$3250**

Tank Evaluation Sheet

AST ID#: NAB757F
Product: Fuel Oil
Capacity (gal): 500
Year Installed: Unkwn

Facility: Coal Car Thaw House
Usage: Equip Power Gen
Status: Active

AST Information

(H)orizontal or (V)ertical: H
Formal Internal Inspection: N/A
Formal External Inspection: N/A
Cathodic Protection: N/R
Cathodic Protection Survey: N/R
Type: N/R
Date: N/R
Automatic Shutdown System: N/A
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: Y
Tank capacity marked @ gauge: Y
High Level Alarm: N/A
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N/R
Monitoring wells present: N/A
Previous tank upgrades: None

Secondary Containment:

Volume Adequate: Y
Berm Construction: Conc
Floor Construction: Conc

Piping:

Buried piping: N
Cathodic Protection: N/A
Wrapped and Coated: N/A
Type: N/A
Painted: Y
Aboveground piping: Y
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N/A

NFPA 30 Requirements:

Dike valve accessible from outside dike: N/R
Tank separation distance adequate: N/R
Tank normal venting adequate: N/R

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N/A
Secondary containment has manual drainage valve: Y
Lockable: N
Security fencing: Y
Security lighting: Y

AST ID#: **NAB 757-F**

Regulated by

VR 680-14-13:	**N**
NFPA 30:	**N**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Adequate tank painting.
- Dike drain locking device.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Re-paint tank and apply markings.	150		
1996	Install dike drain locking device.			0/50
	Total:	150		50
	Grand Total:			**$200**

Tank Evaluation Sheet

AST ID#: NAB 759
Product: Empty
Capacity (gal): 500000
Year Installed: 1956

Facility: Steam Plant
Usage: Boilers
Status: OOS

AST Information

(H)orizontal or (V)ertical: V
Formal Internal Inspection: Y
Formal External Inspection: Y
Cathodic Protection: Y
Cathodic Protection Survey: N/A
Type: Imp. Curr.
Date: N/A
Automatic Shutdown System: N
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: Y
Tank capacity marked @ gauge: Y
High Level Alarm: N
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N
Monitoring wells present: Y
Previous tank upgrades: Unkwn

Secondary Containment:

Volume Adequate: Y
Berm Construction: Clay
Floor Construction: Clay

Piping:

Buried piping: Y
Cathodic Protection: N/A
Wrapped and Coated: Y
Type: N/A
Aboveground piping: Y
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: **NAB 759**

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Pressure test piping.
- Secondary containment evaluation/certification.
- Inoperable cathodic protection system.
- Lighting of tank and surrounding area.
- High level alarm.
- Automatic shutdown system (high-high level switch).

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Pressure test piping (by govt. personnel).	0		
1997	Repair impressed current cathodic protection system (does not work).	1500		
1997	Perform secondary containment evaluation.		1000	
1997	Install high level alarm.			675/4500
1997	Install high-high level switch.			1875/12500
1998	Install diked area lighting.			1875/12500
	Total:	1500	1000	33925
	Grand Total:			**$36425**

Tank Evaluation Sheet

AST ID#: NAB 760
Product: Empty
Capacity (gal): 500000
Year Installed: 1956

Facility: Steam Plant
Usage: Boilers
Status: OOS

AST Information

(H)orizontal or (V)ertical: V
Formal Internal Inspection: Y
Formal External Inspection: Y
Cathodic Protection: Y
Cathodic Protection Survey: N/A
Type: Imp. Curr.
Date: N/A
Automatic Shutdown System: N
Gauge: Y
AST ID clearly marked: Y
AST ID marked @ gauge: Y
Tank capacity clearly marked: Y
Tank capacity marked @ gauge: Y
High Level Alarm: N
(V)isual/(A)udible/(B)oth: N/A
Sec. Containment Certification: N
Monitoring wells present: Y
Previous tank upgrades: Unkwn

Secondary Containment:

Volume Adequate: Y
Berm Construction: Clay
Floor Construction: Clay

Piping:

Buried piping: Y
Cathodic Protection: N/A
Wrapped and Coated: Y
Type: N/A
Aboveground piping: Y
Painted: N/A
Piping through berms or under roads: N
Cathodic Protection: N/A
Casing: N/A
Hydrostatically tested: N

NFPA 30 Requirements:

Dike valve accessible from outside dike: Y
Tank separation distance adequate: Y
Tank normal venting adequate: Y

40 CFR 112 Requirements:

Pipe supports allow movement w/o abrasion: Y
Tank has high-high level switch: N
Secondary containment has manual drainage valve: Y
Lockable: Y
Security fencing: Y
Security lighting: N

AST ID#: **NAB 760**

Regulated by

VR 680-14-13:	**Y**
NFPA 30:	**Y**
40 CFR 112:	**Y**

Compliance Status: Out of Compliance

Deficiencies:

- Secondary containment evaluation/certification.
- Pressure test piping.
- Inoperable cathodic protection system.
- Lighting of tank and surrounding area.
- Automatic shutdown system (high-high level switch).
- High level alarm.

Upgrade Recommendations:

FY	Action	O & M	Study	Design/Construction
1996	Pressure test piping (by govt. personnel).	0		
1997	Repair impressed current cathodic protection system (does not work).	1500		
1997	Perform secondary containment evaluation.		1000	
1997	Install high level alarm.			675/4500
1997	Install high-high level switch.			1875/12500
1998	Install diked area lighting.			1875/12500
	Total:	1500	1000	33925
	Grand Total:			**$36425**

SECTION 6.0

COMPLIANCE SCHEDULE

6.1 BASIS OF WORK SCHEDULE

6.1.1 Annual Basis

The annual work schedules are based on a government fiscal year calendar. For example, the year 1996 shown on the schedules is defined as the period from October 1, 1995 to September 30, 1996.

6.1.2 Compliance Dates

Prioritization of required upgrades in the annual work schedules takes into account the necessity of the upgrade to avoid potential environmental problems (adequate secondary containment, etc.) as well as the items with specified compliance dates. Upgrades which are critical and require engineering design are scheduled for the second year (FY-97) to allow for production of the contract documents. As discussed previously in section 2.1.1, the effective date for VR 680-14-13 with respect to military installations has not been revised but will most likely occur during the summer of 1996. Once the effective date is finalized, required upgrades and their deadlines will be as follows:

Action	Compliance required for effective date
Tank Markings	120 days
Level Gauges	120 days
Formal Tank Inspections	
• Internal inspections	
Tanks > 5 yrs. oil and > 12,000 gallons	3 years
Tanks < 5 yrs. oil and > 12,000 gallons	5 years
• External inspections	5 years

Action	Compliance required for effective date
Secondary Containment Dike Certifications	5 years
AST Cathodic Protection Evaluations	5 years
Hydrostatic Testing of Piping	5 years

6.1.3 Formal Tank Inspections

Although internal and external inspections are initially required within different compliance dates, it is assumed that the both will be performed concurrently.

6.1.4 Additional Schedule Factors

Recommendations that are deemed more critical than others, such as overfill protection devices (high level alarms and adequate secondary containment areas), are given a higher priority than less critical upgrades such as dike lighting.

TABLE 9

ANNUAL WORK SCHEDULE
FOR AST's UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

AST ID	BLDG #	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Total
1130-1	1130	Re-paint tank & apply markings Anchor tank to slab $300					$ 300
1130-2	1130	Re-paint tank & apply markings $150					$ 150
1231-1	1231		Secondary containment Install dike drain valve $1,350				$ 1,350
1262-1	1262	Re-paint tank & apply markings Anchor tank to slab Clean containment $400					$ 400
1262-2	1262	Re-paint tank & apply markings Anchor tank to slab Clean containment $400					$ 400
1515-1	1515	Paint support structure Install dike drain valve $175					$ 175
1515-2	1515	Paint support structure Install dike drain valve $175					$ 175

TABLE . (CONT.)

ANNUAL WORK SCHEDULE
FOR AST's UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

AST ID	BLDG #	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Total
1618-P	1618	Re-paint tank & apply markings Repair support leg Anchor tank to slab $350					$ 350
3022-1	3022	Re-paint tank & apply markings Drain locking device $200					$ 200
3022-2	3022	Re-paint tank & apply markings Drain locking device $200					$ 200
3105A	3860	Paint markings Eval. cath. protection Drain locking device High level alarm Drainage pipe External inspection Pressure test piping $4,725	Sec. cont. evaluation $375	Diked area lighting $2,300			$ 7,400
3105B	3860	Paint markings Eval. cath. protection Drain locking device High level alarm Drainage pipe External inspection Pressure test piping $4,725	Sec. cont. evaluation $375	Diked area lighting $2,300			$ 7,400

TABLE 9 (CONT.)

ANNUAL WORK SCHEDULE
FOR AST's UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

AST ID	BLDG #	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Total
3144-3	3144	Re-paint tank & apply markings $150	Sec. cont. volume $1,725				$ 1,875
3151-1	3151	Anchor tank to slab Check containment $250	Security fencing Diked area lighting $2,475				$ 2,725
3151-2	3151	Paint bottom of tank Anchor tank to slab $175	Addtl sec. containment Security fencing $1,650				$ 1,825
3165-3	3165	Anchor tank to slab $100	Addtl sec. containment $900				$ 1,000
3373-1	3373	Re-paint tank & apply markings $150	Security fencing $750				$ 900
3511-2	3511	Level gauge Paint markings External inspection $2,325	Sec. cont. evaluation $450				$ 2,775
3530-1	3530	Clean tank, wall, and containment $100	Addtl sec. containment $1,250				$ 1,350
3615-1	3615	Re-paint tank and piping $200					$ 200

TABLE 9 (CONT.)

ANNUAL WORK SCHEDULE
FOR AST's UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

AST ID	BLDG #	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Total
3699-1	3699	Repair level gauge Extend vent height $400	Addtl sec. containment Diked area lighting $2,625				$ 3,025
3699-2	3699		Addtl sec. containment Diked area lighting $2,975				$ 2,975
3821-3	3821	Level gauge Paint markings External inspection $2,325	Install sec. containment Certify contain. area $6,200				$ 8,525
3823-2	3823	Paint markings External inspection $600					$ 600
3825	3860	Paint markings Pressure test piping Internal & external inspection $15,100	Sec. cont. evaluation High level alarm High-high level switch $20,300	Diked area lighting Containment area liner $32,775		Sandblast & paint piping $14,375	$ 82,550
3845	3860	Drain locking device Paint markings Pressure test piping Internal & external inspection $17,700	Sec. cont. evaluation High level alarm High-high level switch $21,450	Diked area lighting $6,900			$ 46,050

TABLE 5 (CONT.)

ANNUAL WORK SCHEDULE
FOR AST's UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

AST ID	BLDG #	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Total
3846	3860	Drain locking device Paint markings Pressure test piping Internal & external inspection $17,700	Sec. cont. evaluation High level alarm High-high level switch $21,450	Diked area lighting $6,900			$ 46,050
3862	3860	Paint markings Calibrate gauge & high level alarm Pressure test piping $100	Repair high-high level switch Sec. cont. evaluation $3,250	Diked area lighting Containment area liner $32,775	Paint tank $74,750	Paint piping $14,375	$ 125,250
3863	3860	Paint markings Calibrate gauge & high level alarm Internal & external inspection Pressure test piping $15,100	Repair high-high level switch Sec. cont. evaluation $3,250	Diked area lighting Containment area liner $35,650	Paint tank $74,750	Paint piping $14,375	$ 143,125
3864	3860	Paint markings Calibrate gauge & high level alarm Internal & external inspection Pressure test piping $15,100	Repair high-high level switch Sec. cont. evaluation $3,250	Diked area lighting Containment area liner $32,775	Paint tank $74,750	Paint piping $14,375	$ 140,250

TABLE > (CONT.)

ANNUAL WORK SCHEDULE
FOR AST's UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

AST ID	BLDG #	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Total
3865	3860	Paint markings Calibrate gauge Pressure test piping $100	Repair high-high level switch Sec. cont. evaluation High level alarm $8,425	Diked area lighting Containment area liner $35,650	Paint tank $74,750	Paint piping $14,375	$ 133,300
3866	3860	Paint markings Calibrate gauge and high level alarm Pressure test piping $100	Repair high-high level switch Sec. cont. evaluation $3,250	Diked area lighting Containment area liner $32,775	Paint tank $74,750	Paint piping $14,375	$ 125,250
3869-1	3869	Anchor tank to slab $100					$ 100
3869-2	3869	Anchor tank to slab $100					$ 100
3869-3	3869	Anchor tank to slab $100					$ 100
3869-4	3869	Anchor tank to slab $100					$ 100
3870-1	3870	Paint markings External inspection $600	Upgrade sec. cont. Sec. cont. evaluation Diked area lighting $4,475				$ 5,075
3872-1	3872		Upgrade sec. cont. Diked area lighting $2,875				$ 2,875

TABLE > (CONT.)

ANNUAL WORK SCHEDULE
FOR AST's UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

AST ID	BLDG #	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Total
3892-1	3892		Diked area lighting $1,725				$ 1,725
TOTAL		**$ 100,575**	**$ 116,800**	**$ 220,800**	**$ 373,750**	**$ 86,250**	**$ 898,175**

Note: Tank #'s 1265-1A and 3108-1 do not have required or recommended upgrades. Tank #5000 is to be installed within the next several months.

TABLE 10

ANNUAL WORK SCHEDULE SUMMARY
FOR AST'S UNDER RESPONSIBILITY OF NAB LITTLE CREEK

Date: December 1995

Category	COSTS PER FISCAL YEAR (ROUNDED)					Totals
	1996	1997	1998	1999	2000	
Ops & Main	$5,825	$12,500	$0	$0	$0	$18,325
Study	$84,000	$8,100	$0	$0	$0	$92,100
Design/Const.	$10,750	$96,200	$220,800	$373,750	$86,250	$787,750
Yearly Subtotal	$100,575	$116,800	$220,800	$373,750	$86,250	
Grand Total						**$898,175**

TABLE 11

ANNUAL WORK SCHEDULE
FOR AST'S UNDER RESPONSIBILITY OF PUBLIC WORKS CENTER

Date: December 1995

AST ID	BLDG #	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Total
1518-1	1518	Install dike drain locking device $50					$50
2115-1	2115	Install dike drain locking device $50					$50
3081B-1	3081B	Re-paint tank & apply markings Anchor tank to slab $250					$ 250
3400-1	3400	Re-paint tank & apply markings Anchor tank to slab $250					$ 250
3661-1	3661	Re-paint tank $150					$ 150
3661-3	3661	Anchor tank to slab $100					$ 100
3879-1	3879	Re-paint tank & apply markings $150					$ 150
NAB 752-1	NAB 752	External inspection $500	Sec. cont. evaluation Sec. cont. volume $2,750				$ 3,250

TABLE 11 (CONT.)

ANNUAL WORK SCHEDULE
FOR AST'S UNDER RESPONSIBILITY OF PUBLIC WORKS CENTER

Date: December 1995

AST ID	BLDG #	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000	Total
NAB 757-F	NAB 757F	Re-paint tank & apply markings Drain locking device $200					$ 200
NAB 759	NAB 759	Pressure test piping $0	Repair cath. protection Sec. cont. evaluation High level alarm High-high level switch $22,050	Diked area lighting $14,375			$ 36,425
NAB 760	NAB 760	Pressure test piping $0	Repair cath. protection Sec. cont. evaluation High level alarm High-high level switch $22,050	Diked area lighting $14,375			$ 36,425
TOTAL		$ 1700	$ 46,850	$ 28,750	$ 0	$ 0	$ 77,300

Note: Tank # 1501-1 does not have any required or recommended upgrades.

TABLE 12

ANNUAL WORK SCHEDULE SUMMARY
FOR AST'S UNDER RESPONSIBILITY OF PWC, LITTLE CREEK SITE

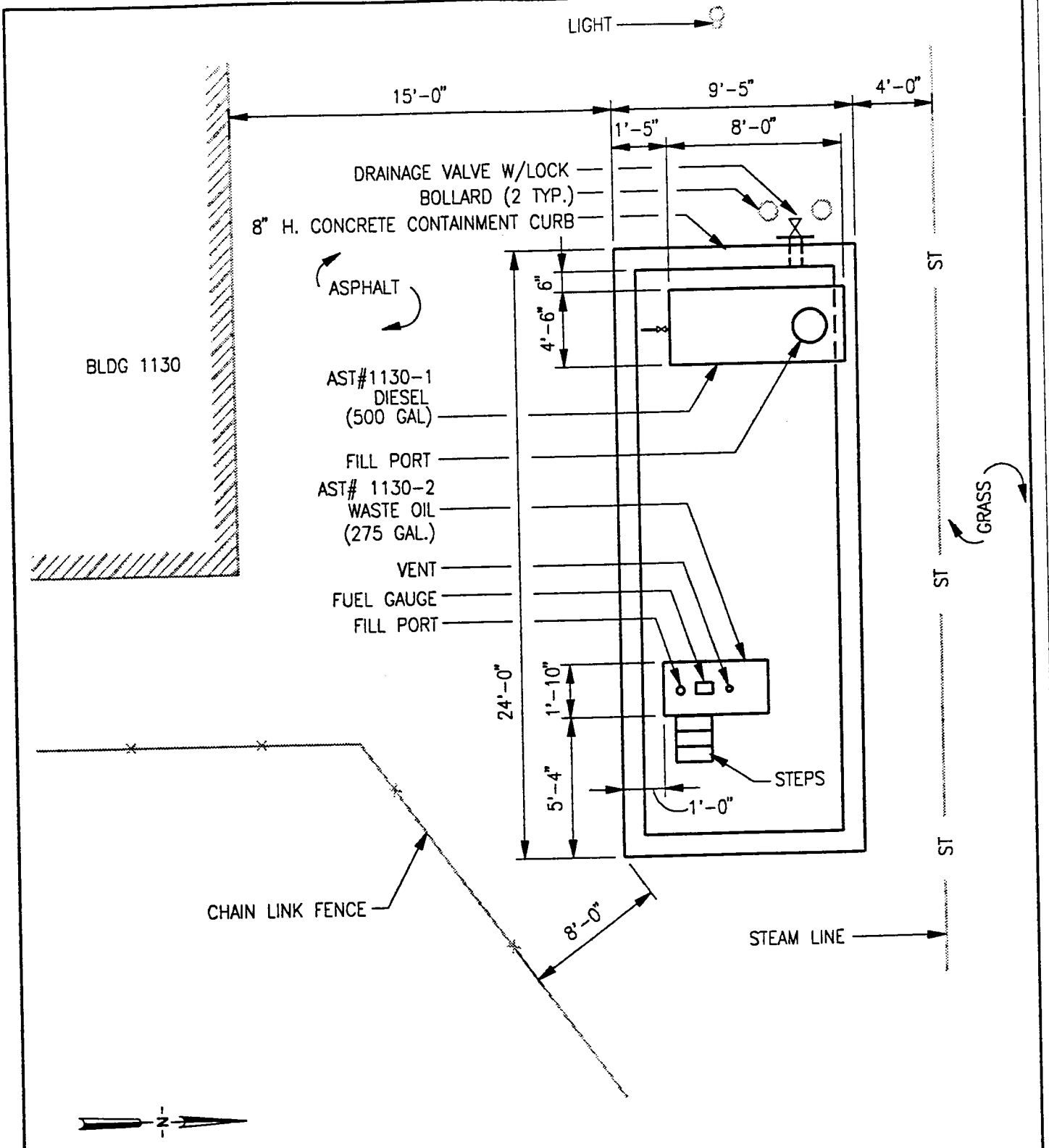
Date: December 1995

Category	COSTS PER FISCAL YEAR (ROUNDED)					Totals
	1996	1997	1998	1999	2000	
Ops & Main	$1,050	$3,000	$0	$0	$0	$4,050
Study	$500	$2,450	$0	$0	$0	$2,950
Design/Const.	$150	$41,400	$28,750	$0	$0	$70,300
Yearly Subtotal	$1,700	$46,850	$28,750	$0	$0	
Grand Total						$77,300

SECTION 7.0

SITE SKETCHES

SITE SKETCHES
for Tanks Under the Responsibility of NAB Little Creek



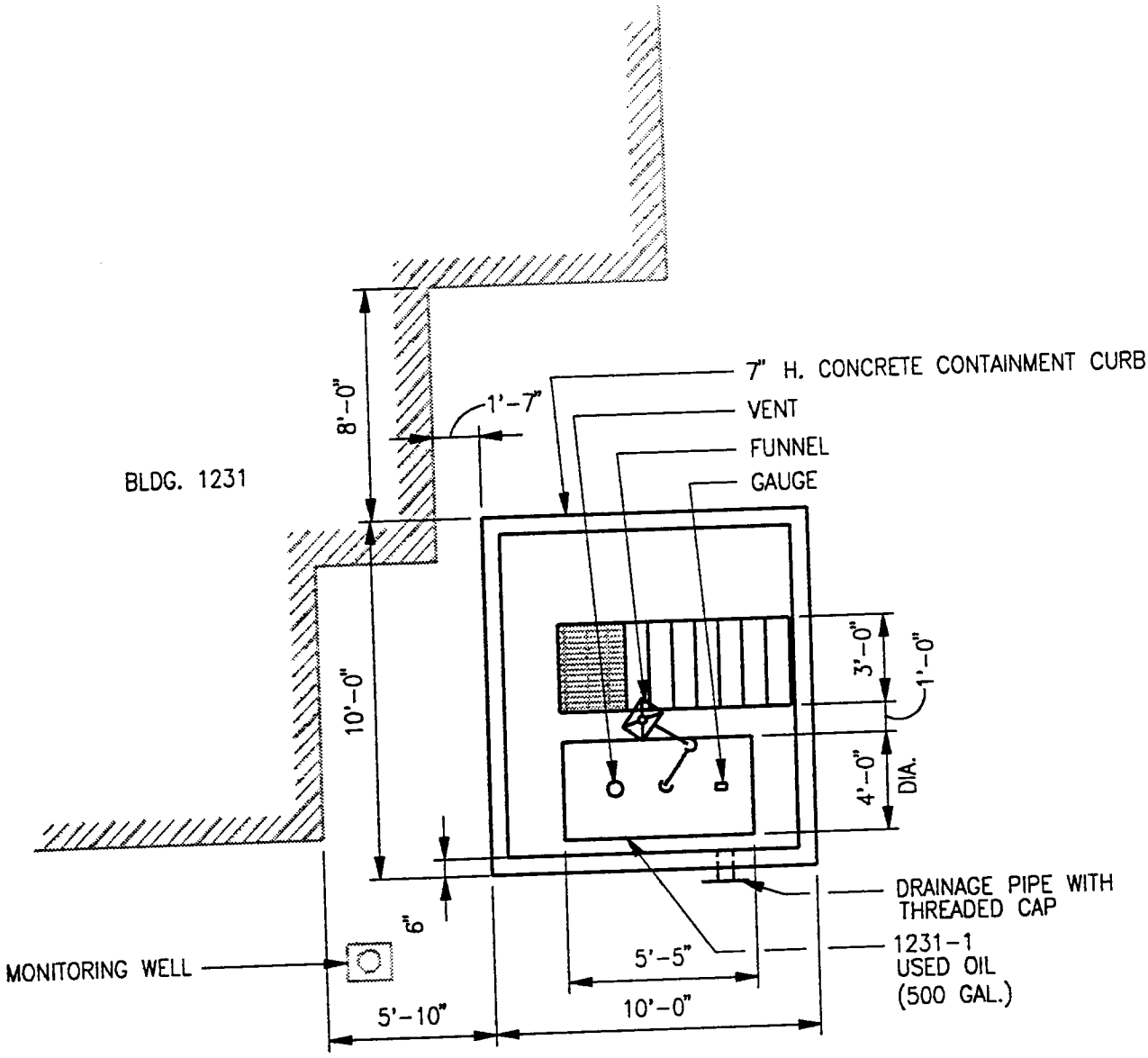
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 4
AST I.D. NO. 1130-1&2

SCALE: N.T.S.
FILE: FIG4
DATE: JULY 1995

ARMOUR CAPE & POND
2839 CENTURY PARKWAY
ATLANTA GA. 30345



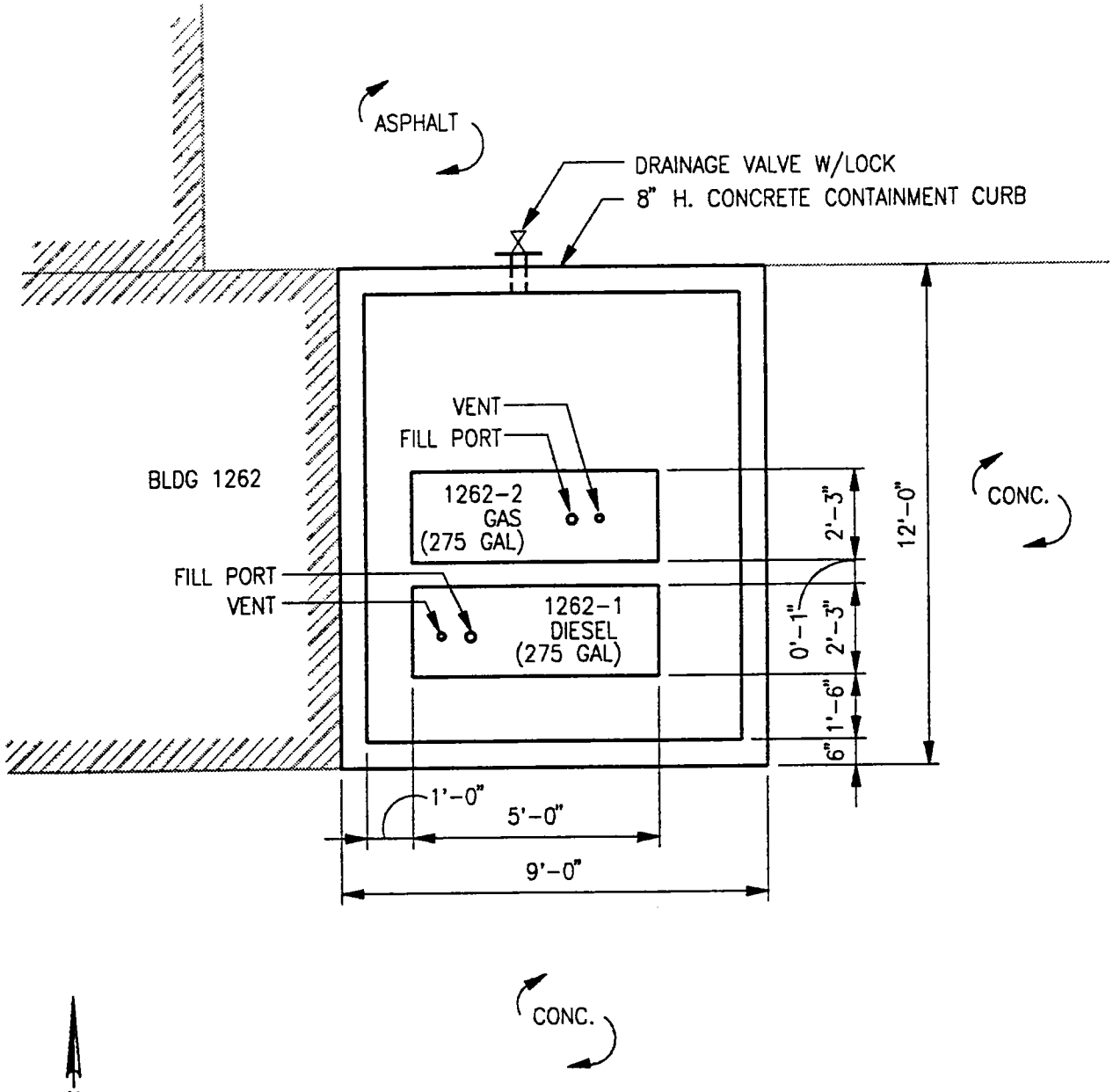
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 5
AST I.D. NO. 1231-1

SCALE: N.T.S.
FILE: FIG5
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



AST MANAGEMENT PLAN

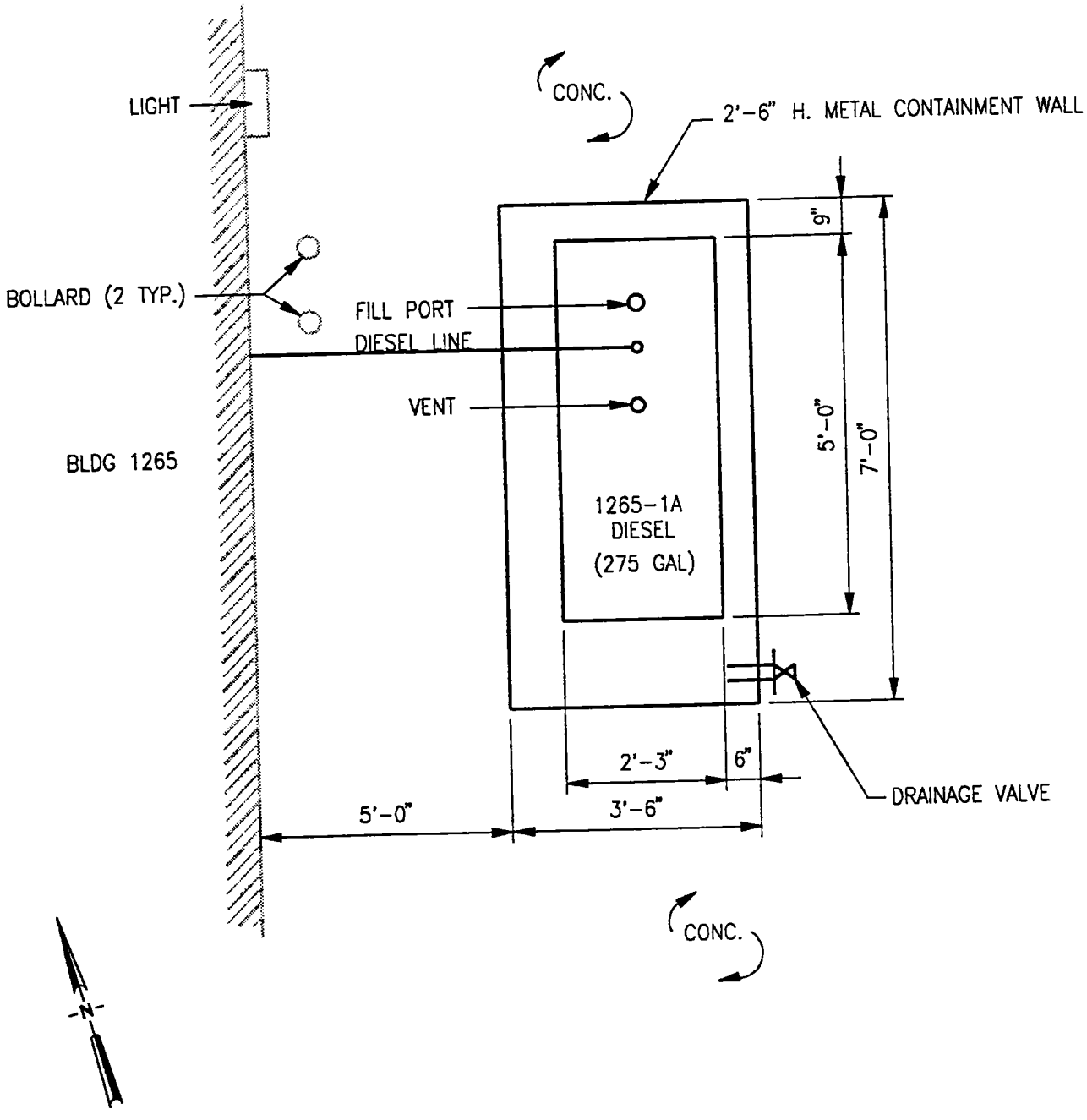
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 6
AST I.D. NO. 1262-1&2

SCALE: N.T.S.
FILE: FIG 6
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA. 30345



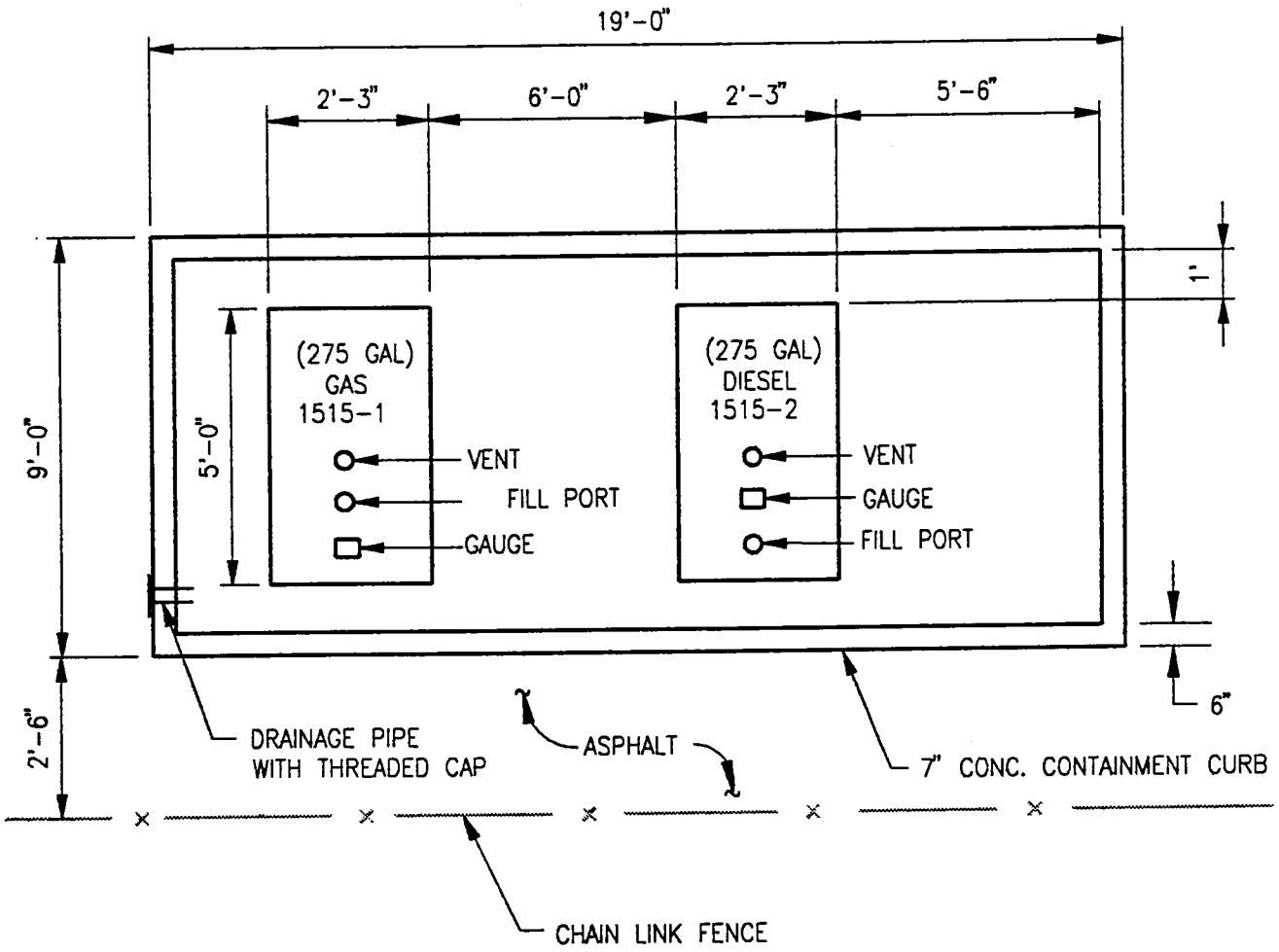
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 7
AST I.D. NO. 1265-1A

SCALE: N.T.S.
FILE: FIG 7
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345



AST MANAGEMENT PLAN

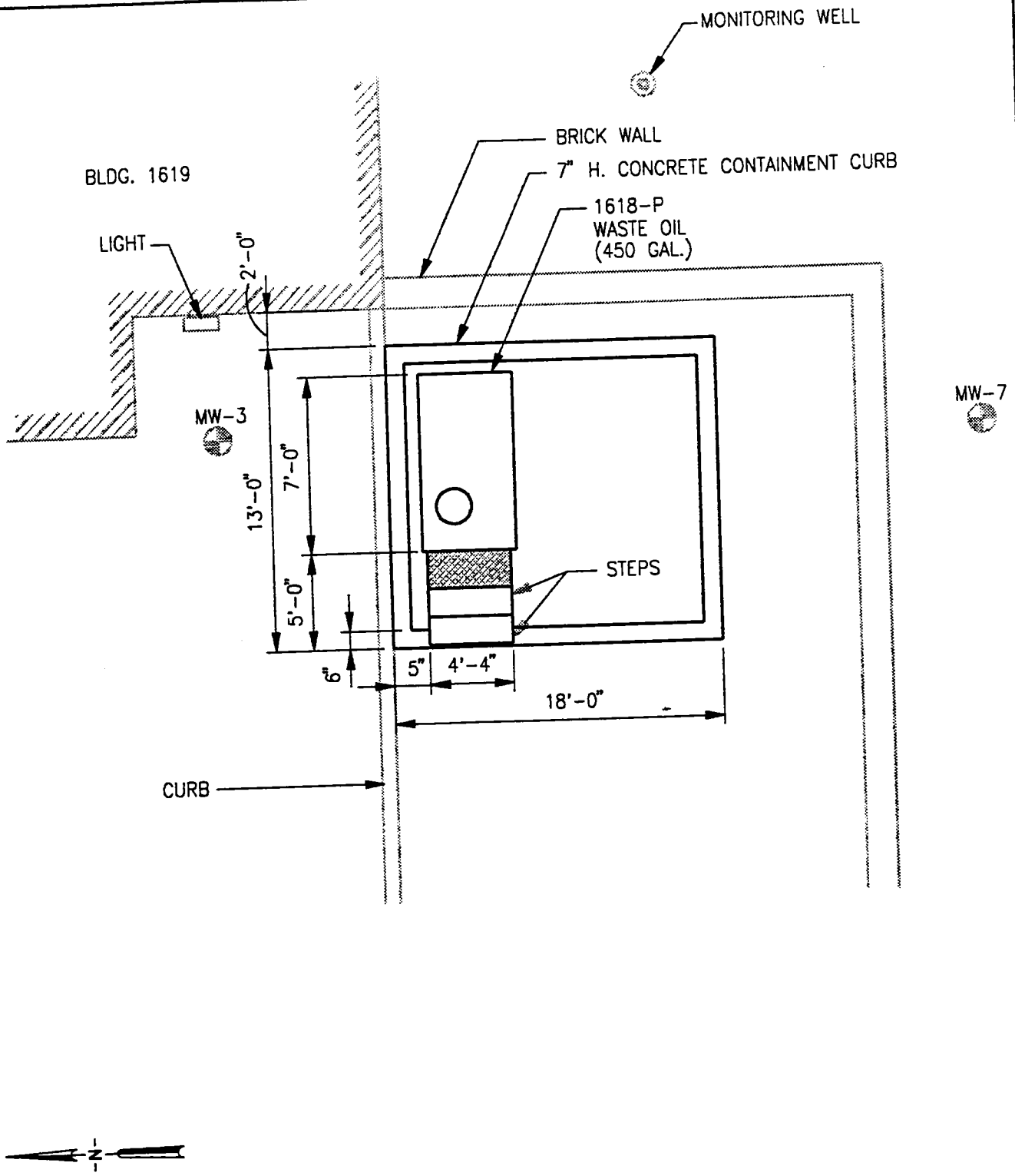
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 8
AST I.D. NO. 1515-1&2

SCALE: N.T.S.
FILE: FIG 8
DATE: JULY 1995

ARMOUR CAPE & POND
2935 CENTURY PARKWAY
ATLANTA GA. 30345



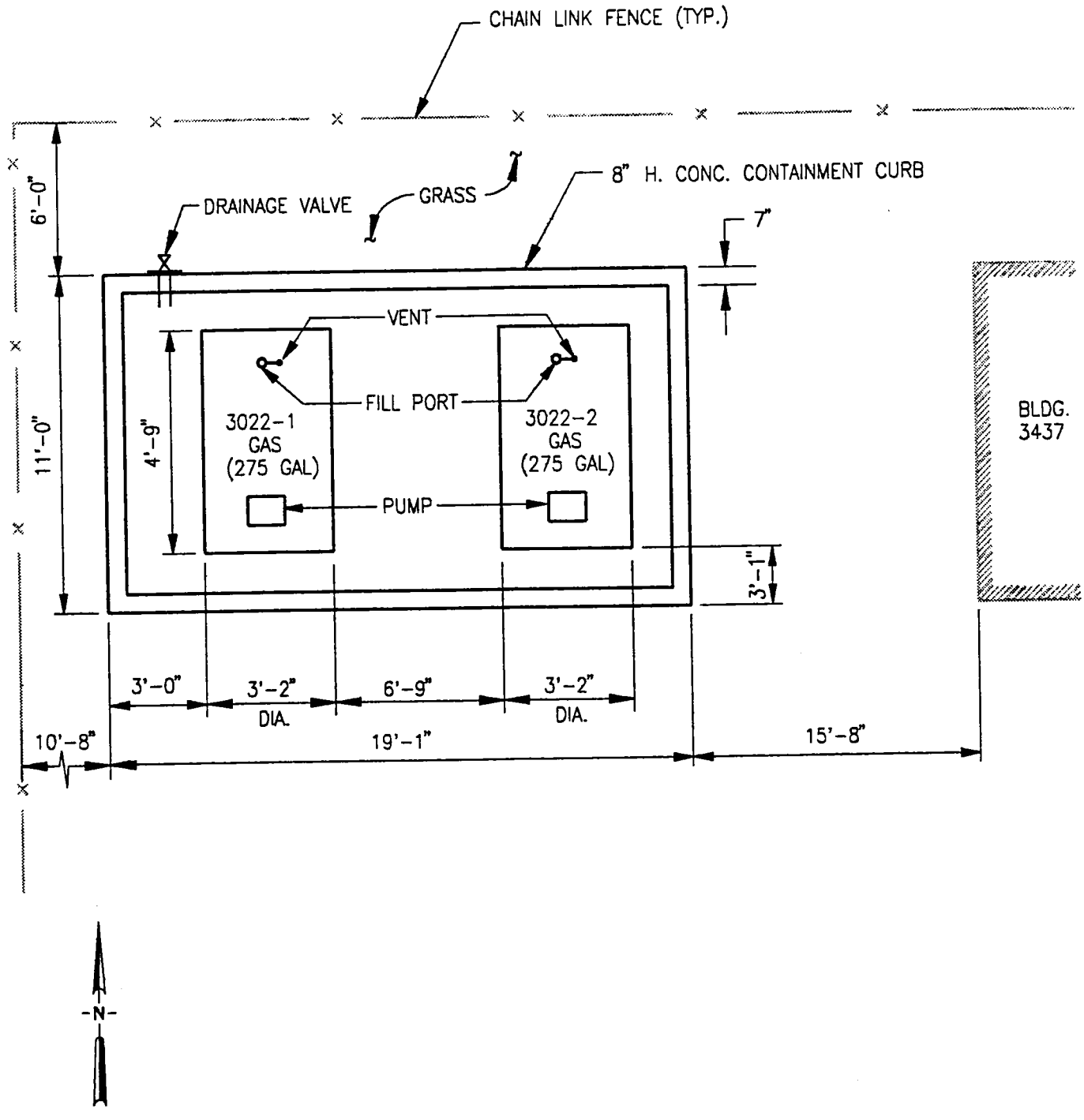
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 9
AST I.D. NO. 1618-P

SCALE: N.T.S.
FILE: FIG 9
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA. 30345



AST MANAGEMENT PLAN

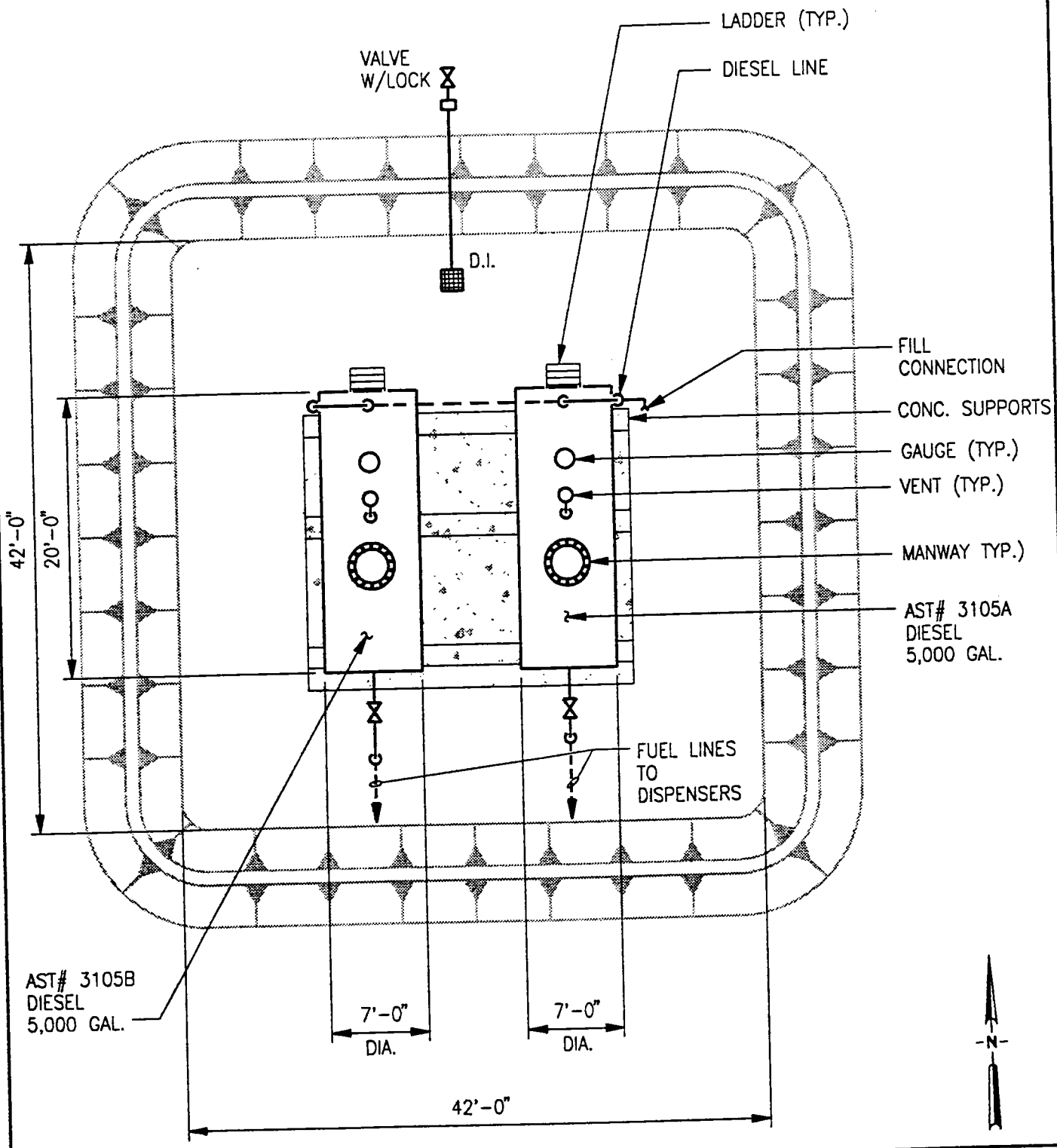
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 10
AST I.D. NO. 3022-1&2

SCALE: N.T.S.
FILE: FIG 10
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345



AST MANAGEMENT PLAN

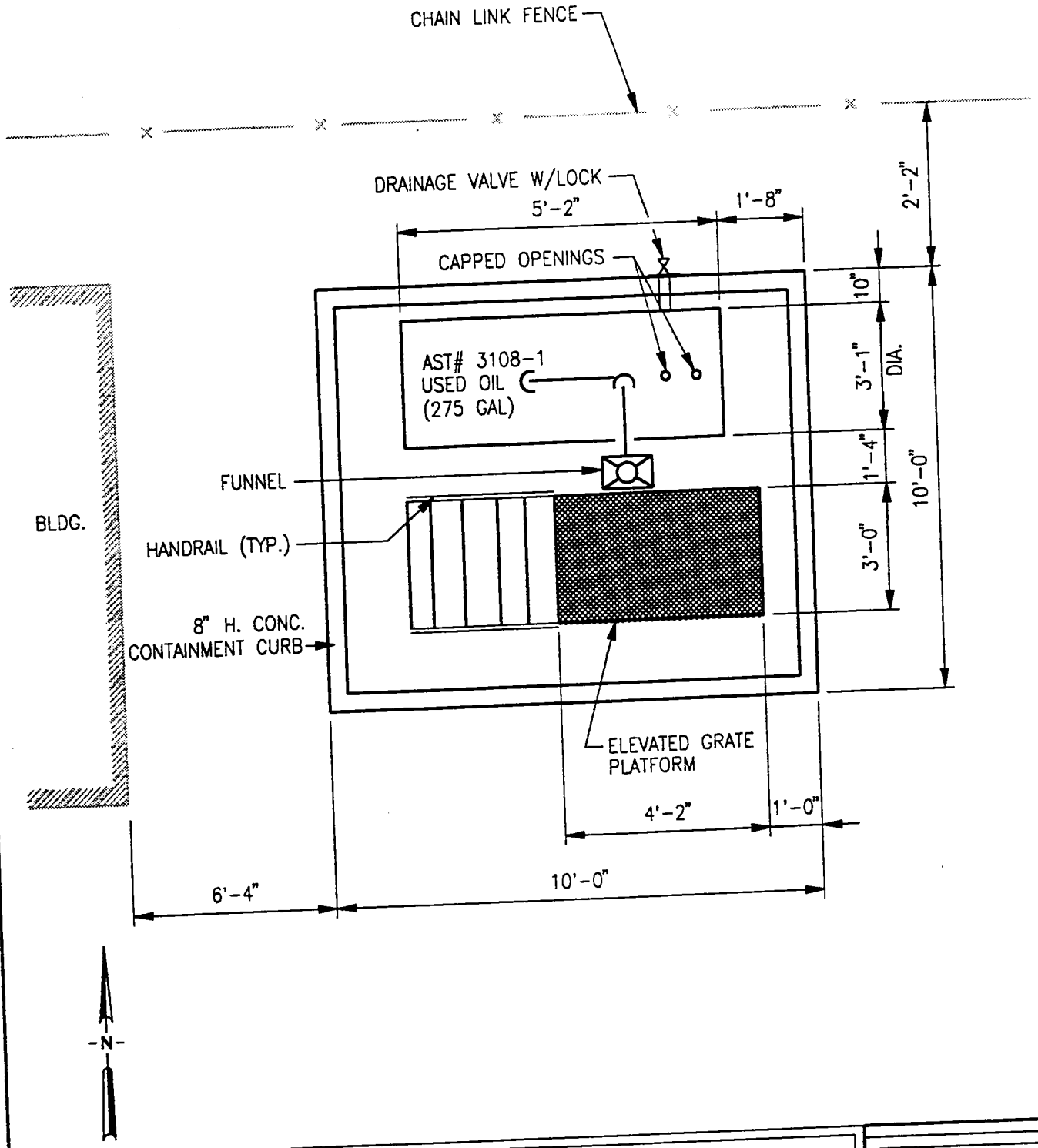
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 11
AST I.D. NO. 3105A&B

SCALE: N.T.S.
FILE: FIG 11
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA 30345



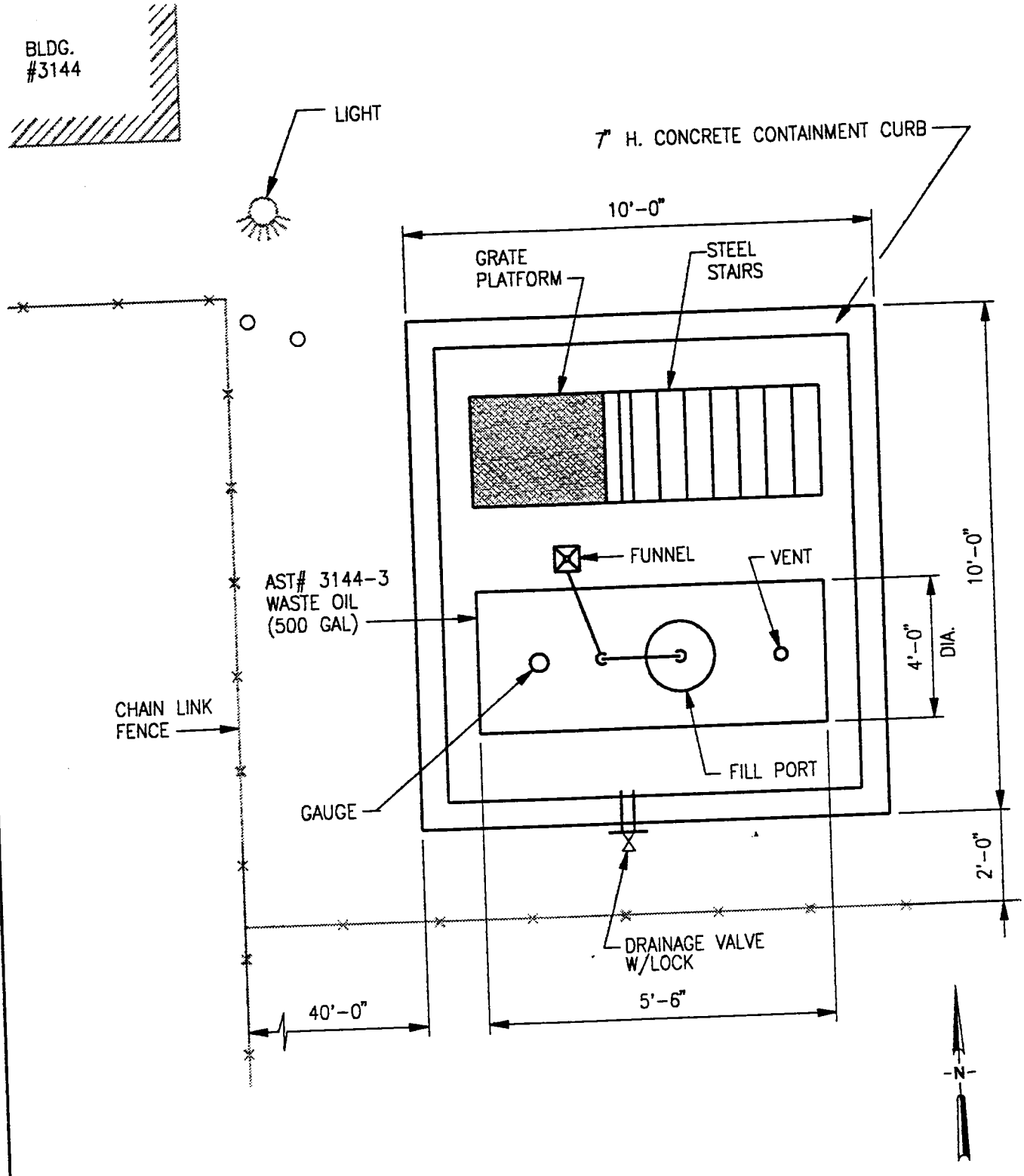
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 12
AST I.D. NO. 3108-1

SCALE: N.T.S.
FILE: FIG 12
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



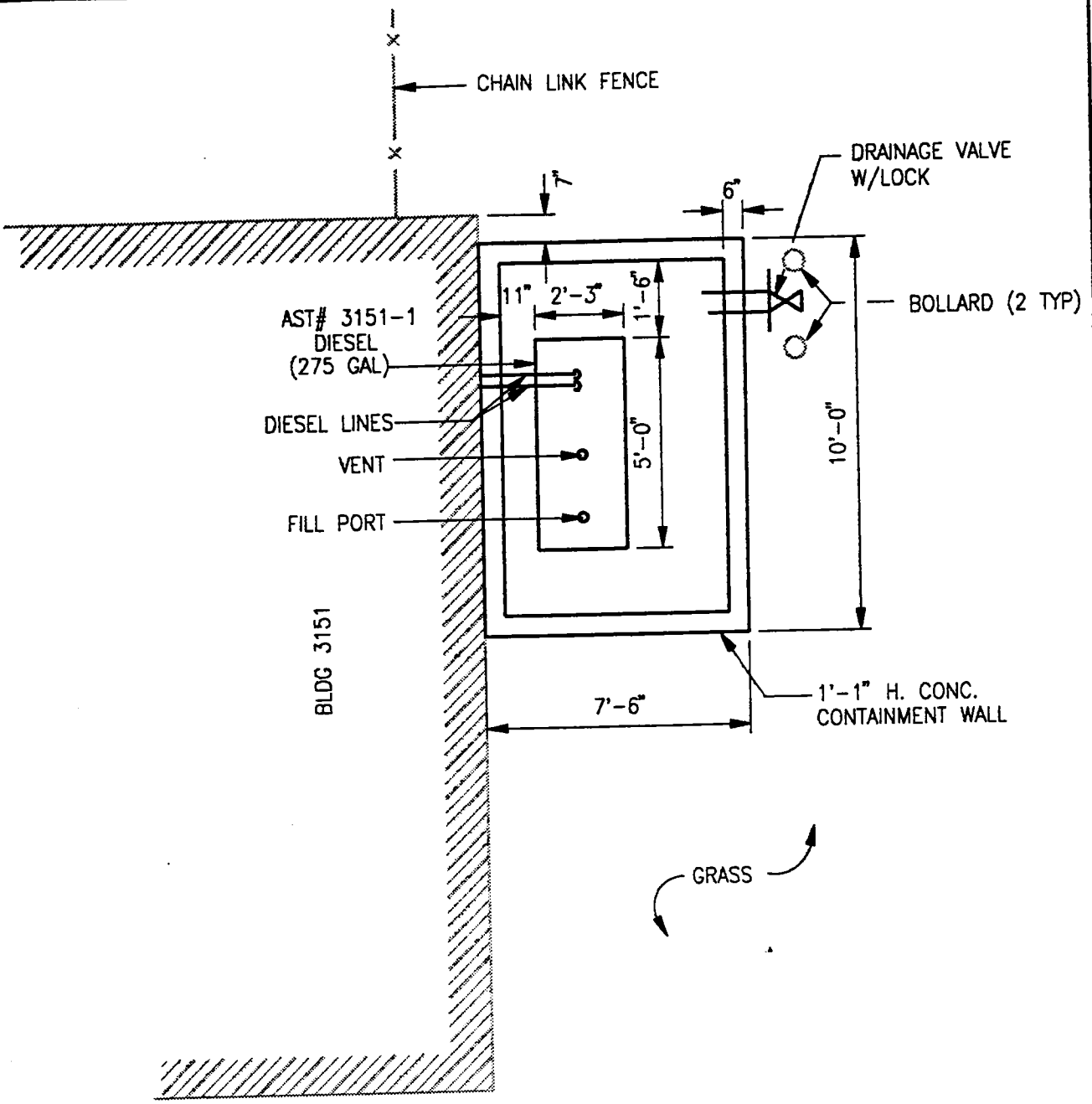
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 13
AST I.D. NO. 3144-3

SCALE: N.T.S.
FILE: FIG 13
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



AST MANAGEMENT PLAN

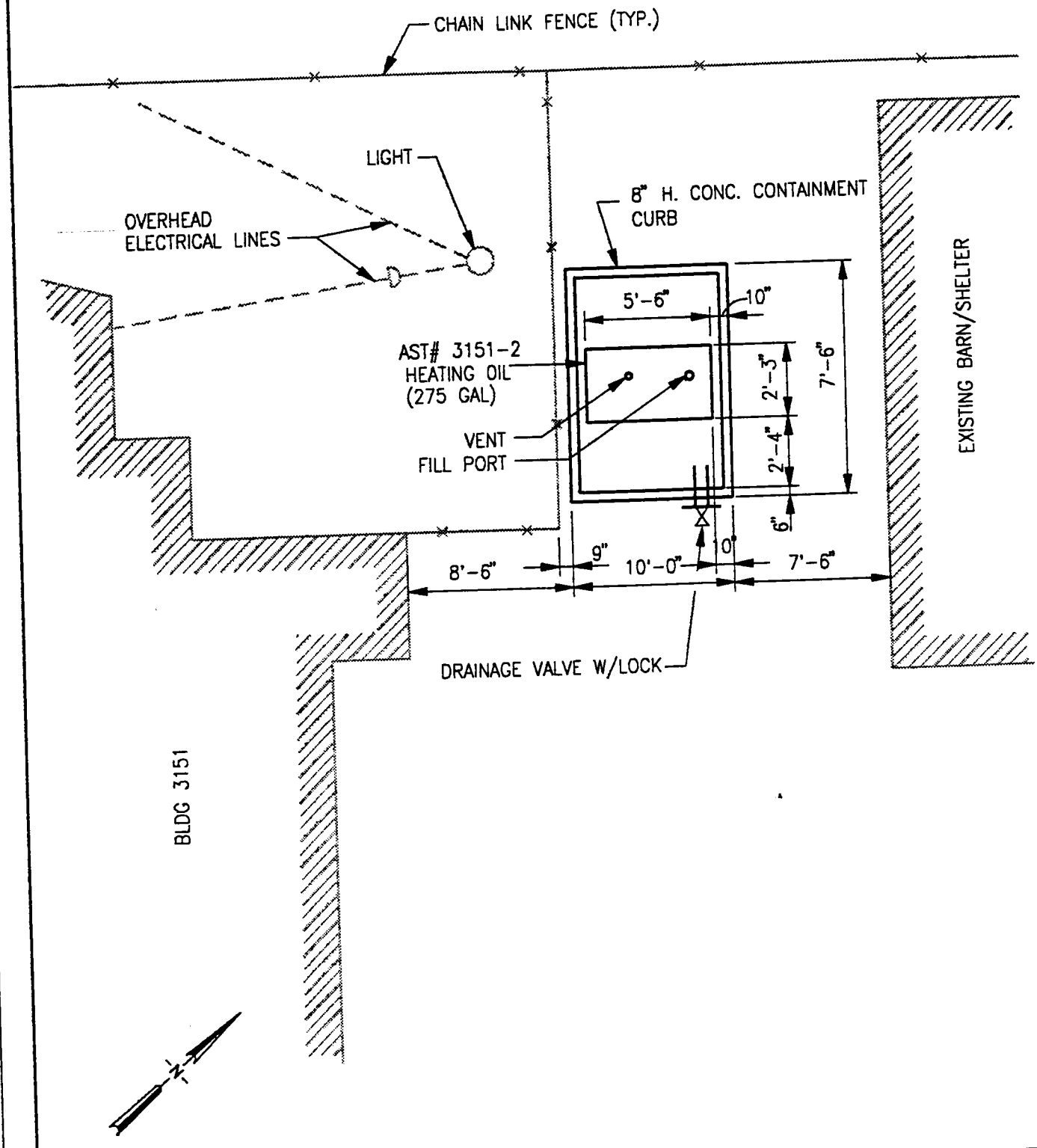
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 14
AST I.D. NO. 3151-1

SCALE: N.T.S.
FILE: FIG 14
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA. 30345



AST MANAGEMENT PLAN

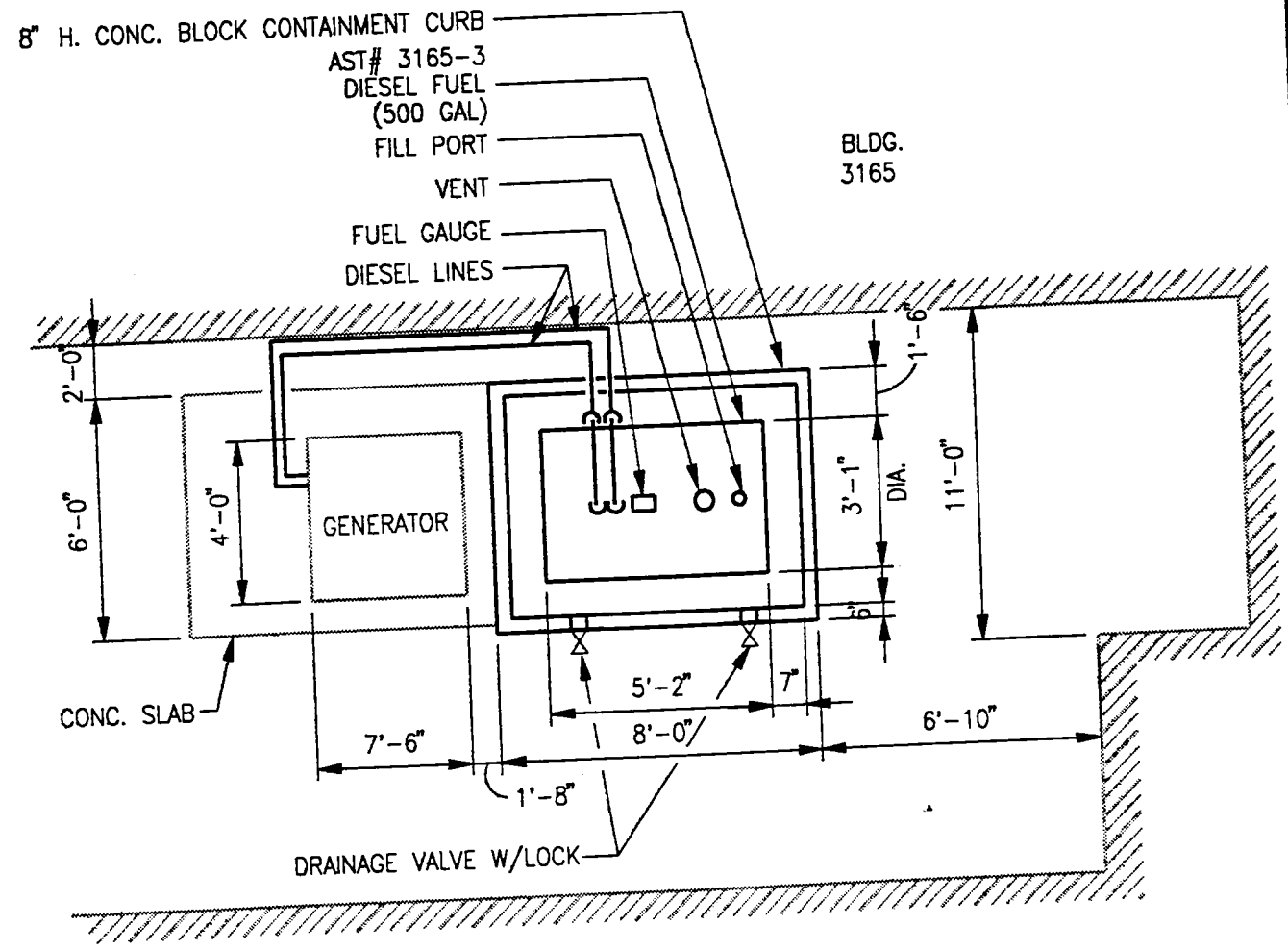
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 15
AST I.D. NO. 3151-2

SCALE: N.T.S.
FILE: FIG 15
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA. 30345



N

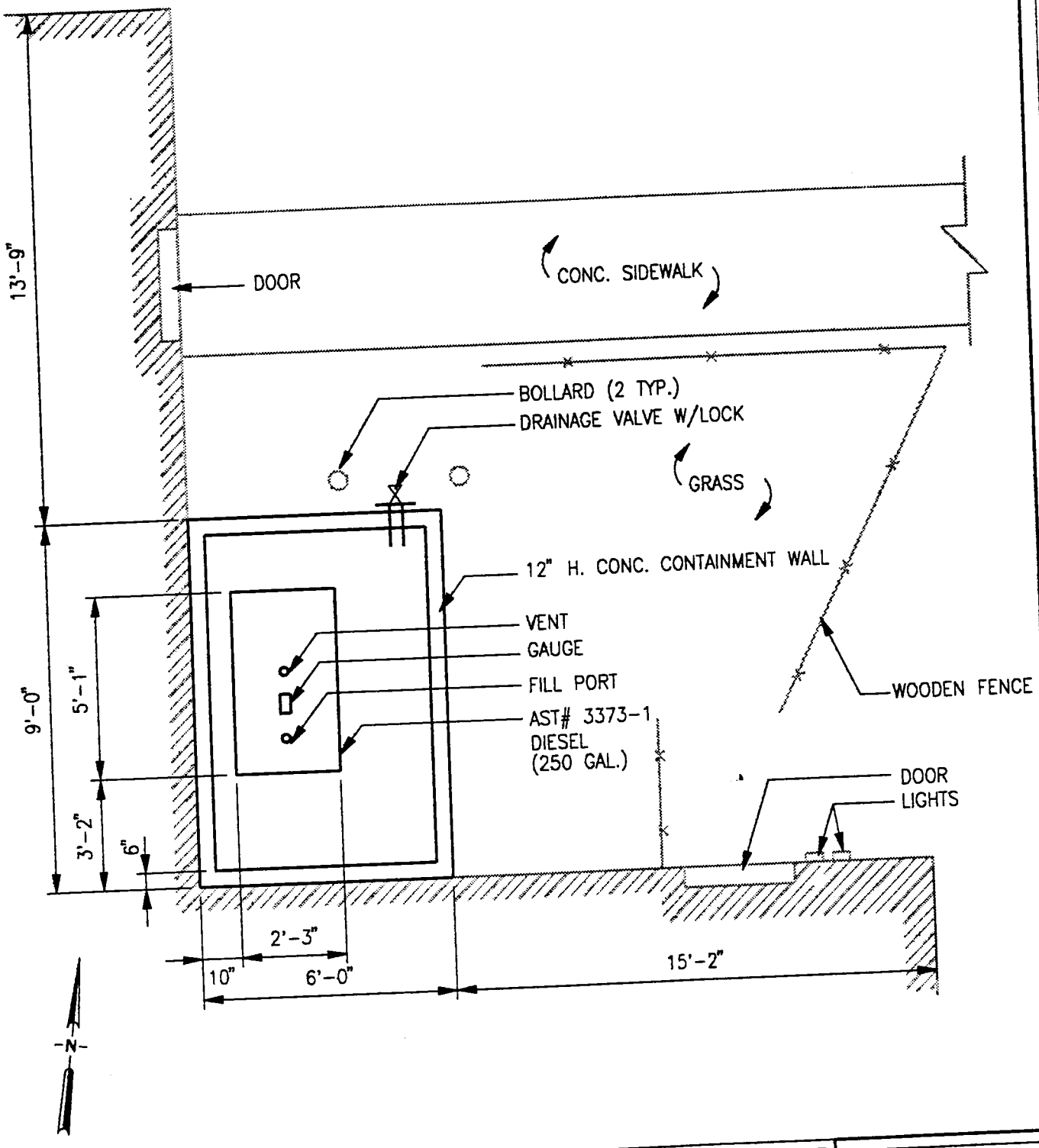
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 16
AST I.D. NO. 3165-3

SCALE: N.T.S.
FILE: FIG 16
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA. 30345



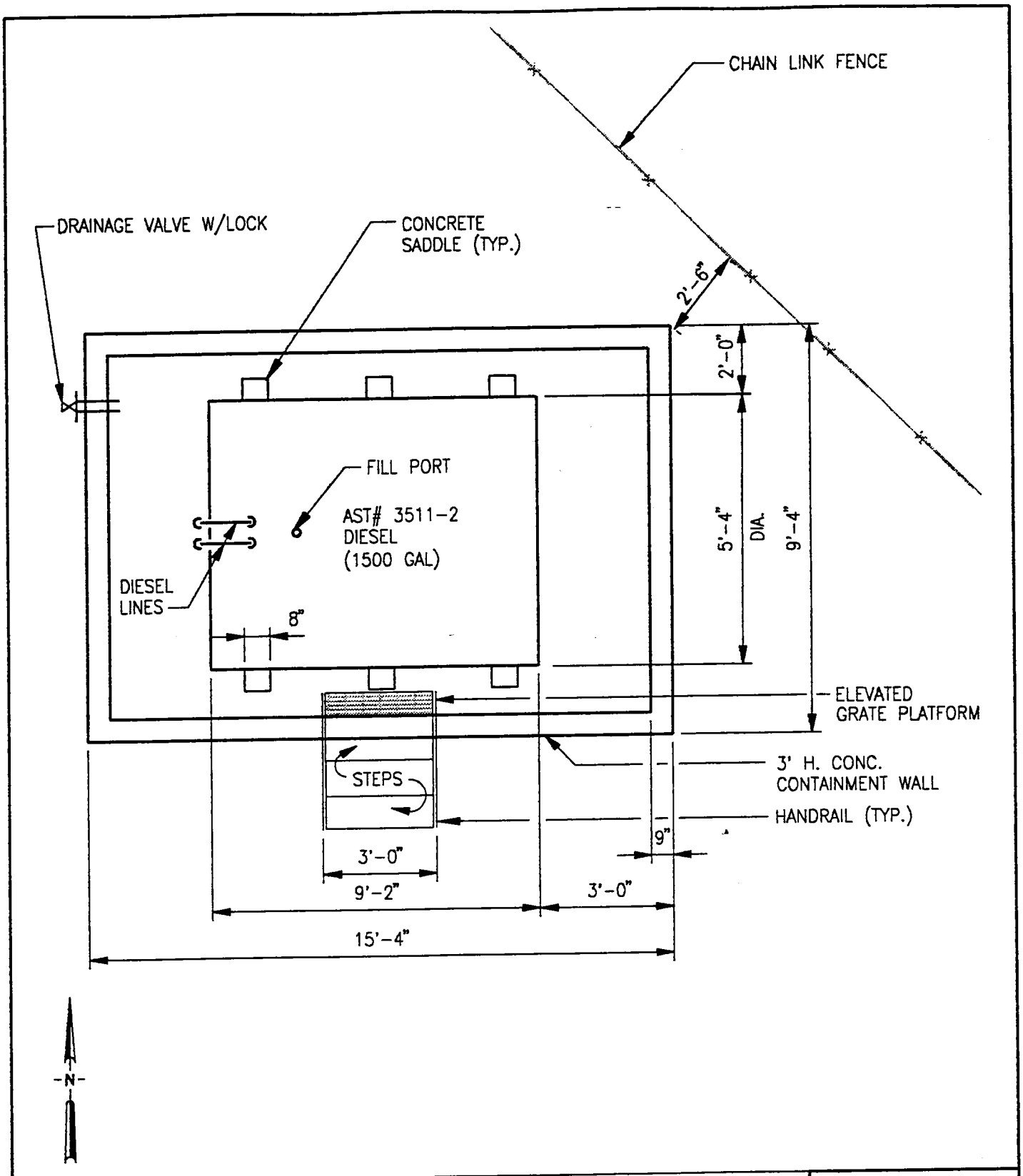
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 17
AST I.D. NO. 3373-1

SCALE: N.T.S.
FILE: FIG 17
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345



AST MANAGEMENT PLAN

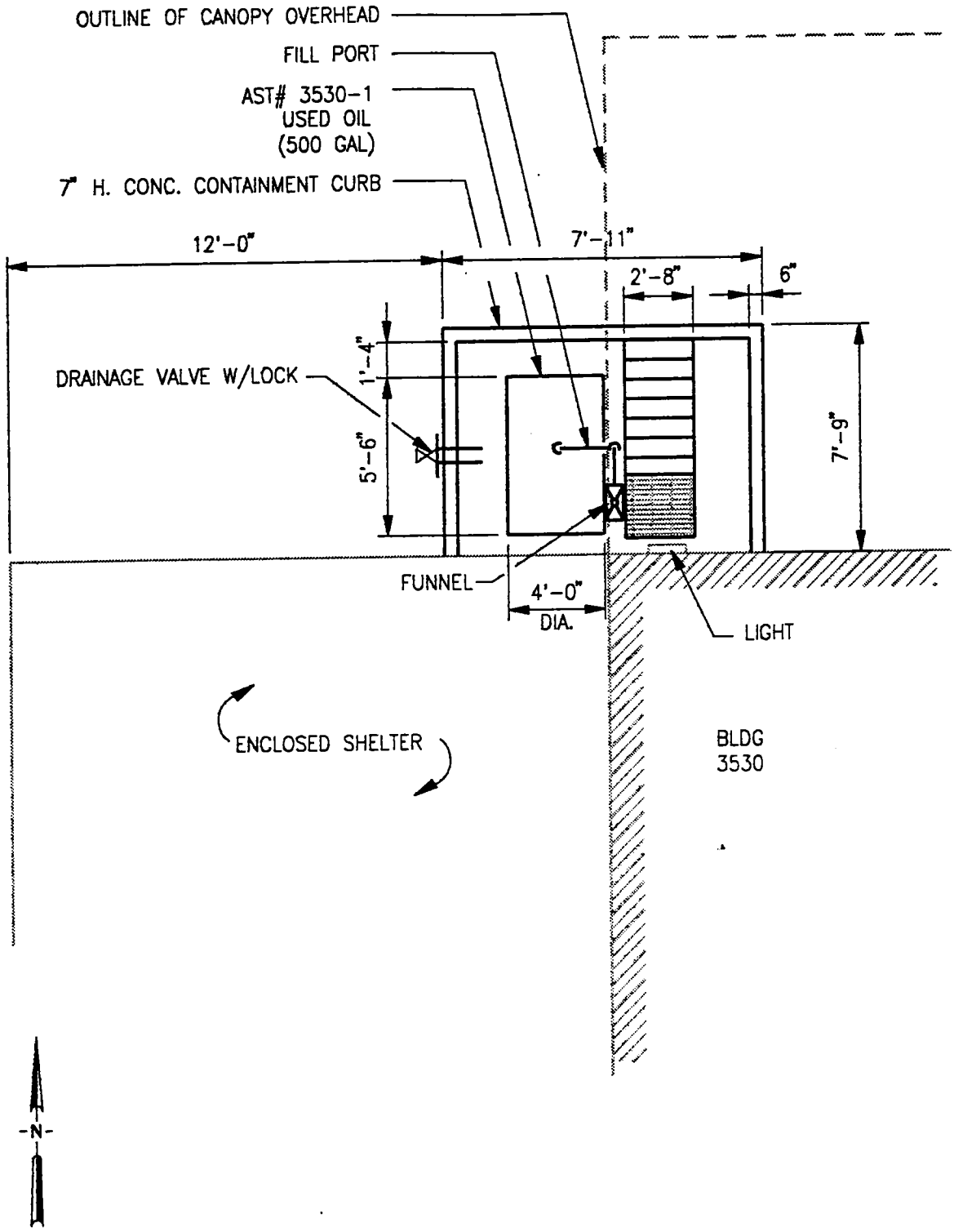
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 18
AST I.D. NO. 3511-2

SCALE: N.T.S.
FILE: FIG 18
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



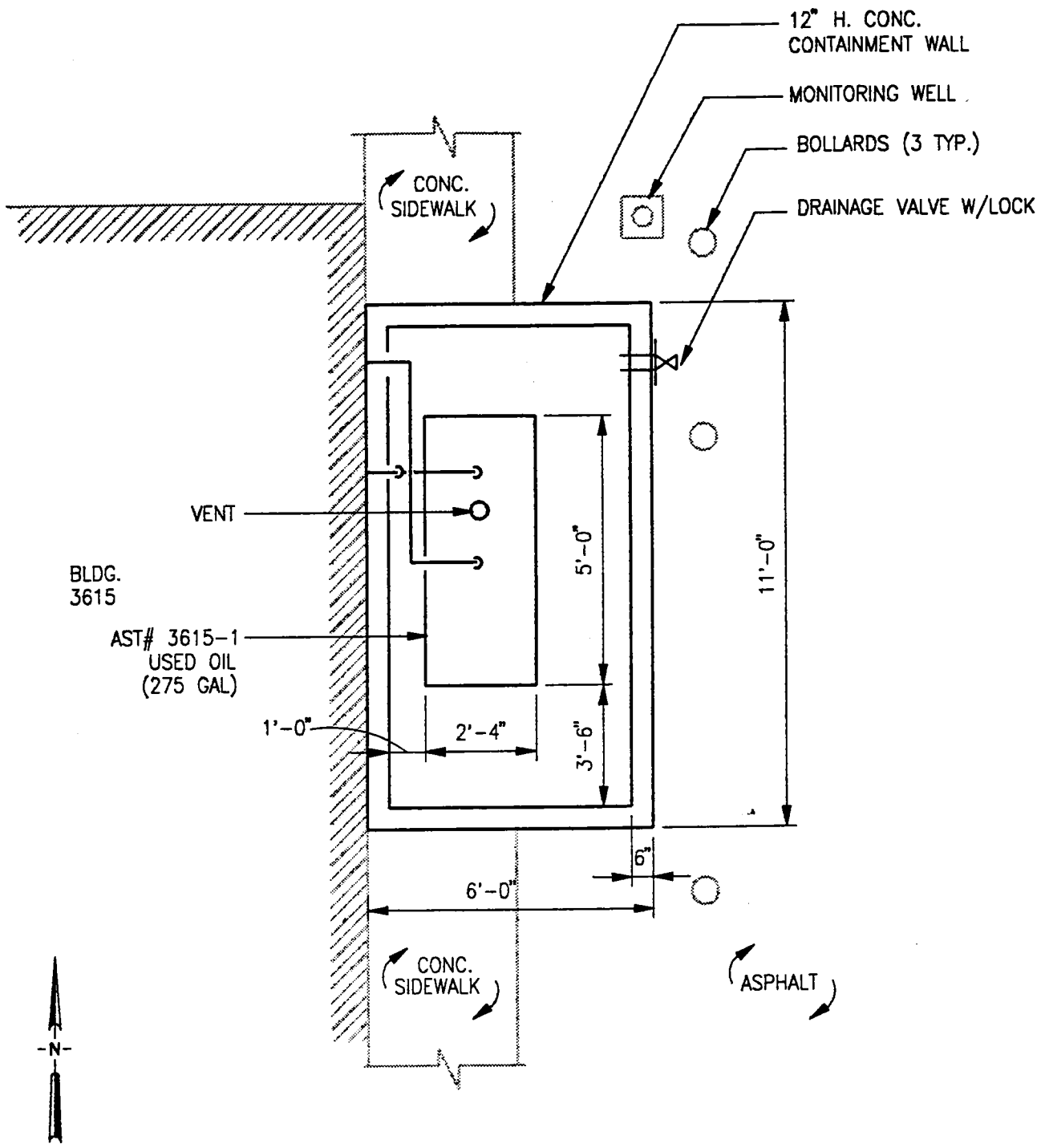
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 19
AST I.D. NO. 3530-1

SCALE: N.T.S.
FILE: FIG 19
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA 30345



AST MANAGEMENT PLAN

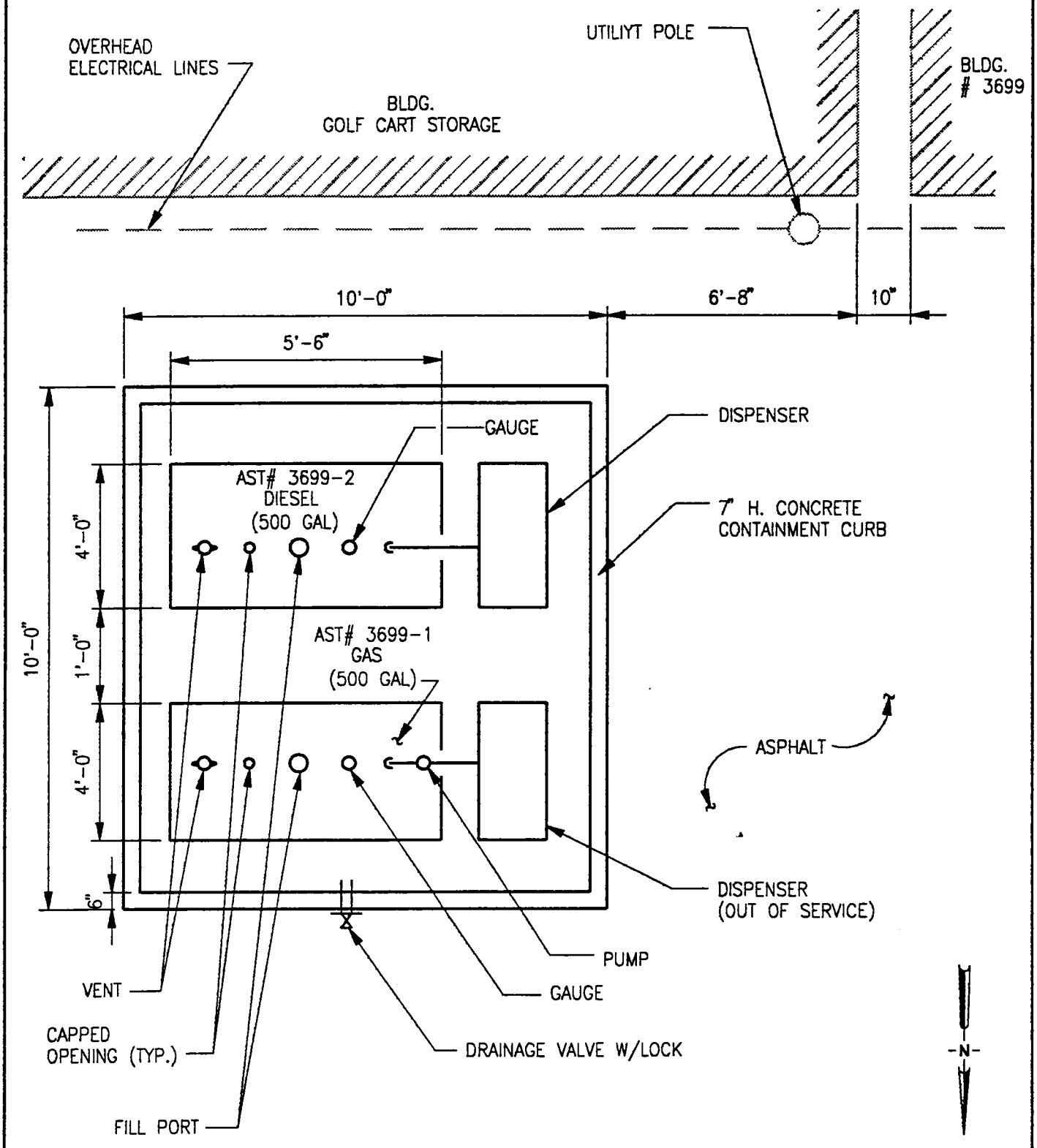
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 20
AST I.D. NO. 3615-1

SCALE: N.T.S.
FILE: FIG 20
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA. 30345



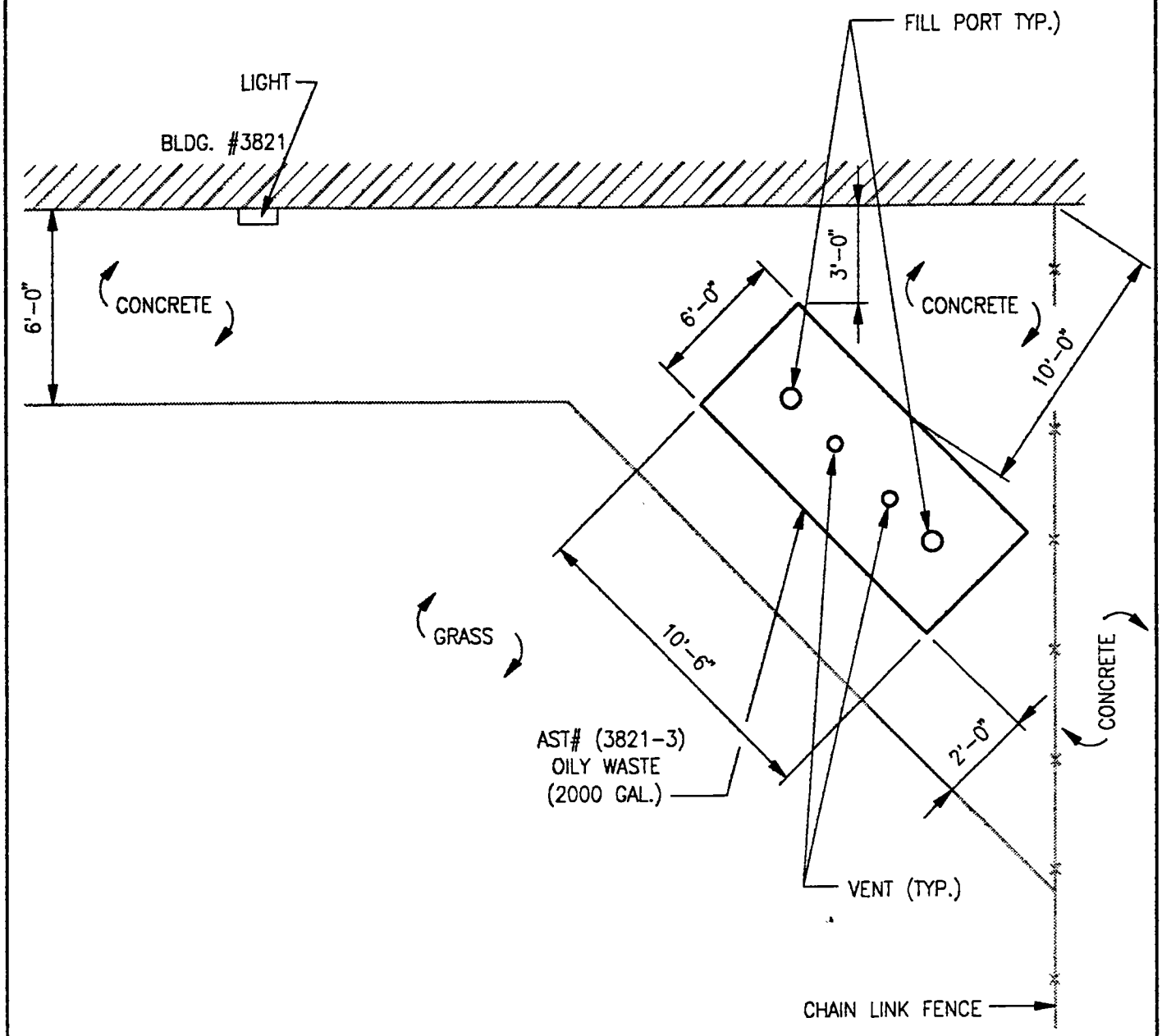
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 21
AST I.D. NO. 3699-1&2

SCALE: N.T.S.
FILE: FIG 21
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



AST MANAGEMENT PLAN

NAB LITTLE CREEK

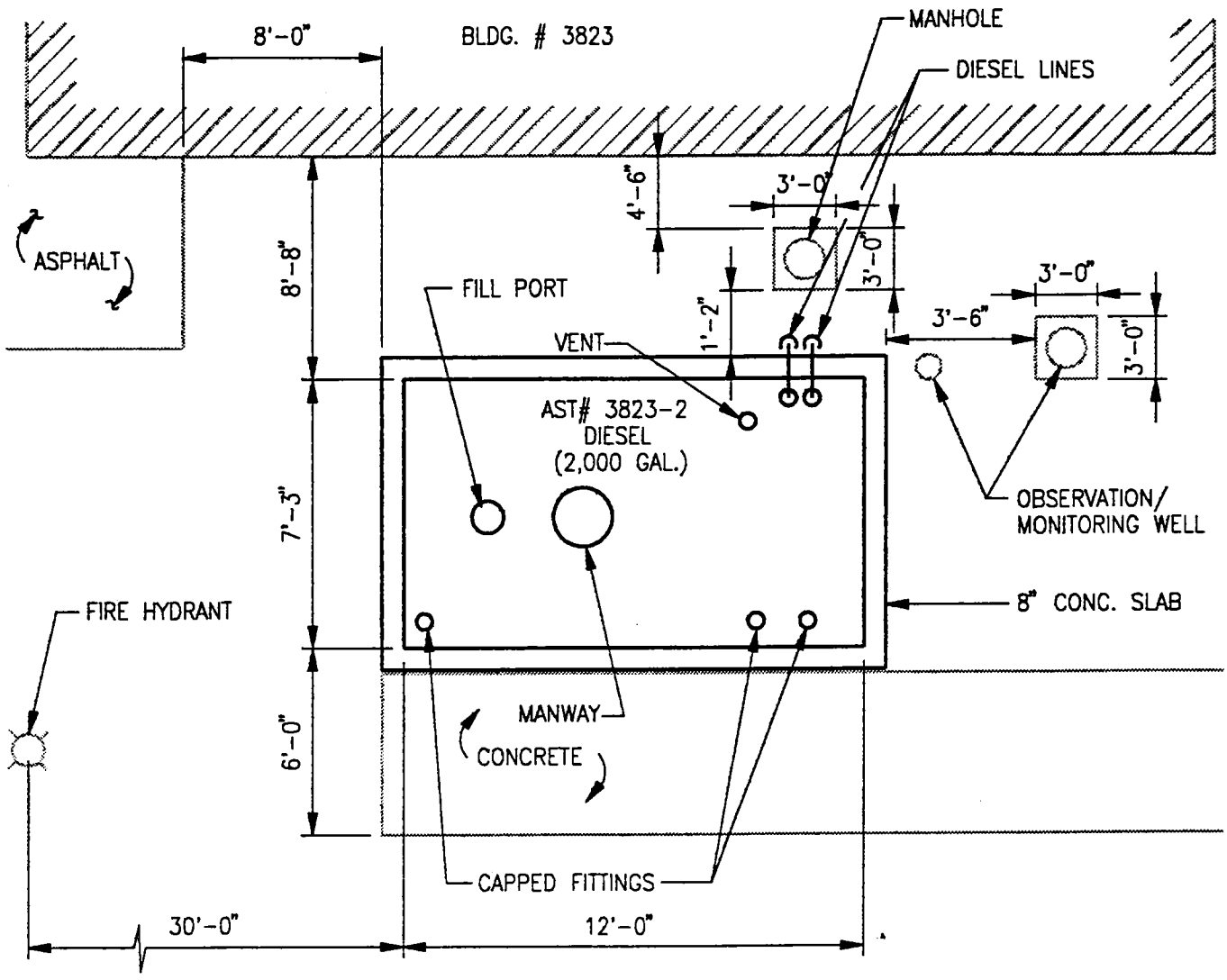
NORFOLK, VIRGINIA

FIGURE NO. 22
AST I.D. NO. 3821-3

SCALE: N.T.S.
FILE: FIG 22
DATE: JULY 1995

ARMOUR CAPE & POND

2635 CENTURY PARKWAY
ATLANTA GA. 30345



AST MANAGEMENT PLAN

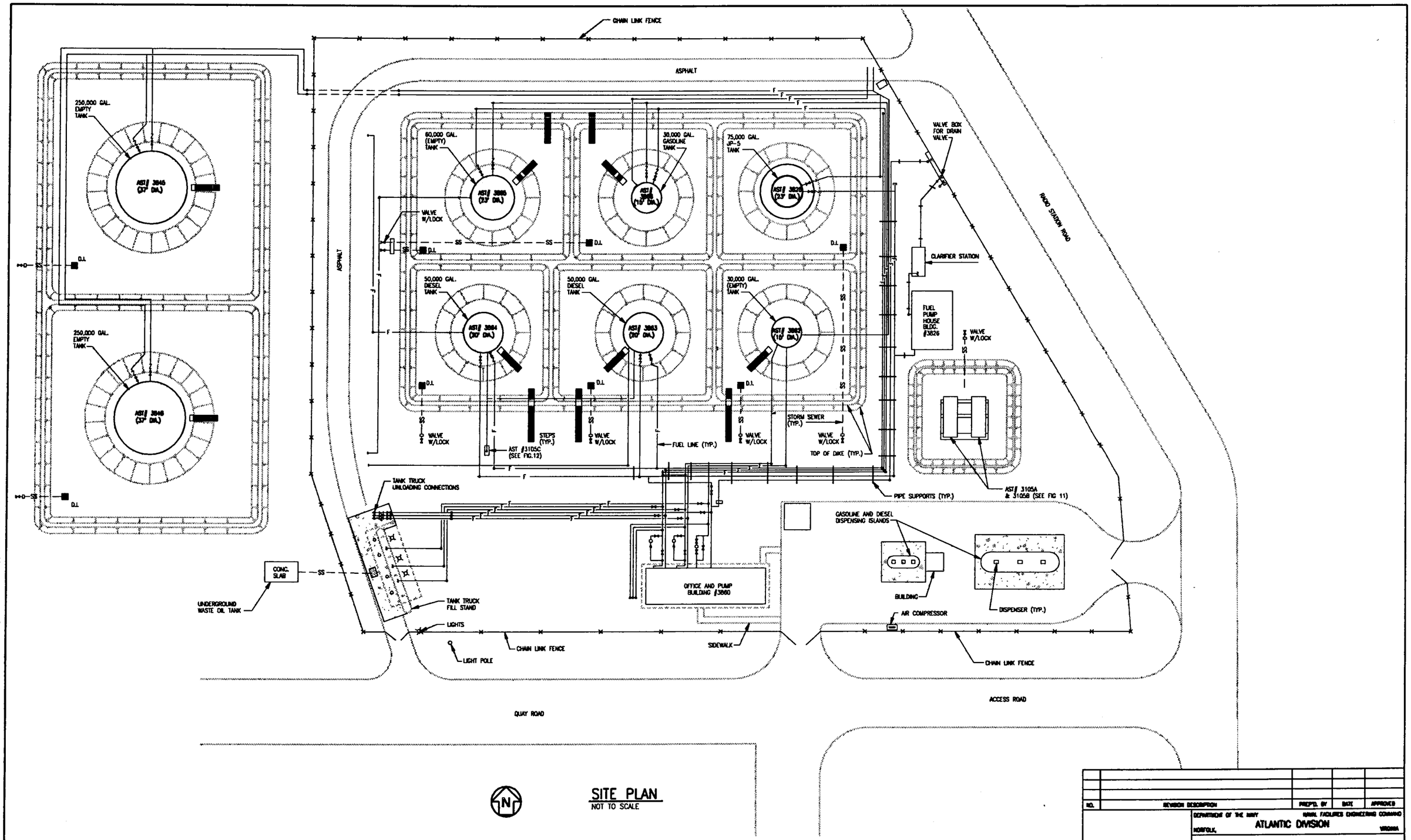
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 23
AST I.D. NO. 3823-2

SCALE: N.T.S.
FILE: FIG 23
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



SITE PLAN
NOT TO SCALE

FIGURE 24

NO.	REVISION DESCRIPTION	PREP'D. BY	DATE	APPROVED

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ATLANTIC DIVISION
NORFOLK, VIRGINIA

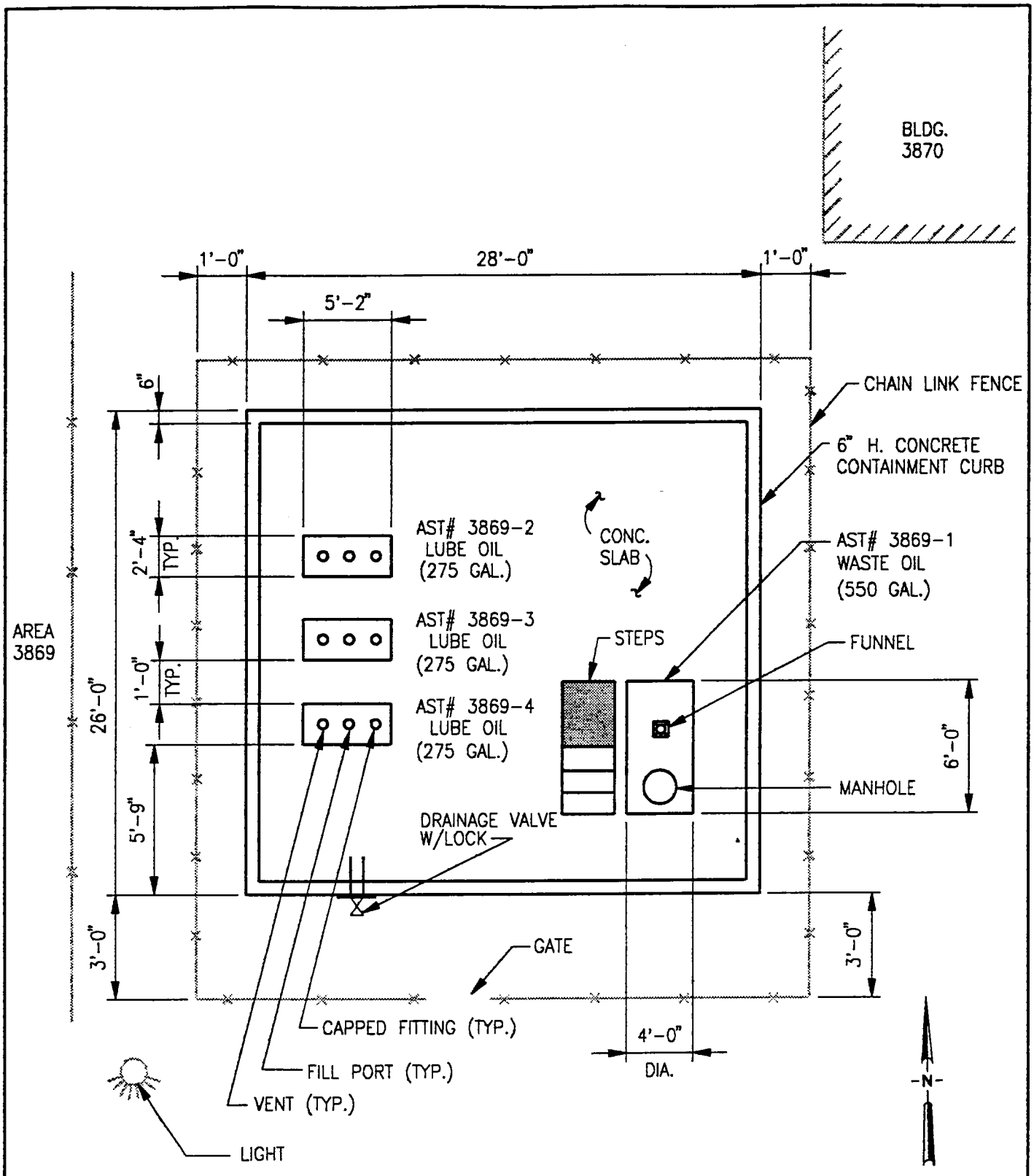
NAVAL AMPHIBIOUS BASE LITTLE CREEK
AST MANAGEMENT PLAN
FUEL FARM
EXISTING CONDITIONS

APPROVED _____ DATE _____

SIZE F | CODE IDENT. NO. | NAVFAC DRAWING NO.

SCALE: NOT TO SCALE | SHEET: 1 OF 1

Drawing File: M:\DWG\95042\CIVIL\A01CGBRE.DWG Last Modified: 12/14/95 @2:11PM by FANNINC Application: AutoCAD



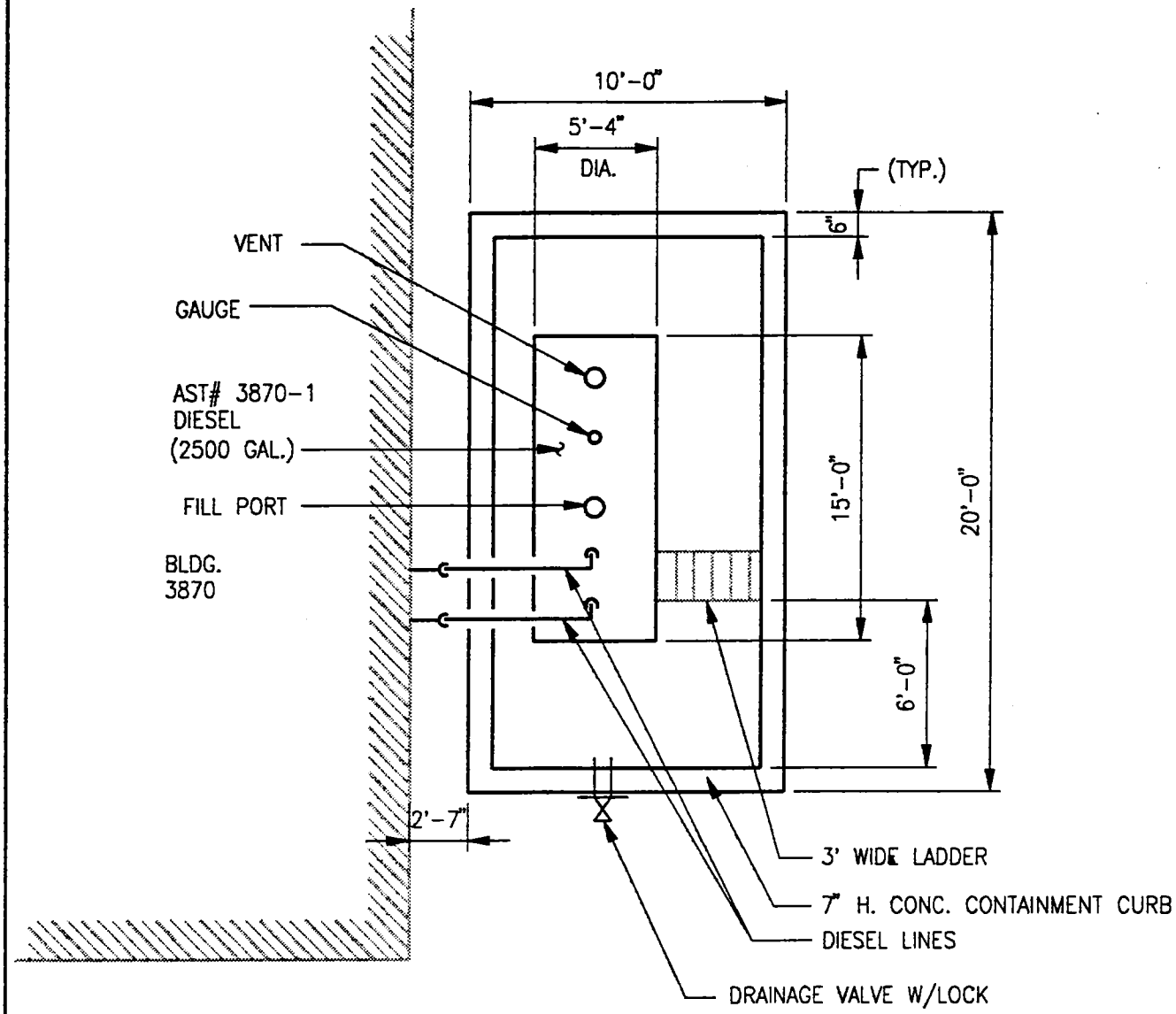
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 25
AST I.D. NO. 3869-1,2, 3&4

SCALE: N.T.S.
FILE: FIG 25
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA. 30345



AST MANAGEMENT PLAN

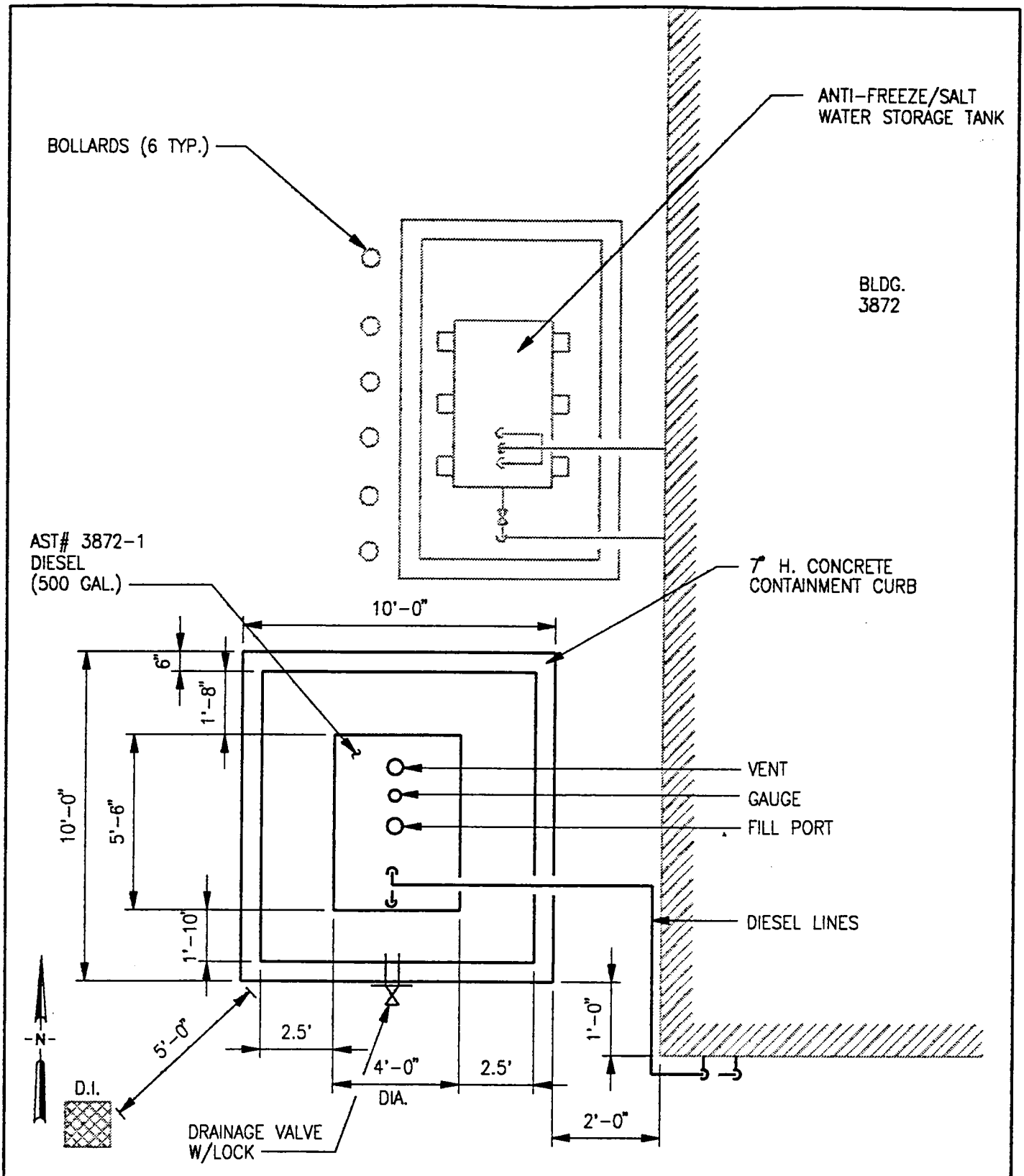
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 26
AST I.D. NO. 3870-1

SCALE: N.T.S.
FILE: FIG 26
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345



AST MANAGEMENT PLAN

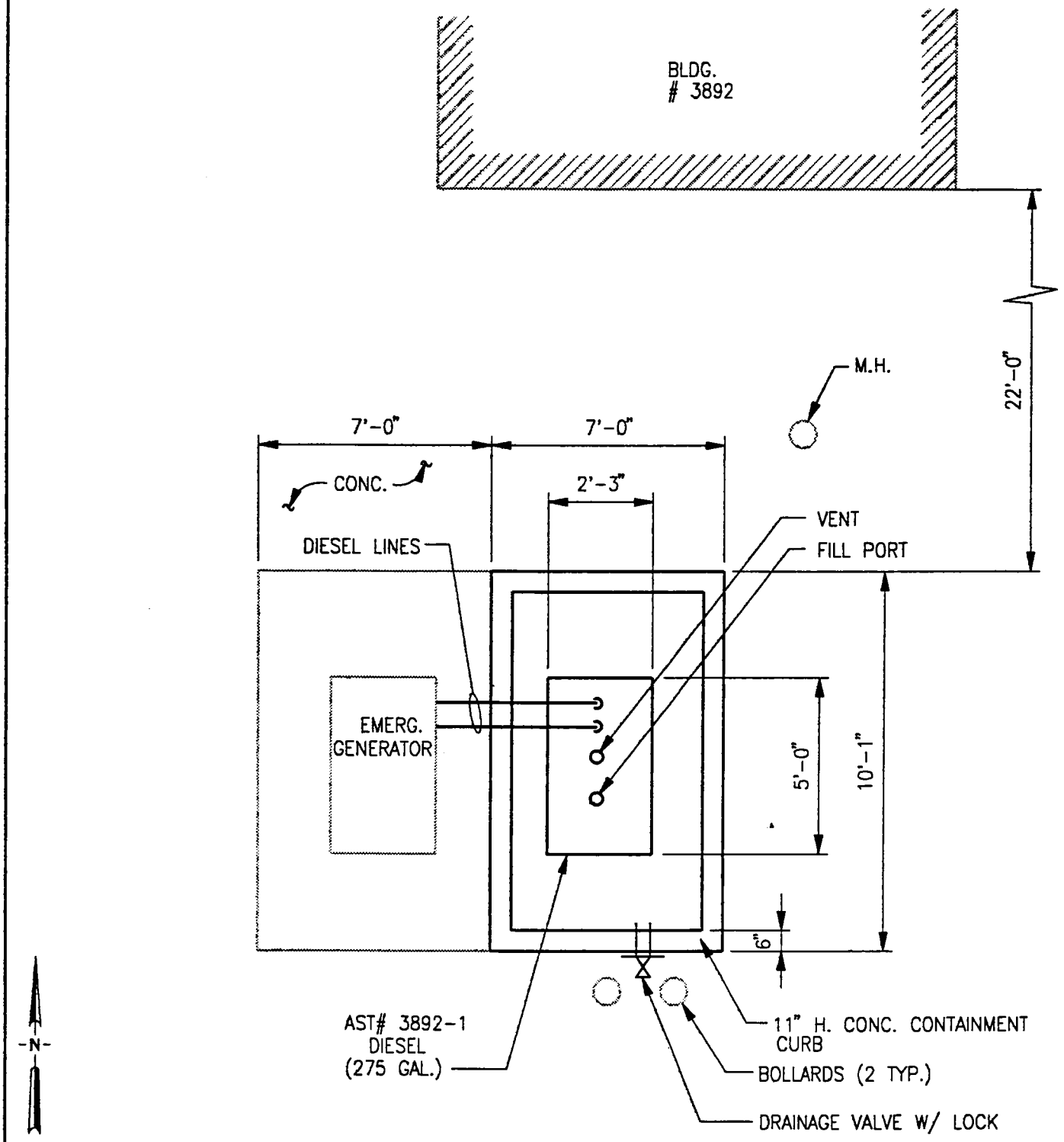
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 27
AST I.D. NO. 3872-1

SCALE: N.T.S.
FILE: FIG 27
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



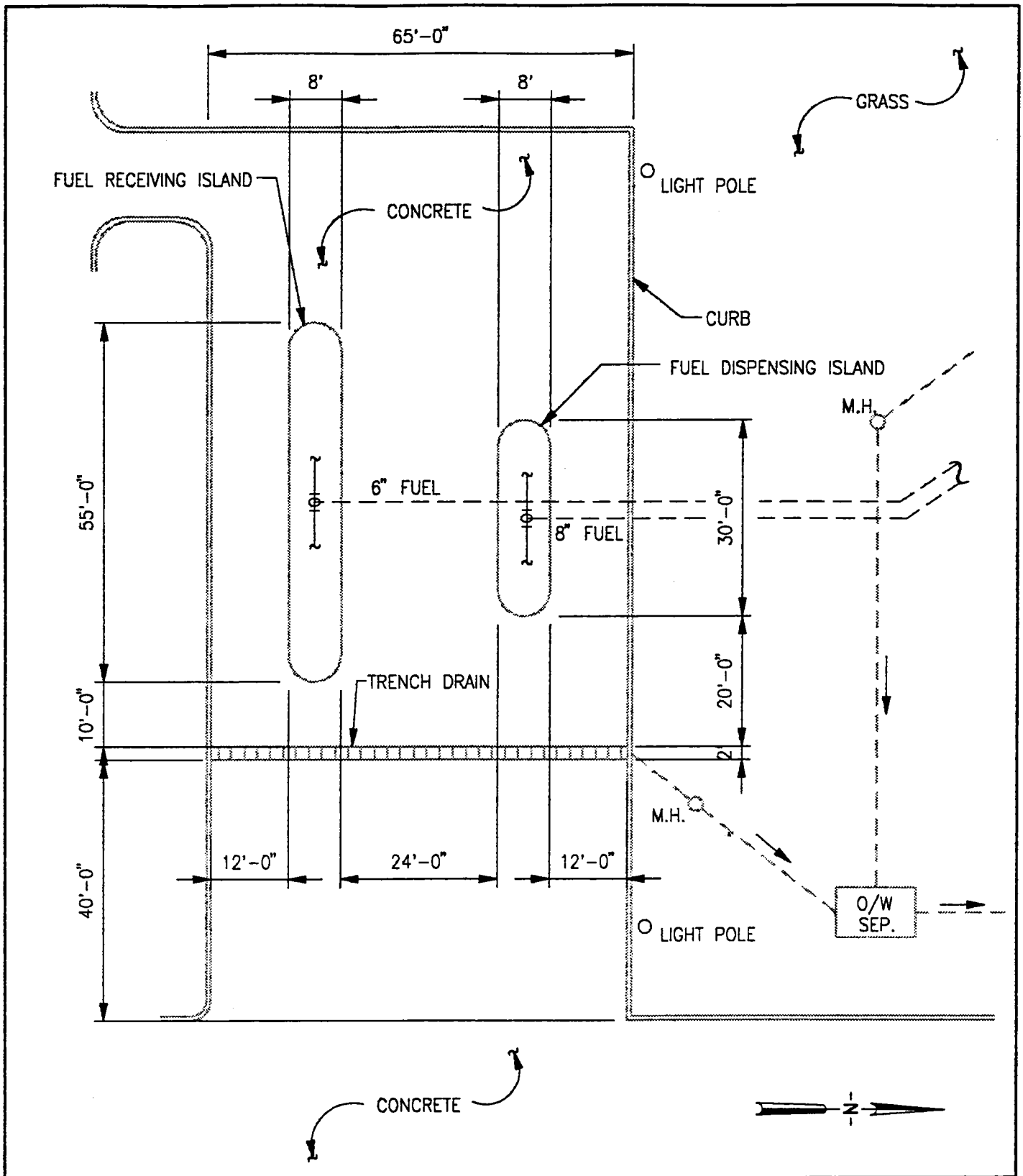
AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 28
AST I.D. NO. 3892-1

SCALE: N.T.S.
FILE: FIG 28
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345



AST MANAGEMENT PLAN

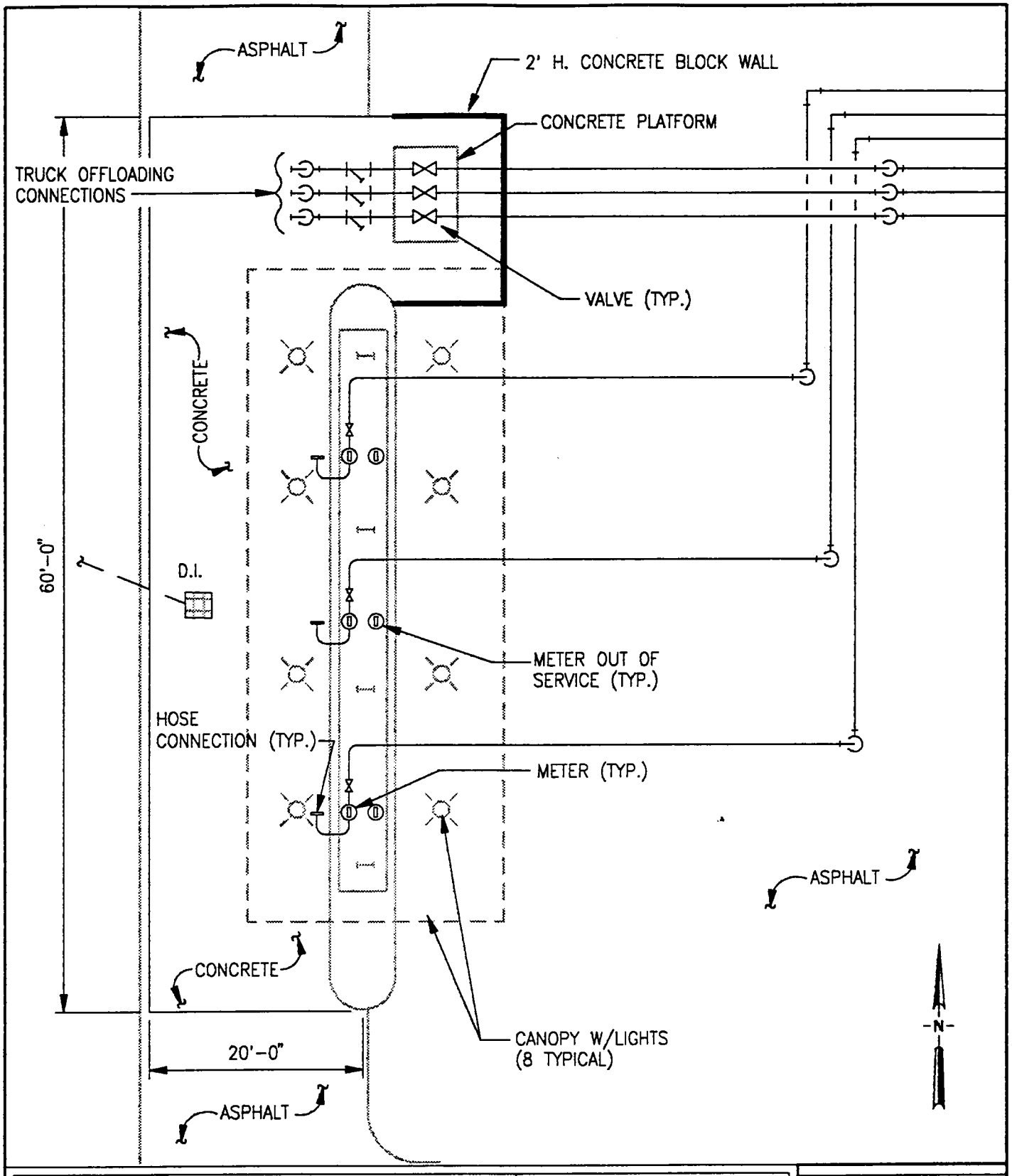
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 29
JP-5 LOADING AREA

SCALE: N.T.S.
FILE: FIG 26
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA. 30345



AST MANAGEMENT PLAN

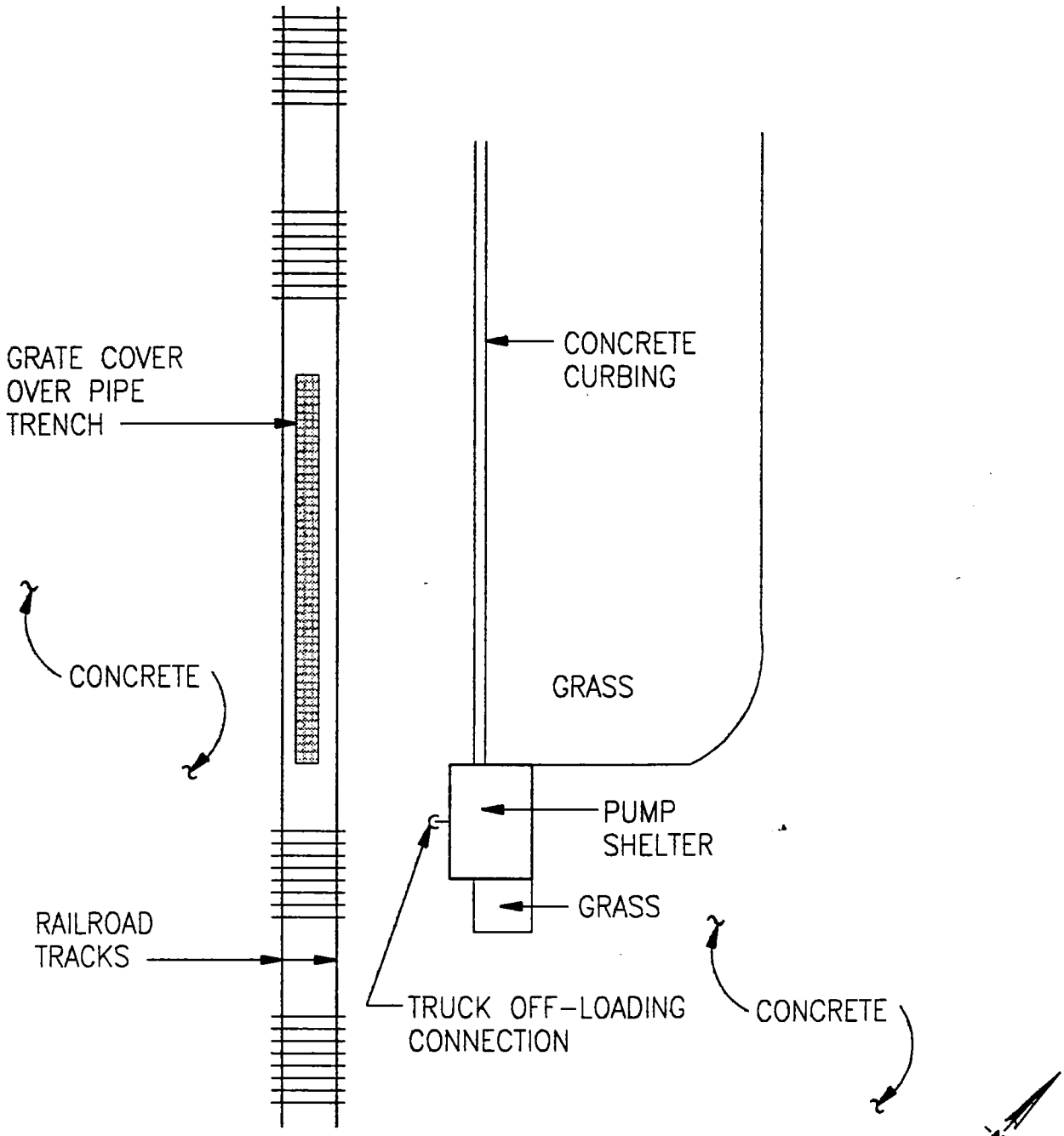
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 30
LOADING AREA #3861

SCALE: N.T.S.
FILE: FIG 30
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA. 30345



STEAM PLANT TRUCK UNLOADING AREA

AST MANAGEMENT PLAN

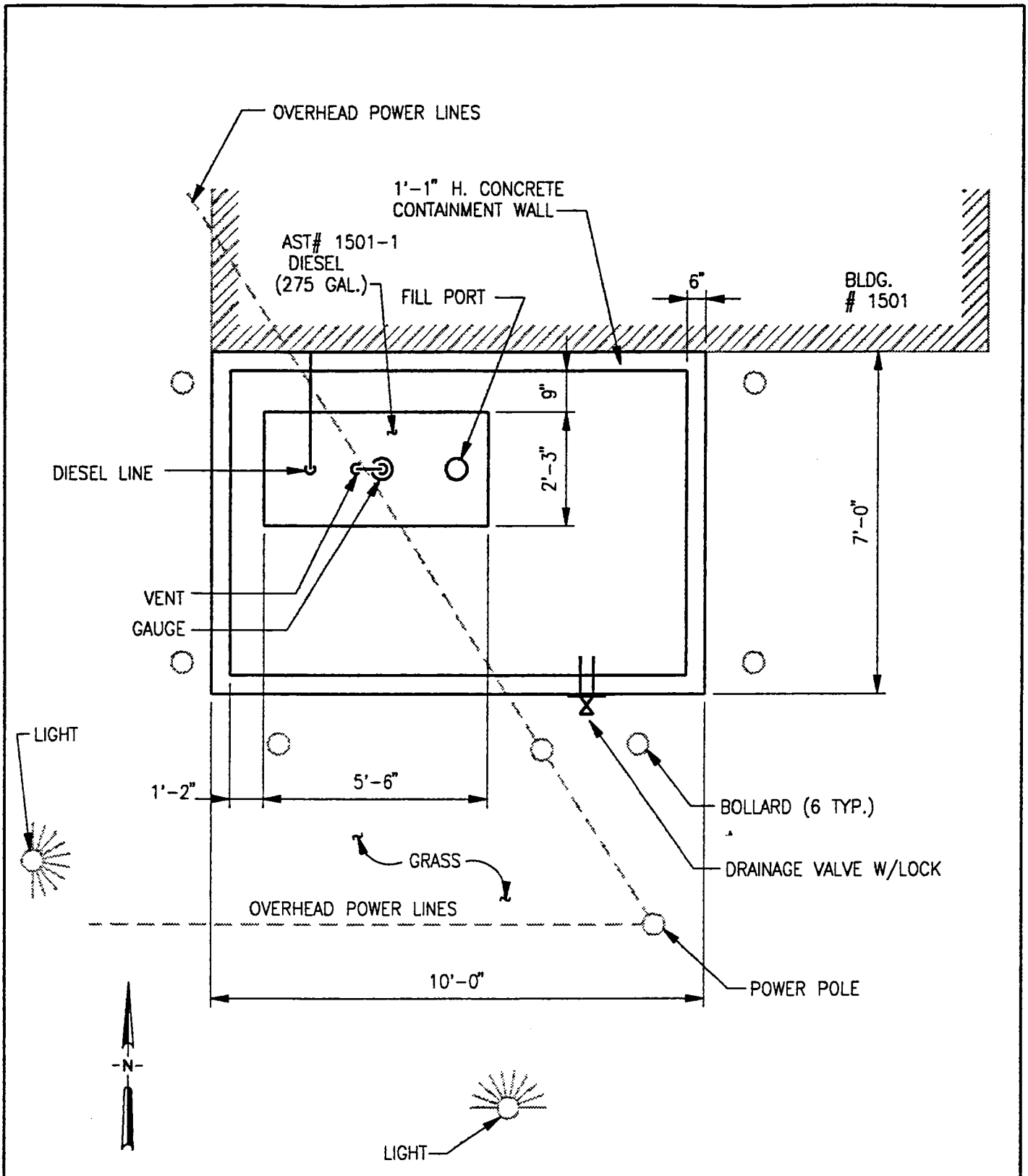
NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 31
STEAM PLANT UNLOADING

SCALE: N.T.S.
FILE: FIG. 31
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345

SITE SKETCHES
for Tanks Under the Responsibility of PWC

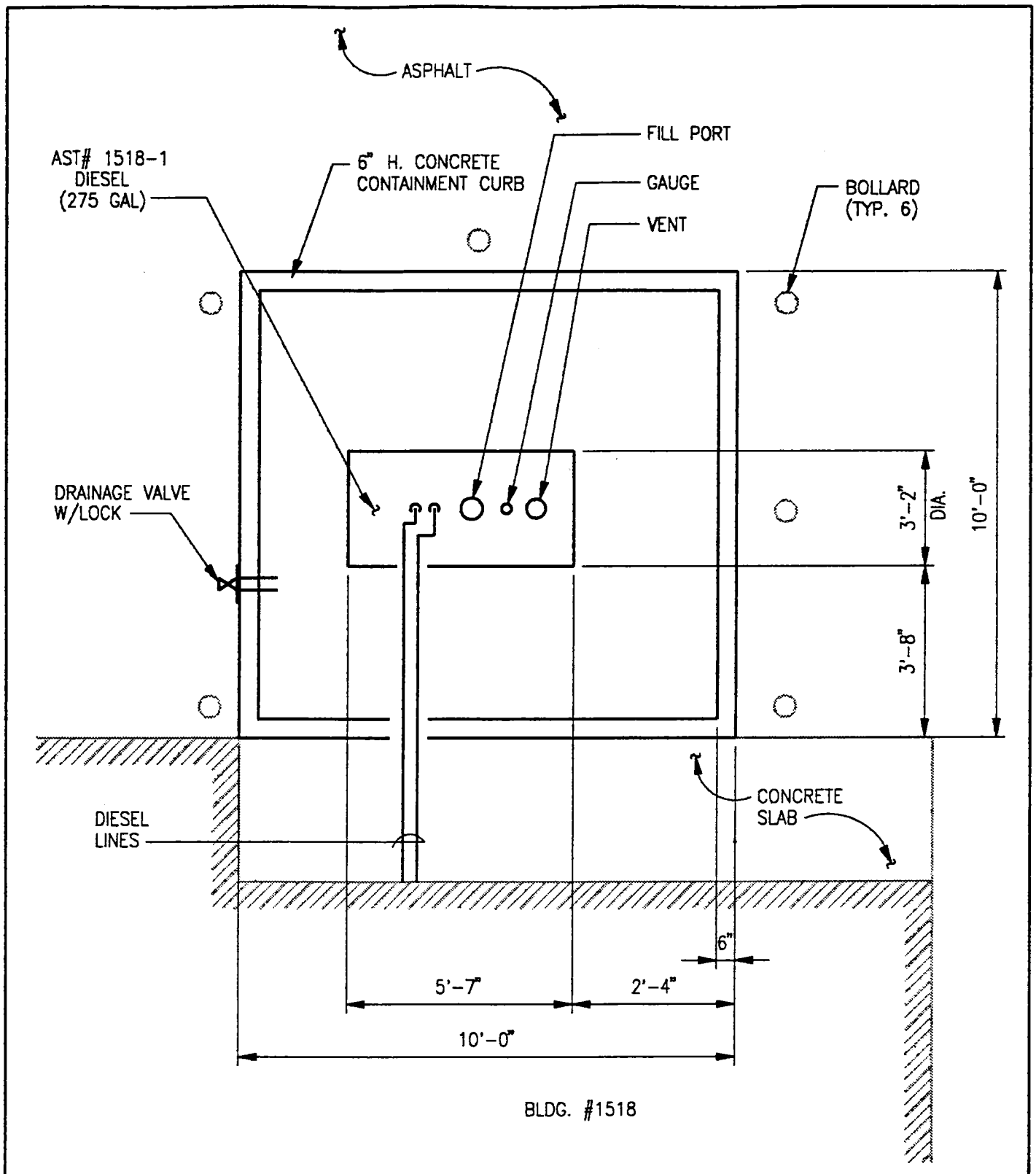


AST MANAGEMENT PLAN

NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO.	32
AST I.D. NO.	1501-1
SCALE:	N.T.S.
FILE:	FIG 32
DATE:	JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



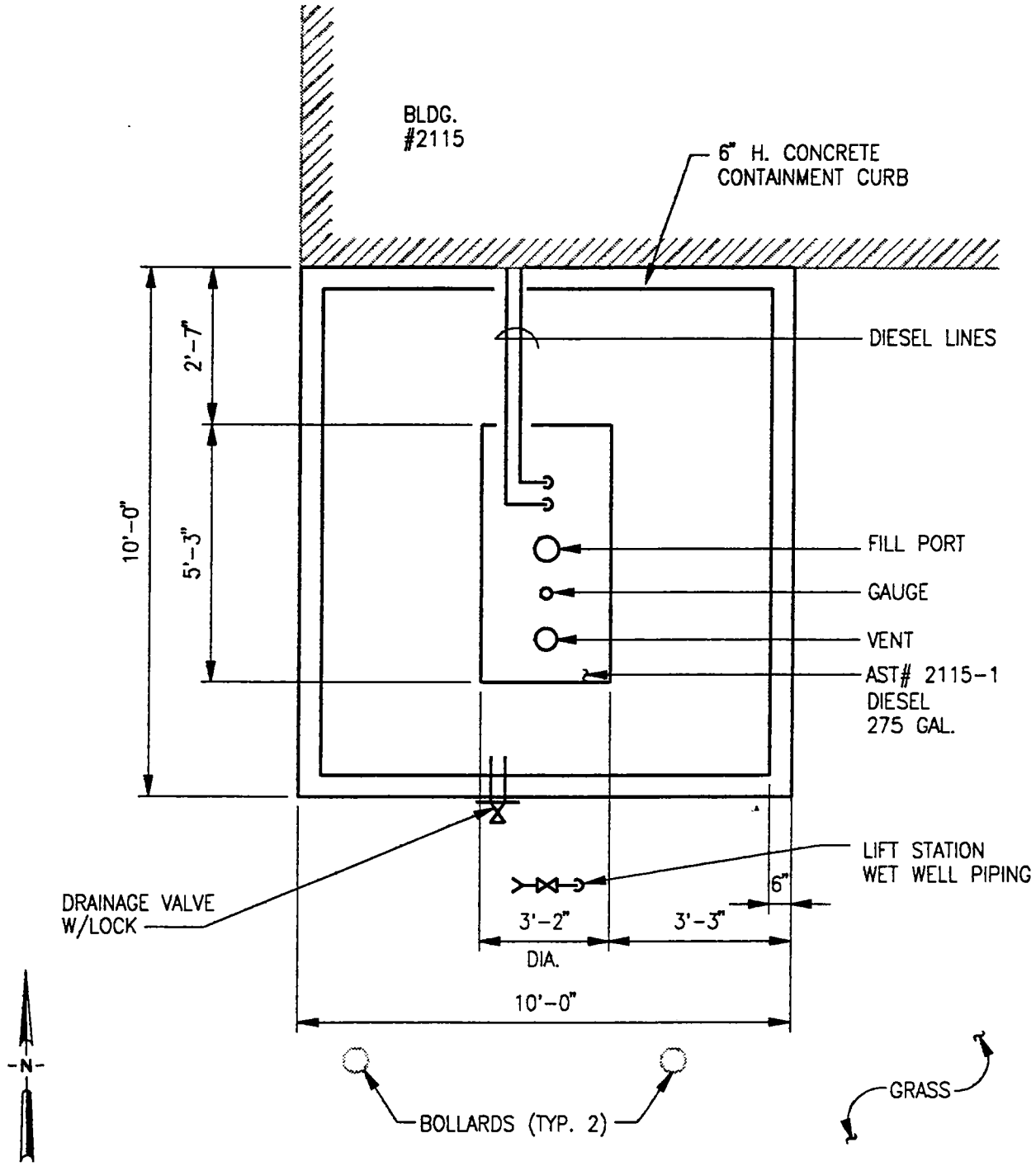
AST MANAGEMENT PLAN

NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO.	33
AST I.D. NO.	1518-1
SCALE:	N.T.S.
FILE:	FIG 33
DATE:	JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



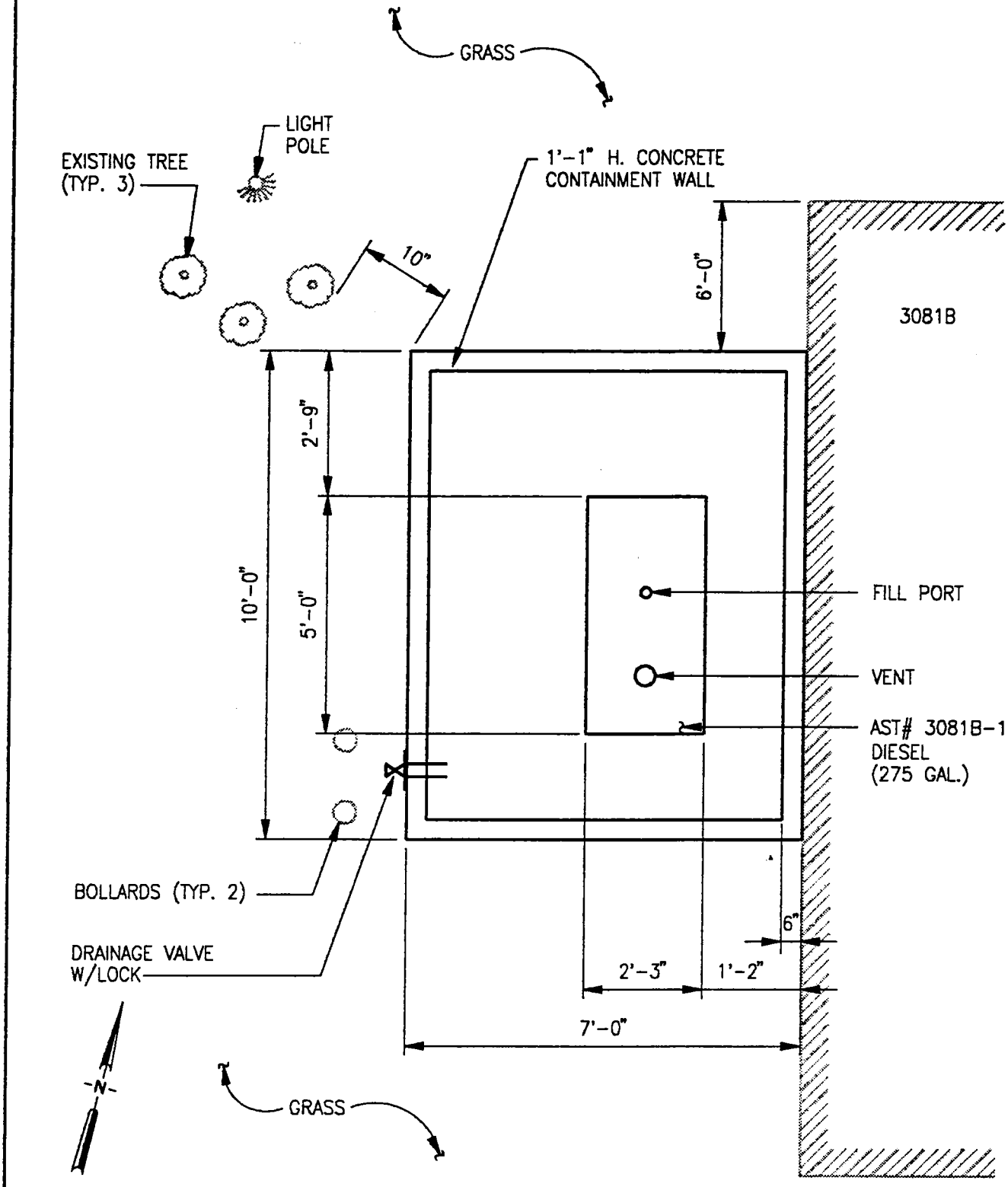
AST MANAGEMENT PLAN

NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO.	34
AST I.D. NO.	2115-1
SCALE:	N.T.S.
FILE:	FIG 34
DATE:	JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345



AST MANAGEMENT PLAN

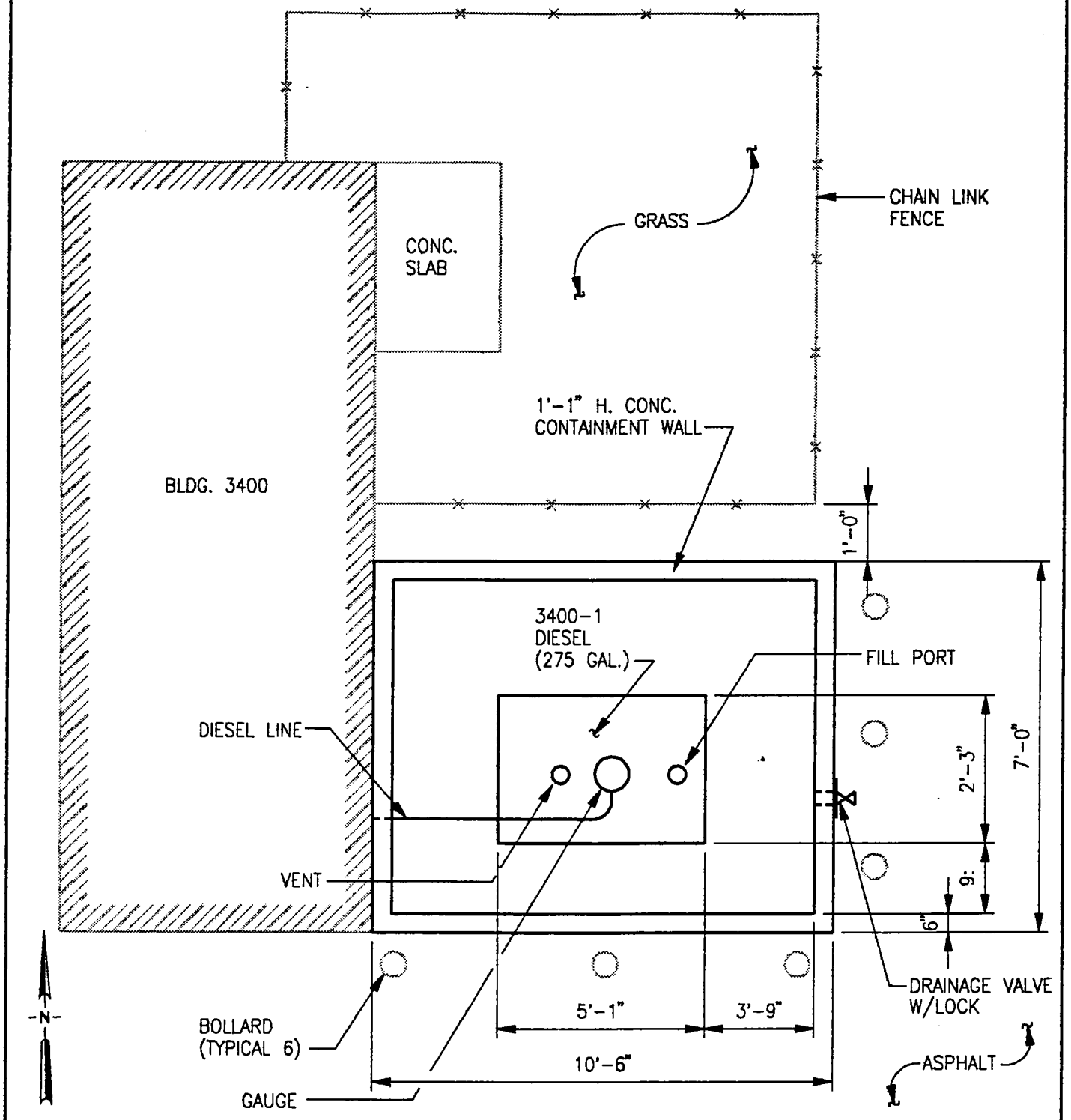
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO.	35
AST I.D. NO.	3081B-1
SCALE:	N.T.S.
FILE:	FIG 35
DATE:	JULY 1995

ARMOUR CAPE & POND

2835 CENTURY PARKWAY
ATLANTA GA. 30345



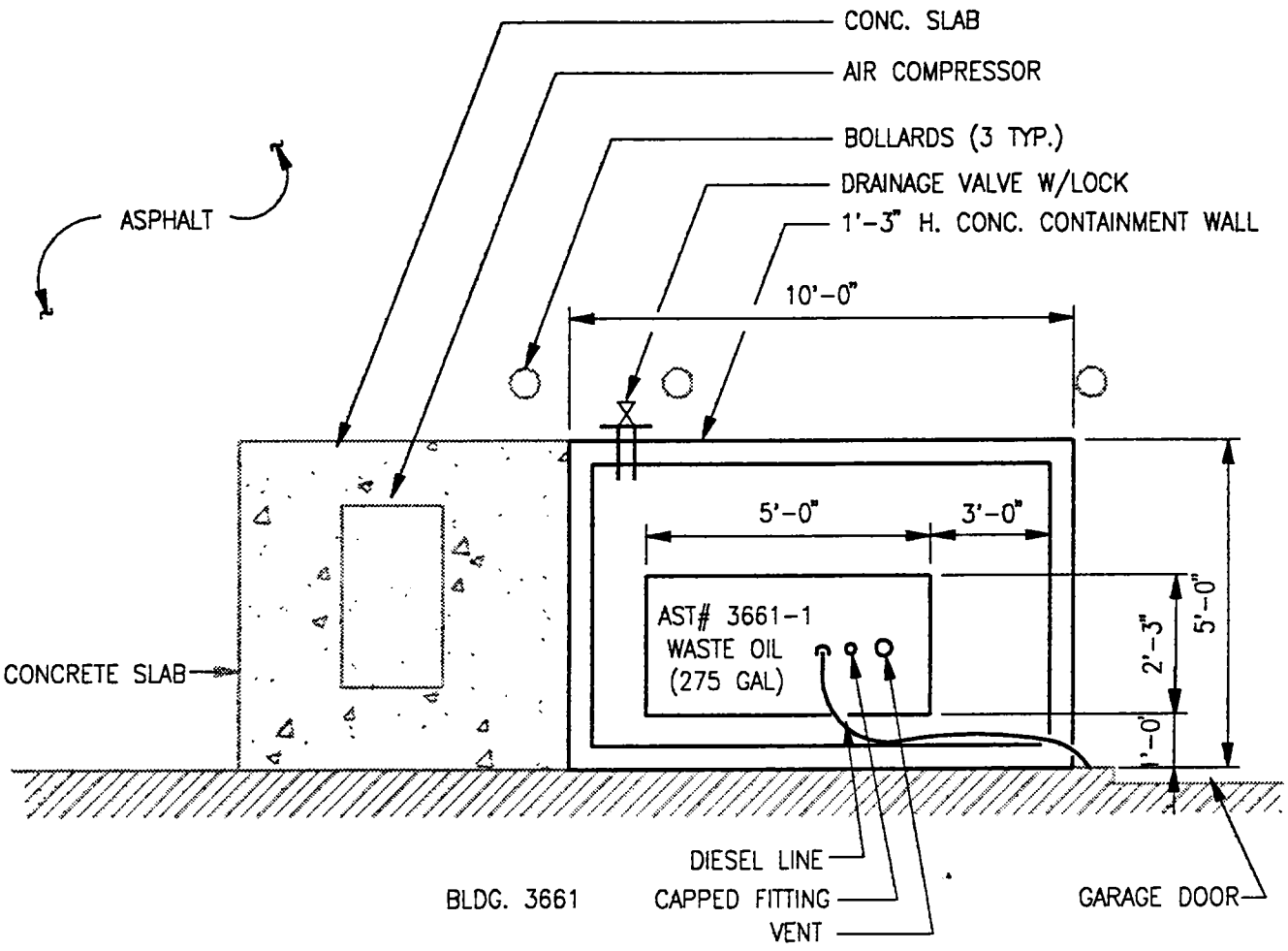
AST MANAGEMENT PLAN

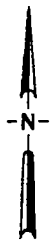
NAB LITTLE CREEK
NORFOLK, VIRGINIA

FIGURE NO. 36
AST I.D. NO. 3400-1

SCALE: N.T.S.
FILE: FIG 36
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345





AST MANAGEMENT PLAN

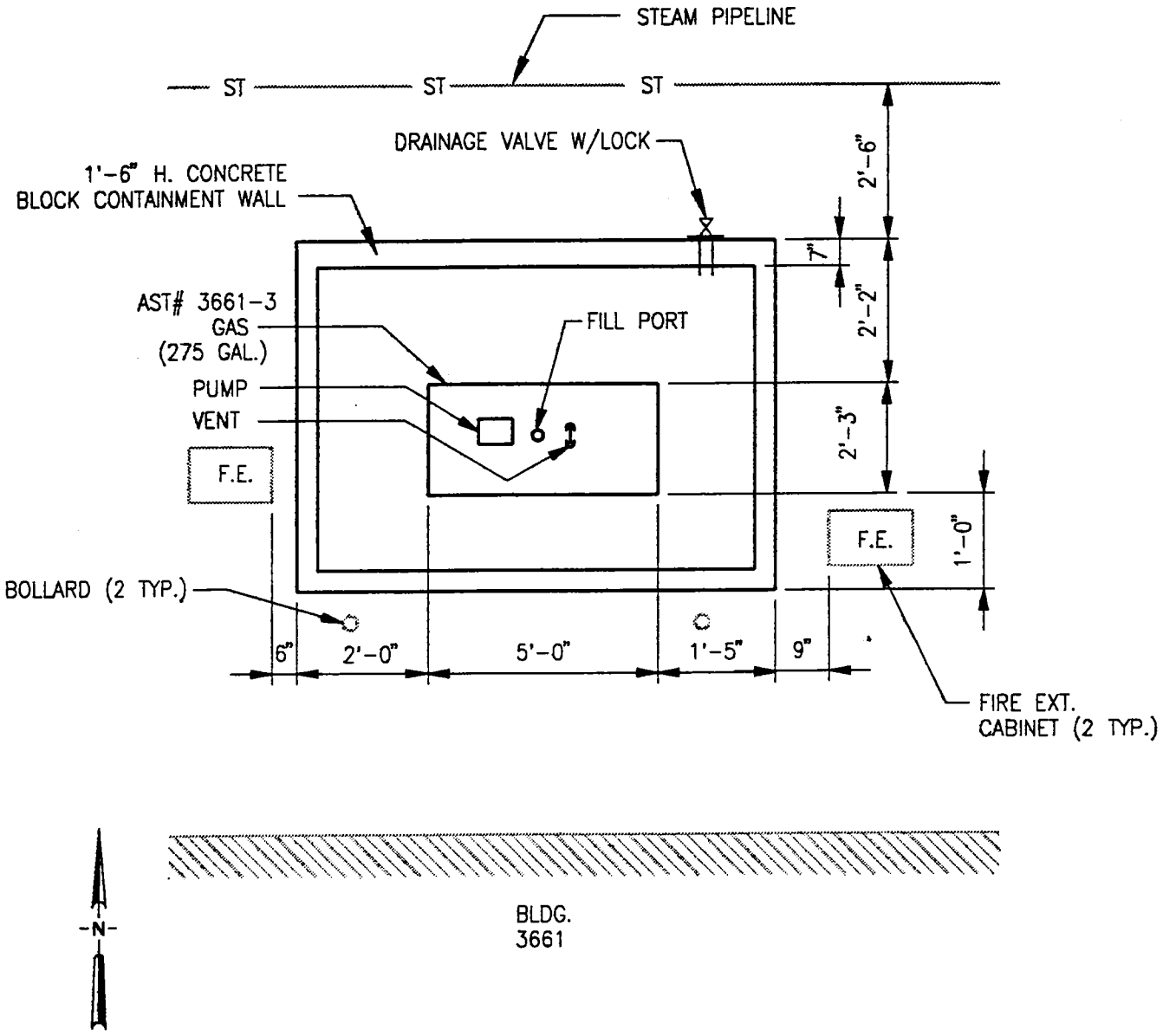
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 37
AST I.D. NO. 3661-1

SCALE: N.T.S.
FILE: FIG 37
DATE: JULY 1995

ARMOUR CAPE & POND
2835 CENTURY PARKWAY
ATLANTA GA 30345



AST MANAGEMENT PLAN

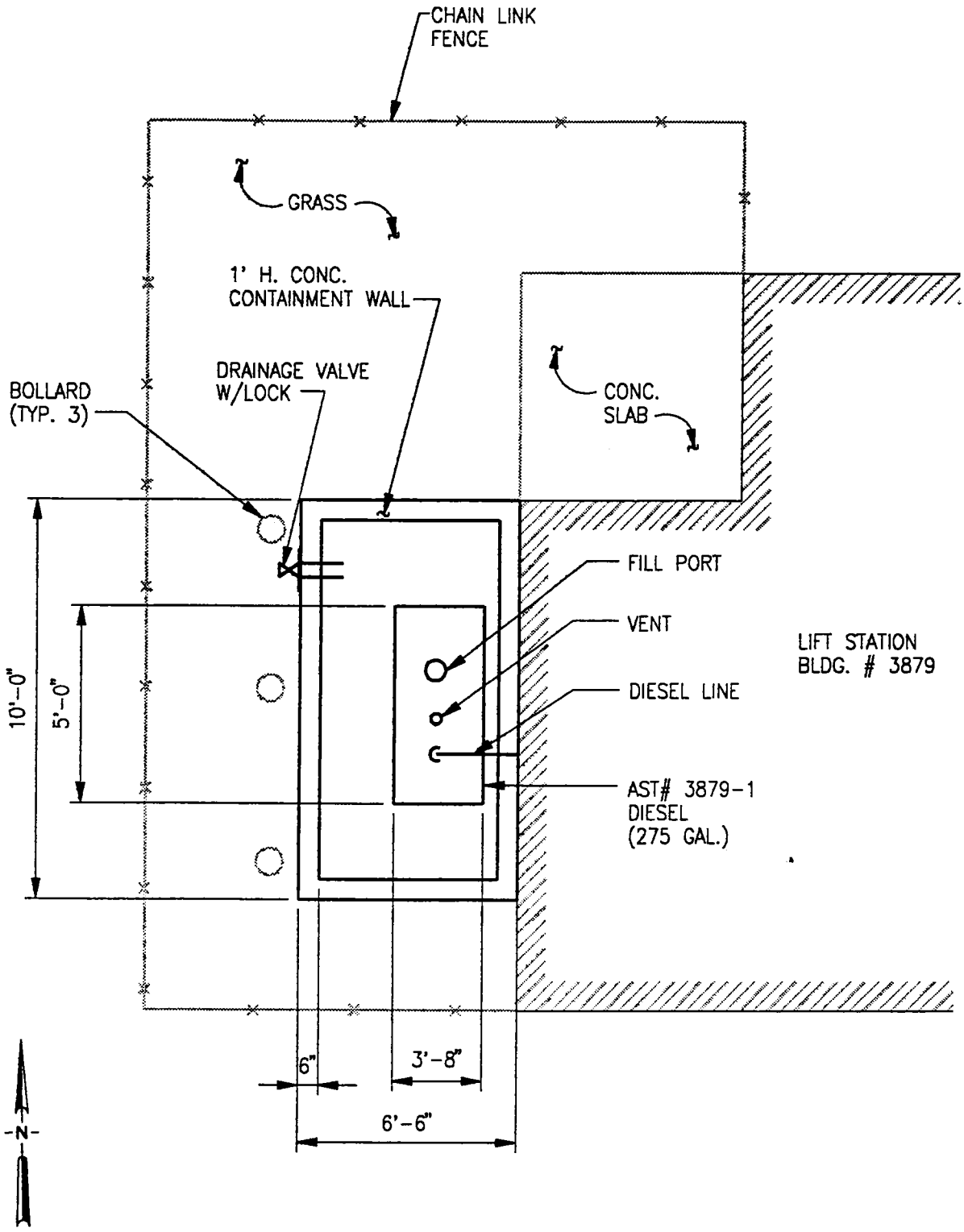
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 38
AST I.D. NO. 3661-3

SCALE:	N.T.S.
FILE:	FIG 38
DATE:	JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345



AST MANAGEMENT PLAN

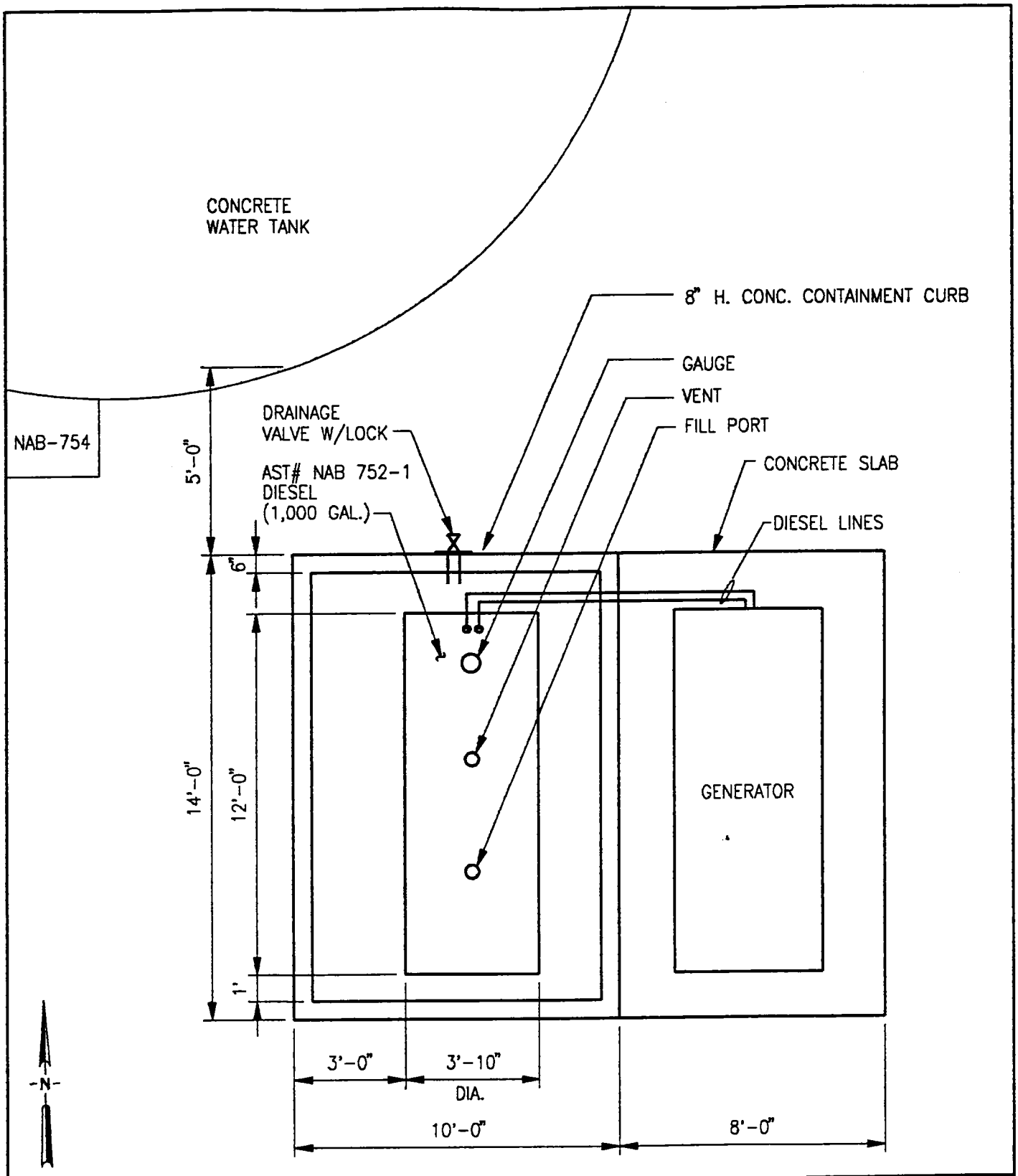
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 39
AST I.D. NO. 3879-1

SCALE: N.T.S.
FILE: FIG 39
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



AST MANAGEMENT PLAN

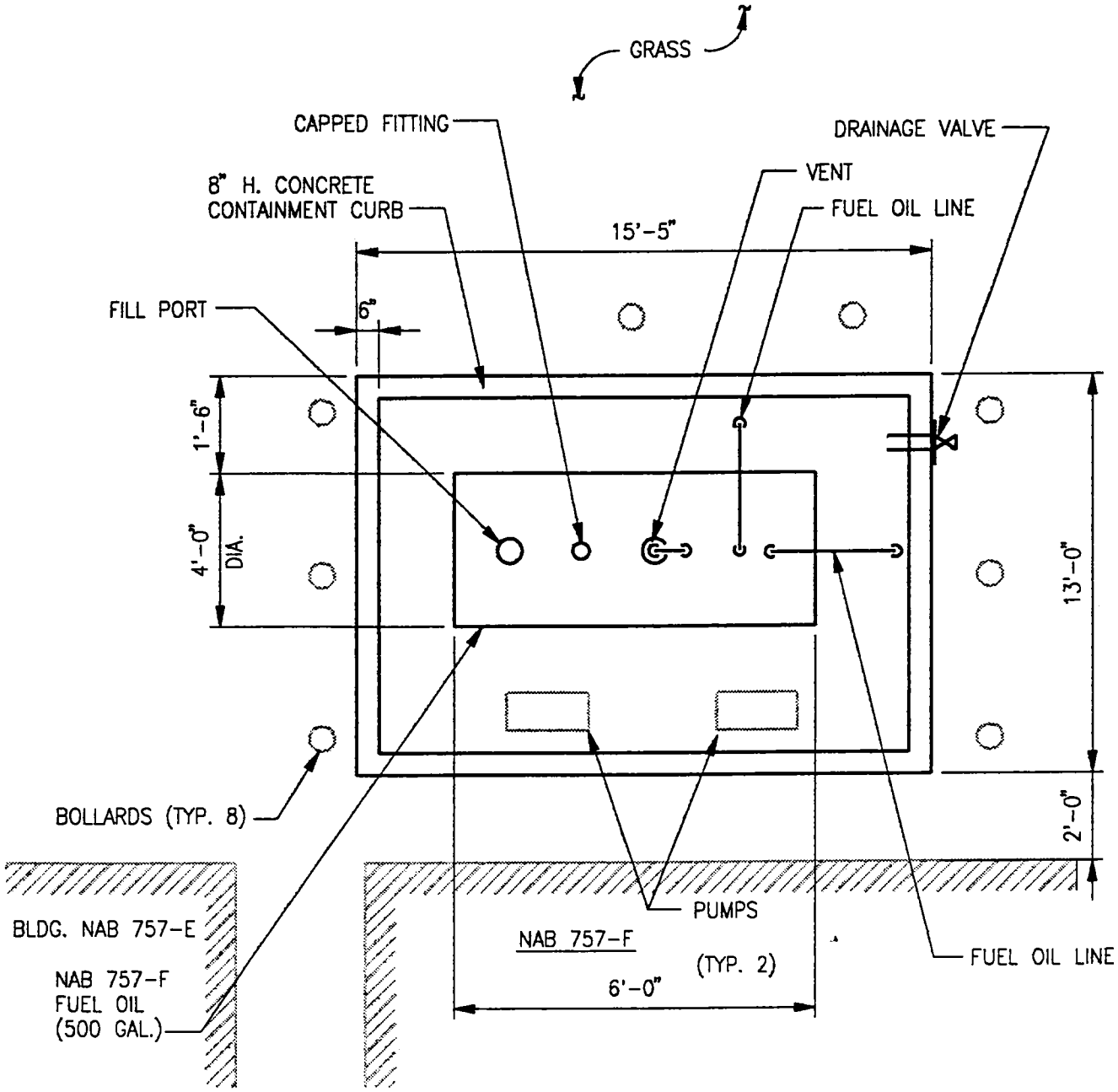
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 40
AST I.D. NO. NAB 752-1

SCALE: N.T.S.
FILE: FIG 40
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345



AST MANAGEMENT PLAN

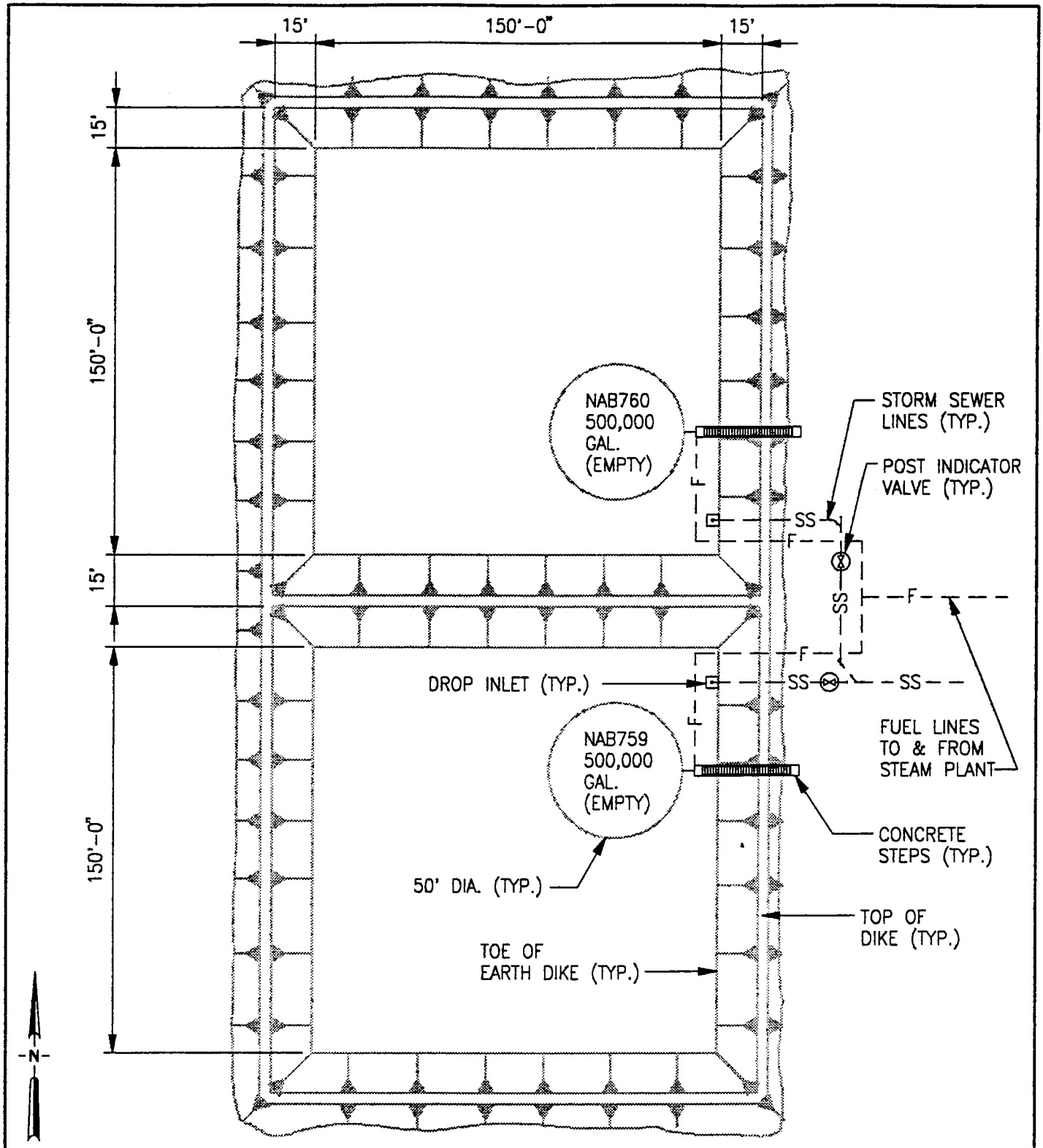
NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 41
AST I.D. NO. NAB 757-F

SCALE: N.T.S.
FILE: FIG 41
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA 30345



AST MANAGEMENT PLAN

NAB LITTLE CREEK

NORFOLK, VIRGINIA

FIGURE NO. 42
AST I.D. NO. 759 & 760

SCALE: N.T.S.
FILE: FIG 42
DATE: JULY 1995

ARMOUR CAPE & POND
2635 CENTURY PARKWAY
ATLANTA GA. 30345

Waste Oil Storage Tank (#1231-1)

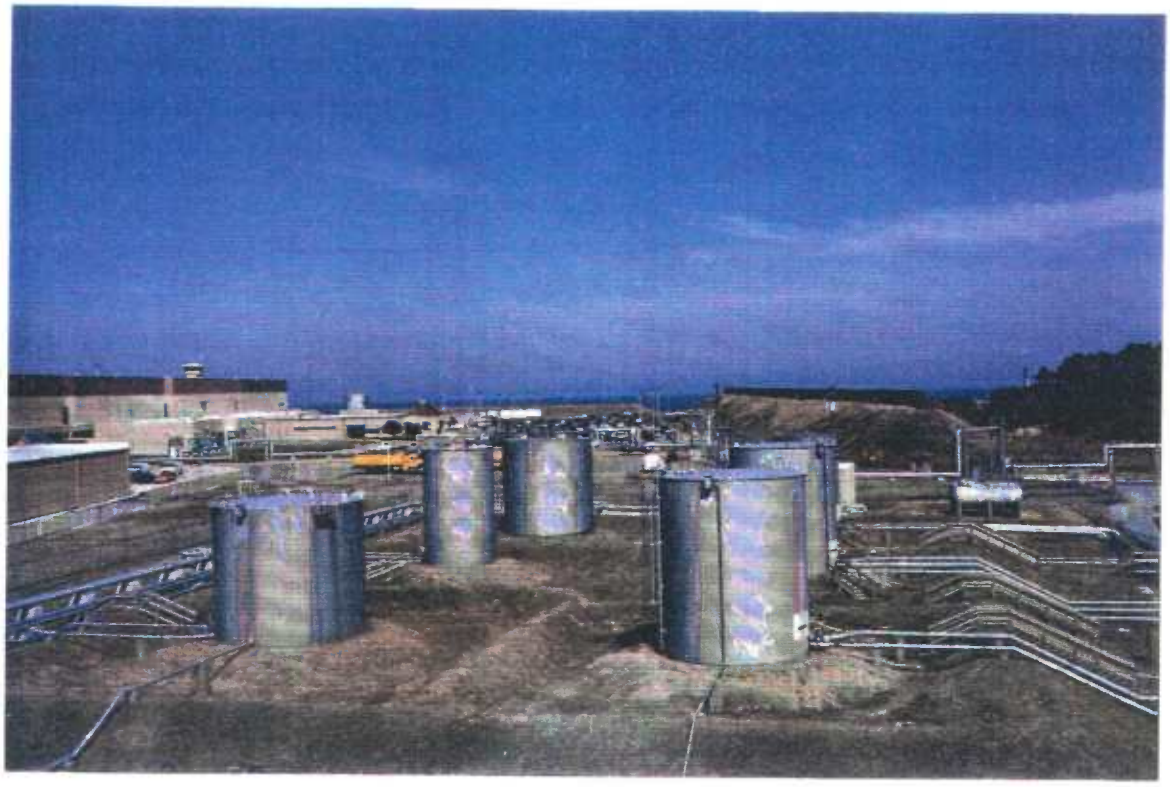
Heating Oil Storage Tank (#3151-2)

Diesel Storage Tank for Emergency Generator (#3823-2)

Diesel Storage Tank for Emergency Generator (#NAB 752-1)

Gasoline and Diesel Storage Tanks for Dispensing (#3699-1 and #3699-2)

Gasoline and Diesel Storage Tanks for Dispensing (#1515-1 and #1515-2)



Bulk Storage Tanks at Fuel Farm

Bulk Storage Tanks at Fuel Farm

Bulk Storage Tanks at Fuel Farm (#3845 and #3846)

Bulk Storage Tank at Fuel Farm (#3865)

Fuel Oil Storage Tank for Steam Plant (#NAB 759)

Steam Plant Truck Unloading Area (Bldg. #NAB 757)

Loading Area (#3861)

JP-5 Loading Area (ACU-4)

Horizontal Storage Tanks at Fuel Farm (#3105A and #3105B)

Oily Waste Storage Tank
(Tank not included in plan)

APPENDICES

APPENDIX A

Commonwealth of Virginia Regulations
"Aboveground Storage Tank Pollution Prevention Requirements"
(VR 680-14-13)

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF ENVIRONMENTAL QUALITY

VR 680-14-13 - Aboveground Storage Tanks Pollution Prevention Requirements.

Adopted: May 10, 1993 - Effective Date: June 30, 1993

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VR 680-14-13. Aboveground Storage Tanks Pollution Prevention Requirements.

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§ 1. Definitions.

The following words and terms, when used in this regulation, shall have the following meaning, unless the context clearly indicates otherwise:

"Aboveground storage tank" or "AST" means any one or combination of tanks, including pipes, used to contain an accumulation of oil at atmospheric pressure, and the volume of which, including the volume of the pipes, is more than 90% above the surface of the ground. This term does not include line pipe and breakout tanks of an interstate pipeline regulated under the Hazardous Liquid Pipeline Safety Act of 1979.

"Containment and cleanup" means abatement, containment, removal and disposal of oil, and to the extent possible, the restoration of the environment to its existing state prior to an oil discharge.

"Department" means the Department of Environmental Quality.

"Discharge" means any spilling, leaking, pumping, pouring, emitting, emptying, or dumping.

"Facility" means any development or installation within the Commonwealth that deals in, stores or handles oil, and includes a pipeline.

"Local building official" means the person authorized by the Commonwealth to enforce the provisions of the Uniform Statewide Building Code (USBC).

"Local director of emergency services" means any person or any coordinator appointed pursuant to § 44-146.19 of the Code of Virginia.

"Oil" means oil of any kind and in any form, including, but not limited to, petroleum and petroleum by-products, fuel oil, lubricating oils, sludge, oil refuse, oil mixed with other wastes, crude oils, and all other liquid hydrocarbons regardless of specific gravity. For the purpose of this regulation only, this definition does not include dredge spoils.

"Operator" means any person who owns, operates, charters, rents, or otherwise exercises control over or responsibility for a facility or a vehicle or vessel;

"Person" means any firm, corporation, association or partnership, one or more individuals, or any governmental unit, or agency thereof;

"Pipeline" means all new and existing pipe, rights-of-way, and any equipment, facility, or building used in the transportation of oil, including but not limited to, line pipe, valves, and other appurtenances connected to line pipe, pumping units, fabricated assemblies associated with pumping units, metering and delivery stations and fabricated assemblies therein, and breakout tanks.

"Storage capacity" means the total capacity of an AST or a container, whether the AST or container is filled in whole or in part with oil, or a mixture of oil or other substances, or is empty. This term does not include the capacity of any AST, which has been permanently closed in accordance with this regulation.

"Tank" means a device designed to contain an accumulation of oil and constructed of nonearthen materials, such as concrete, steel, or plastic, which provide structural support. This term does not include flow-through process equipment used in processing or treating oil by physical, biological, or chemical means;

"Tank vessel" means any vessel used in the transportation of oil as cargo;

"Uniform Statewide Building Code" or "USBC" means § 36-99 et seq. of the Code of Virginia.

"Vehicle" means any motor vehicle, rolling stock, or other artificial contrivance for transport whether self-propelled or otherwise, except vessels.

"Vessel" includes every description of watercraft or other contrivance used as a means of transporting on water, whether self-propelled or otherwise, and shall include barges and tugs.

"VR 680-14-12" means the Facility and Aboveground Storage Tank Registration Requirements.

§ 2. Applicability.

A. This regulation applies to (i) a facility located within the Commonwealth with an aggregate aboveground storage

capacity of more than 25,000 gallons of oil, or (ii) any individual AST located within the Commonwealth with a storage capacity of more than 25,000 gallons of oil, unless otherwise specified within this regulation.

B. The requirements of this regulation do not apply to:

1. Vessels or vehicles;

2. An AST containing petroleum, including crude oil or any fraction thereof, which is liquid at standard conditions of temperature and pressure (60°F and 14.7 pounds per square inch absolute) subject to and specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. § 9601);

3. Any wastewater treatment tank system that is part of a wastewater treatment facility regulated under § 402 or § 307(b) of the Clean Water Act;

4. An AST which is regulated by the Department of Mines, Minerals and Energy under Chapter 22.1 of Title 45.1 of the Code of Virginia;

5. An AST used for the storage of products that are regulated pursuant to the Federal Food, Drug, and Cosmetic Act, (21 U.S.C. § 301, et seq.);

6. An AST which is used to store hazardous wastes listed or identified under Subtitle C of the Solid Waste Disposal Act, (42 U.S.C. § 6901, et seq.) or a mixture of such hazardous wastes and other regulated substances;

7. An AST which is used to store propane gas;

8. An AST used to store nonpetroleum hydrocarbon-based animal and vegetable oils;

9. A nonstationary AST liquid trap or associated gathering lines directly related to oil and gas production or gathering;

10. A surface impoundment, pit, pond, or lagoon;

11. A stormwater or wastewater collection system;

12. Equipment or machinery that contains oil for operational purposes;

13. A farm or residential tank of 1,100 gallons or less capacity used for storing motor fuel for noncommercial purposes;

14. A tank of 1,100 gallons or less capacity used for storing heating oil for consumptive use on the premises where stored;

15. An AST with a storage capacity of 660 gallons or less of oil unless otherwise specified in this regulation; or

16. AST(s) used to contain oil for less than 120 days and only in connection with activities related to the containment and clean up of oil or to any vessel engaged only in activities within state waters related to the containment and clean up of oil, including response related training or drills.

§ 3. Compliance dates.

Operators of facilities with an aggregate aboveground storage capacity of more than 25,000 gallons of oil shall comply with this regulation within 120 days after the effective date of this regulation unless otherwise specified in this regulation. Operators of facilities that will be required to upgrade the existing facility design to comply with this regulation shall submit a compliance schedule to the department within 90 days after the effective date of this regulation.

§ 4. Statement of purpose.

The purpose of this regulation is to develop standards and procedures for operators of facilities with an aggregate aboveground storage capacity of more than 25,000 gallons of oil relating to the prevention of pollution from aboveground storage tanks.

§ 5. Incorporation by reference.

A. The following versions of standards and recommended practices, codes, and federal regulations are hereby incorporated by reference:

1. Underwriters Laboratories Standards. Specification 142, "Steel Aboveground Tanks for Flammable and Combustible Liquids," (1982).

2. American Petroleum Institute Standards.

a. Specification Number 12B and Supplement 2, October 1, 1990, "Specification for Bolted Tanks for Storage of Production Liquids," Thirteenth Edition.

b. Specification Number 12D and Supplement 2, 1982 as supplemented 1985, "Specification for Field Welded or Storage of Production Liquids," Ninth Edition.

c. Specification Number 12 F, and Supplement 1, 1982 as supplemented 1988, "Specification for Shop Welded Tanks for Storage of Production Liquids," Tenth Edition.

d. Standard Number 620, 1985 "Design and Construction of Large, Welded, Low-Pressure Storage Tanks," Eighth Edition.

e. Standard Number 650, 1988, "Welded Steel Tanks for Oil Storage," Eighth Edition, Appendices G and I.

f. Recommended Practice 651, April 1991, "Cathodic Protection of Aboveground Petroleum Storage Tanks," First Edition.

g. Recommended Practice 652, April 1991, "Lining of Aboveground Petroleum Storage Tank Bottoms," First Edition.

h. Standard 653, January 1991, "Tank Inspection, Repair, Alteration, and Reconstruction," First Edition. incorporates Supplement 1, January 1992,

i Recommended Practice 1632, 1987 as supplemented March 1989, "Cathodic Protection of Underground Storage Tanks and Piping Systems."

j. Recommended Practice 2350, March 1987, "Overfill Protection for Petroleum Storage Tanks."

k. Standard 2000, "Venting Atmospheric and Low-Pressure Storage Tanks, (Nonrefrigerated and Refrigerated)."

3. National Fire Protection Association Standards.

a. NFPA 30, "Flammable and Combustible Liquids Code."

b. NFPA 70, "National Electrical Code."

4. National Association of Corrosion Engineers Standards.

a. Recommended Practice 0169-83, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems," 1983.

b. Recommended Practice 0285-85, "Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems," 1985.

5. 33 C.F.R. Part 154, "Oil Pollution Prevention Regulations for Marine Oil Transfer Facilities."

6. 40 C.F.R. Part 112, "Oil Pollution Prevention."

7. 29 C.F.R. Part 1910.106, "Flammable and Combustible Liquids."

B. Industry specifications, standards, and codes, to the extent specified in the text of this regulation, are adopted and by reference are incorporated into and shall form a part of the regulation as limited, modified, or replaced by specific requirements stated otherwise and approved by the department.

C. The current issue of the industry specification, standard, or code, including addenda or changes, described in the regulation as adopted by reference, shall be used unless circumstances warrant the use of an earlier or later date and specifically authorized by the department.

§ 6. Pollution prevention standards and procedures.

A. For existing aboveground storage tanks at a facility with an aggregate storage capacity of 1 million gallons of oil or greater or an existing individual aboveground storage tank with a storage capacity of 1 million gallons of oil or greater the following requirements apply unless previously exempted in this regulation:

1. Inventory control, testing for variations, and formal tank tests. An AST with a storage capacity of less than 12,000 gallons shall not be subject to the reinspection requirement unless circumstances warrant and deem a reinspection necessary by the department.

a. Each operator shall institute inventory control procedures capable of detecting a significant variation of inventory. A significant variation shall be considered a variation in excess of 1/2 of 1.0% of the storage capacity of each individual AST. For a refinery, a significant variation of inventory shall be considered a loss in excess of 1/2 of 1.0% by weight of the difference between the refinery's input and output. Reconciliations shall be conducted monthly. If the significant variation persists for two consecutive reconciliation periods, the operator

shall conduct an investigation to determine the cause of the variation. This investigation shall be completed within five working days of the end of the second reconciliation period. If this investigation does not reveal the source of the inventory variation, the operator shall notify the department and the local director or coordinator of emergency services and conduct additional testing to determine the reason for the variation. The testing method, schedule, and results shall be submitted to the department for review. Inventories shall also be reconciled after each pipeline/tank vessel receipt or transfer of oil, and the investigating procedures, and requirements of reporting variances in reconciliations described above shall be followed.

b. Inventory records shall be kept of incoming and outgoing volumes of oil and oil movements within the facility. All tanks shall be gauged on a daily basis during each day of normal operation and after each pipeline/tank vessel receipt or transfer of oil. Physical measurements shall be reconciled to 60°F and 14.7 pounds per square inch absolute.

c. All AST's shall be formally inspected on the following basis:

(1). Each AST shall undergo a formal external tank inspection every five years using industry accepted methods of nondestructive testing or method approved by the department in accordance with the provisions of API 653 or accepted industry standard and test procedure approved by the department. The initial external inspection shall be completed within five years after the effective date of this regulation. The operator of each facility shall submit to the department for approval, within six months after the effective date of this regulation, a schedule of external tank inspections for all tanks at the facility.

(2). Each existing AST that has been in operation for more than five years shall be internally inspected within three years after the effective date of this regulation. The operator of the AST may request an extension of time for the formal internal inspection. If supporting documentation is submitted demonstrating that compliance with this section is not feasible and deemed acceptable by the department, an extension of time may be granted by the department not greater than 24 months. An internal inspection conducted on or after January 1, 1991, in accordance with the provisions of API 653 may satisfy this requirement based upon review and acceptance by the

department of supporting documentation submitted by the operator. Inspections shall be conducted in accordance with the provisions of API 653 or procedure approved by the department and shall include formal inspection of the entire tank bottom. If construction practices allow external access to the tank bottom, a formal external inspection utilizing accepted methods of nondestructive testing or procedure approved by the department shall be allowed in lieu of the internal inspection. An AST with a release prevention barrier installed shall be internally inspected in accordance with the provision of API 653 or procedure accepted by the department. The operator of each facility shall submit to the department, within six months of the effective date of this regulation, a schedule of tank inspections for all tanks at the facility applicable to this regulation. An AST with a storage capacity of less than 12,000 gallons shall not be subject to the formal internal inspection unless the integrity of the AST is in question and an inspection is deemed necessary by the department.

(3). Each existing AST that has been in operation for less than five years shall be internally inspected within five years of the effective date of this regulation. Inspections shall be conducted in accordance with the provisions of API 653 or procedure accepted by the department and shall include formal inspection of the entire tank bottom. If construction practices allow external access to the tank bottom, a formal external inspection utilizing accepted methods of non-destructive testing or method accepted by the department may be allowed in lieu of the internal inspection. An AST with a release prevention barrier installed shall be internally inspected in accordance with the provisions of API 653 or method accepted by the department. The operator of each facility shall submit to the department, within six months after the effective date of this regulation, a schedule of tank internal inspections for all tanks at the facility applicable to this regulation. An AST with a storage capacity of less than 12,000 gallons shall not be subject to the formal internal inspection unless the integrity of the AST is in question and an inspection is deemed necessary by the department.

(4). Each AST shall undergo an internal reinspection every 10 years after the inspection required in subdivisions A 1 c (2) and A 1 c (3) of this section unless the operator can demonstrate to the department that an extension of the reinspection period is warranted. Such demonstration shall be provided to the department for approval at least six months prior to the

date reinspection is due. This internal reinspection may be required sooner than 10 years if there is an indication of an increased corrosion rate that was established from the initial internal inspection. Inspections shall be conducted in accordance with the provisions of API 653 or procedures approved by the department and shall include formal inspection of the entire tank bottom. If construction practices allow external access to the tank bottom, a formal external inspection utilizing accepted methods of nondestructive testing or other method approved by the department may be allowed in lieu of the internal reinspection. An AST with a release prevention barrier installed shall be reinspected in accordance with provisions of API 653 or other procedures approved by the department. The operator of each facility shall submit a schedule to the department indicating which tanks are to be reinspected three months prior to the scheduled tests. An AST with a storage capacity of less than 12,000 gallons shall not be subject to the formal internal inspection unless the integrity of the AST is in question and an inspection is deemed necessary by the department.

(5). Each secondary containment dike or berm shall be evaluated or certified by a professional engineer or person approved by the department with respect to compliance with 40 C.F.R Part 112, NFPA 30, and 29 C.F.R. Part 1910.106 within five years of the effective date of this regulation and every 10 years thereafter.

(6). Each existing AST that has been in operation for more than five years without cathodic protection of the tank shall be evaluated in accordance with the provisions of API 651, API 653, NACE 0169, and NACE 0285 or procedure approved by the department to determine the need for cathodic protection. This evaluation shall be performed by a corrosion professional and shall be conducted within five years of the effective date of this regulation. This evaluation shall not be required if AST construction design allows external access to the tank bottom, unless deemed necessary by the department.

2. Safe fill and shutdown procedures.

a. Each operator shall institute safe fill and shutdown procedures that will ensure overfilling of tanks does not occur. All receipts of oil shall be authorized by facility personnel trained by the operator. The operator must ensure the volume available in the tank is greater than the volume of oil to be transferred to the tank before the transfer operation commences. The operator must also

ensure the transfer operation is monitored continually, either by manual or automatic means, until complete. Each operator shall also ensure that all tank fill valves not in use are secured. The operator shall ensure that only the tank designated is receiving oil.

b. Each operator of a facility shall ensure compliance with NFPA 30 provisions.

c. All oil transfer areas, where filling connections are made with vehicles, shall be equipped with a spill containment system capable of containing and collecting any spills that may occur. A tank vehicle loading rack must have an automatic shutdown system easily accessible at each loading point. This shutdown system must be tested weekly and records of testing maintained at the facility. The tank vehicle operator shall remain at the loading rack during all phases of any transfer operation. All transfer areas must have collision barriers to protect piping where vehicle or equipment impact may occur.

d. Tank vehicles shall be equipped with brake interlock and secondary automatic shutoff control as required by NFPA 30, Chapter 5, sections 5-4.41.10 and 5-4.41.11 or method approved by the department. The brake interlock and secondary automatic shutoff control of each vehicle using the loading rack shall be tested monthly and records of testing maintained at the facility.

e. If installed, an automatic shutdown system utilized during transfer of oil shall include the capability of directing the flow of oil to another tank capable of receiving the transferred oil or shutting down the pumping or transfer system. This automatic shutdown system shall be tested prior to each receipt of oil or every two weeks, whichever occurs first and records of testing shall be maintained at the facility.

f. All AST's shall be equipped with a gauge that indicates the level of oil or quantity of oil in the tank. In addition, the storage capacity and tank identification number must be clearly marked on the tank and at the location of the gauge. These gauges shall be calibrated annually.

g. If unattended during transfer operations, the AST shall be equipped with a high level alarm. Activation of the high level alarm shall initiate an immediate and orderly emergency shutdown of the transfer. Each operator shall include this emergency shutdown procedure in the facility record and shall ensure that all facility personnel

involved in the transfer operation are trained in this procedure. The alarm shall consist of a visual and audible device capable of alerting the operator, both by sight and hearing, of an impending overfill situation. If the operator is in a control station, this alarm shall cause a warning light and audible signal on the control panel to activate. In addition, this system shall alarm on failure, malfunction or power loss. This high level alarm shall be tested prior to each receipt of oil or every two weeks whichever occurs first and records of testing shall be maintained at the facility.

3. Cathodic protection of piping and pressure testing of piping.

a. The requirement for cathodic protection of piping shall apply to buried piping only. Aboveground piping shall be protected from corrosion using methods and procedures referenced in NFPA 30 or procedure approved by the department. Cathodic protection shall be installed and maintained in accordance with one of the following publications: API 1632, NFPA 30, NACE 01-69, or NACE 02-85. Piping which passes through the wall of the containment berm or dike or under road crossings shall be protected from corrosion using practices recommended in the above listed publications.

b. All piping shall be hydrostatically tested within five years of the effective date of this regulation and every five years thereafter. The use of oil as a hydrostatic test medium is acceptable if the flash point is greater than 120°F and 14.7 pounds per square inch absolute. The department will consider alternatives to the hydrostatic test requirement for aboveground piping based on site specific conditions. The operator shall submit any proposal regarding alternative method(s) to the department six months prior to its application.

4. Visual daily inspection, weekly inspection, monthly gauging and inspection of monitoring wells, monitoring of well head space and quarterly sampling, and analysis of monitoring wells.

a. The operator or his representative shall conduct a daily visual inspection of the facility each day of normal operation. Upon completion of this inspection, the facility person conducting the inspection shall document completion of this inspection by making an appropriate notation in the facility records and shall sign this notation. This visual inspection shall include the following:

(1) A complete walkthrough of the facility property to ensure that no hazardous conditions exist.

(2) An inspection of groundsurface for signs of leakage, spillage, or stained or discolored soils.

(3) A check of the berm or dike area for excessive accumulation of water and to ensure the dike or berm manual drain valves are secured.

(4) A visual inspection of the exterior tank shell to look for signs of leakage or damage.

b. The operator or his representative shall conduct a weekly inspection of the facility using a checklist developed in accordance with department guidance. Department guidance as to content of this checklist is available in Appendix I. The checklist in Appendix I is not intended to be all inclusive of safety or maintenance procedures but as guidance to the requirements within this regulation. The operator shall develop the checklist within ninety days of the effective date of this regulation. The weekly checklist shall be maintained at the facility and provided to the department upon request. This checklist shall be signed and dated by the facility person(s) conducting the inspection and shall become part of the facility record.

c. All monitoring wells required by VR 680-14-07, Oil Discharge Contingency Plans and Administrative Fees for Approval, shall be gauged monthly. The wellhead space of each well shall be sampled for the presence of petroleum vapors. The department developed guidelines for this procedure are found in Appendix II.

d. All monitoring wells required by VR 680-14-07, Oil Discharge Contingency Plans and Administrative Fees for Approval, shall be sampled and analyzed to determine the presence of petroleum or petroleum by-product contamination. The department developed guidelines for this procedure are found in Appendix II.

e. All observations and data gathered as a result of subdivisions A 4 c and A 4 d shall be maintained at the facility, compiled into a summary, and submitted to the department annually. Appendix II provides guidance as to the proper form for submittal. Should any such observations or data indicate the presence of petroleum hydrocarbons in ground water, the results shall be immediately reported to the department and to the local director or coordinator of emergency services appointed

pursuant to § 44-146.19 of the Code of Virginia.

5. To ensure proper training of individuals conducting inspections required by subdivision 6 A 4, the operator of a facility shall certify personnel based on the following:

a. Each facility operator must establish a training program for those facility personnel conducting the daily visual and weekly inspections of the facility and shall document completion of this training in the facility records. The required training may be conducted by the operator or by a third party. The training program shall be established within six months of the effective date of this regulation and maintained at the facility.

b. The required training shall be conducted for facility personnel within 12 months of the effective date of this regulation. Personnel not receiving this training initially, who will be conducting these inspections, shall receive the training prior to conducting any inspection.

c. Initial training shall address at a minimum:

(1) Basic information regarding occupation safety, hazard recognition, personnel protection, and facility operations.

(2) The procedures to be followed in conducting the daily visual and weekly facility inspections.

(3) The procedures to be followed upon recognition of a hazard or the potential for a hazard.

(4) The procedure for evaluating the condition of the aboveground storage tanks.

d. The operator of a facility shall recertify facility personnel upon any changes to the contents of the initial training program or every three years and shall make this recertification action part of the facility records.

e. All formal inspections and testing required by subdivision 6 A 1 c shall be conducted by a person certified to conduct the inspection or test. This certification shall be accomplished in accordance with the provisions of API 650 and API 653 or procedure approved by the department. Proof of this certification shall be maintained in the facility records. The results of all tests and inspections required by subdivision A 1 c shall be maintained at the facility or at a location approved by

the department for the life of the facility.

B. For existing aboveground storage tanks at facilities with an aggregate capacity of less than 1 million gallons but more than 25,000 gallons, the following requirements shall apply:

1. Inventory control and testing for significant variations.

a. Each operator shall institute inventory control procedures capable of detecting a significant variation of inventory. A significant variation shall be considered a variation in excess of 3/4 of 1.0% of the storage capacity of an individual AST. Reconciliations shall be conducted monthly. If the significant variation persists for two consecutive reconciliation periods the operator shall conduct an investigation to determine the cause of the variation. This investigation shall be completed within five working days of the end of the second reconciliation period. If this investigation does not reveal the source of the inventory variation, the operator shall notify the department and the local director or coordinator of emergency services and conduct additional testing to determine the reason for the variation. The testing method and schedule shall be submitted to the department for review and approval. Inventories shall be reconciled after each pipeline/tank vessel receipt or transfer of oil.

b. Inventory records shall be kept of incoming and outgoing volumes of oil and oil movements within the facility. All tanks shall be gauged on a daily basis during each day of normal operation and after each pipeline/tank vessel receipt or transfer of oil. Physical measurements shall be reconciled to 60°F and 14.7 pounds per square inch absolute.

c. Each secondary containment dike or berm shall be evaluated or certified by a professional engineer or person approved by the department with respect to compliance with 40 C.F.R Part 112, NFPA 30, and 29 C.F.R. Part 1910.106 within five years of the effective date of this regulation and every 10 years thereafter.

d. Each existing AST that has been in operation for more than five years without cathodic protection of the tank shall be evaluated in accordance with the provisions of API 651, API 653, NACE 01-69, and NACE 02-85 or procedure approved by the department to determine the need for cathodic protection. This evaluation shall be performed by a corrosion professional and shall be conducted within five years of the effective date of this regulation. This

evaluation shall not be required if AST construction design allows external access to the tank bottom, unless deemed necessary by the department.

2. Safe Fill and Shutdown procedures.

a. Each operator shall institute safe fill and shutdown procedures that will ensure overfilling of tanks does not occur. All receipts of oil shall be authorized by facility personnel trained by the operator. The operator must ensure the volume available in the tank is greater than the volume of oil to be transferred to the tank before the transfer operation commences. The operator must also ensure the transfer operation is monitored continually, either by manual or automatic means, until complete. Each operator shall also ensure that all tank fill valves not in use are secured. The operator shall ensure that only the tank designated is receiving oil.

b. Each operator shall ensure compliance with the provisions of NFPA 30 relating to safe fill and shutdown procedures.

c. All oil transfer areas where filling connections are made with vehicles shall be equipped with a spill containment system capable of containing and collecting any spills that may occur. A tank vehicle loading rack must have an automatic shutdown system easily accessible at each loading point. This shutdown system must be tested weekly and records of testing maintained at the facility. The tank vehicle operator shall remain at the loading rack during all phases of any transfer operation. All transfer areas must have collision barriers to protect piping where vehicle or equipment impact may occur.

d. Tank vehicles shall be equipped with brake interlock and secondary automatic shutoff control as required by NFPA 30, Chapter 5, sections 5-4.41.10 and 5-4.41.11 or method approved by the department. The brake interlock and secondary automatic shutoff control of each vehicle using the loading rack shall be tested monthly and records of testing maintained at the facility.

e. If installed, an automatic shutdown system utilized during transfer of oil shall include the capability of directing the flow of oil to another tank capable of receiving the transferred oil or shutting down the pumping or transfer system. This automatic shutdown system shall be tested prior to each receipt of oil or every two weeks whichever occurs first and records of testing shall be maintained at the facility.

f. All ASTs shall be equipped with a gauge that indicates the level of oil or the quantity of oil in the tank. In addition, the storage capacity and tank identification number must be clearly marked on the tank and at the location of the gauge. These gauges shall be calibrated annually.

g. If unattended during transfer operations, the AST shall be equipped with a high level alarm, or other appropriate mechanism approved by the department to immediately alert the operator of an overfill event. Activation of the high level alarm or other appropriate mechanism shall initiate an immediate and orderly emergency shutdown of the transfer. Each operator shall include this emergency shutdown procedure in the facility records and shall ensure that all facility personnel involved in the transfer operation are trained in this procedure. The alarm shall consist of a visual and audible device capable of alerting the operator, both by sight and hearing, of an impending overfill situation. If the operator is in a control station, this alarm shall cause a warning light and audible signal on the control panel to activate. In addition, this system shall alarm on failure, malfunction or power loss. This high level alarm shall be tested prior to each receipt of oil or every two weeks or whichever occurs first and records of testing maintained at the facility.

3. Pressure testing of piping.

All piping shall be hydrostatically tested within five years of the effective date of this regulation and every five years thereafter. The use of oil as a hydrostatic test medium is acceptable if the flash point is greater than 120°F. The department will consider alternatives to the hydrostatic test requirement for aboveground piping based on site specific conditions. The operator shall submit any proposal regarding alternative method(s) to the department six months before its application. The piping tests required by this section shall be conducted by a person certified or licensed to conduct the inspection or test.

4. Visual daily inspection and weekly inspections of the facility.

a. The operator or his representative shall conduct a daily visual inspection of the facility each day of normal operation. Upon completion of this inspection, the facility person conducting the inspection shall document completion of this inspection by making an appropriate notation in the facility records and shall sign this notation. This visual inspection shall include the

following:

(1) A complete walkthrough of the facility property to ensure that no hazardous conditions exist.

(2) An inspection of ground surface for signs of leakage, spillage or stained or discolored soils.

(3) A check of the berm or dike area for excessive accumulation of water and to ensure the dike or berm manual drain valves are secured.

(4) The procedure for evaluating the condition of aboveground storage tanks.

b. The operator or his representative shall conduct a weekly inspection of the facility using a checklist developed in accordance with department guidance. Department guidance as to content of this checklist is available in Appendix I. The checklist in Appendix I is not intended to be all inclusive of safety or maintenance procedures but as guidance to the requirements within this regulation. The operator shall develop the checklist within 90 days of the effective date of this regulation. The weekly checklist shall be maintained at the facility and provided to the department upon request. This checklist shall be signed and dated by the facility person(s) conducting the inspection and shall become part of the facility record.

5. To ensure proper training of individuals conducting inspections required by subdivision B 4 of this section, the operator of a facility shall certify personnel based on the following:

a. Each facility operator must establish a training program for those facility personnel conducting the daily visual and weekly inspections of the facility and shall document completion of this training in the facility records. The required training may be conducted by the operator or by a third party. The training program shall be established within six months of the effective date of this regulation.

b. The required training shall be conducted for facility personnel within 12 months of the effective date of this regulation. Personnel not receiving this training initially who will be conducting these inspections shall receive the training prior to conducting any inspection.

c. Initial training shall address at a minimum:

(1) Basic information regarding hazard recognition, personnel protection and facility operations.

(2) The procedures to be followed in conducting the daily visual and weekly facility inspections.

(3) The procedures to be followed upon recognition of a hazard or the potential for a hazard.

(4) The procedure for evaluating the condition of the aboveground storage tanks.

d. The operator of a facility shall recertify facility personnel upon any changes to the contents of the initial training program or every three years and shall make this recertification action part of the facility records.

§ 7. Performance standards for aboveground storage tanks installed, retrofitted, or brought into use.

A. All ASTs brought into use after June 30, 1993, shall be built in accordance with design standards adopted by Underwriters Laboratories and the American Petroleum Institute. All newly installed ASTs shall be installed in a manner consistent with the applicable requirements found in NFPA 30. Approval and any applicable permits must be obtained from the local building official before construction starts.

B. All ASTs installed after June 30, 1993, must be strength tested before being placed in use in accordance with the applicable code or standard under which they were built.

C. ASTs installed after June 30, 1993, which have the tank bottom in direct contact with the soil, must have a determination made by a corrosion professional as to the type and degree of corrosion protection needed to ensure the integrity of the tank system during the use of the tank. If a survey indicates the need for corrosion protection for the new installation, corrosion protection shall be provided.

D. ASTs installed after June 30, 1993, shall have a release prevention barrier (RPB) installed either under or in the bottom of the tank. This RPB shall be capable of preventing the escape of contained materials and containing or channeling the released material for release detection.

E. Existing ASTs that are retrofitted (reconstruction or bottom replacement) or brought back into use after June 30, 1993, shall be brought into compliance with all accepted industry standards applicable to new tank construction

including the installation of a RPB. The operator of the facility shall submit a compliance schedule and documentation of the method of compliance to the department six months prior to its application.

F. Operators of ASTs installed, retrofitted, (reconstruction or bottom replacement) or brought back into use after June 30, 1993, shall also comply with § 6 A or § 6 B, whichever is applicable.

§ 8. Aboveground Storage Tank Closure.

A. Prior to temporary closure, the operator of an AST shall obtain a permit and the inspection required in accordance with the provisions of the Uniform Statewide Building Code. No AST shall be deemed to be temporarily closed unless the AST is inspected in accordance with the provisions of the Uniform Statewide Building Code. Notice of intent to temporarily close an AST shall be made to the department in accordance with § 5 of VR-680-14-12.

Where any AST has been temporarily closed for more than 12 months, the operator shall permanently close the AST unless the AST meets the standards established of a new AST established in VR 680-14-13, or the local building official permits an extension of the 12 month temporary closure period. The operator of the temporarily closed AST must complete the site assessment required by § 8 C of this regulation prior to applying for an extension from the local building official.

B. Prior to permanent closure, the operator of an AST shall obtain a permit and the inspections required in accordance with the provisions of the Uniform Statewide Building Code. Notice of intent to permanently close an AST shall be made to the department in accordance with § 5 of VR-680-14-12.

1. If the closure is in response to containment and cleanup actions that necessitate AST removal, the operator of the AST shall immediately notify the local building official and the department utilizing the form prescribed in Appendix I of VR-680-14-12.

2. The assessment of the AST site required by this section shall be conducted by the operator after notifying the department and the local building official, but prior to completion of permanent closure.

3. An AST, including an AST operated by the federal government, shall not be permanently closed unless the

closure is approved by the local building official, except in the case of an AST operated by the Commonwealth. The department of General Services shall function as the local building official in accordance with § 36-98.1 of the Code of Virginia for all ASTs operated by the Commonwealth.

C. Operators shall sample and test for the presence of petroleum hydrocarbons at the AST site in any area where contamination is likely to have occurred. Samples must be taken in accordance with established EPA analytical methods or other methods approved by the department. Depth to ground water must be considered when selecting the appropriate means of sampling.

1. The operator shall submit copies of the laboratory results, a description of the area sampled, a photograph of the site indicating sampled areas, and a site map indicating the location of the closed AST and associated piping as attachments to the registration form required by § 5 B of VR 680-14-12.

2. If contaminated soils, contaminated ground water or free product as a liquid or vapor is discovered, operators shall immediately notify the department and conduct the cleanup in accordance with department requirements.

3. The department may consider modification of the requirements of this section if the operator of the AST can demonstrate to the department's satisfaction that a previously installed leak detection system would have been sufficient to have detected a leak from the closed AST.

D. When deemed necessary by the department, the operator of an AST, which was permanently closed prior to June 30, 1993, shall assess the site and close the AST in accordance with the requirements of this regulation.

E. Operators shall maintain all records relating to compliance with this regulation for a period of five years from the date the department receives notice of the closure. These records shall be made available to the department at any time upon request.

§ 9. Record keeping and access to facilities

A. Each operator of a facility subject to this regulation shall maintain the following records:

1. Books, papers, documents, and records relating to all measurements and inventory of oil at the facility;

2. All information relating to tank/pipe testing;

3. All records relating to spill events and other discharges of oil from the facility;

4. All supporting documentation for developed contingency plans; and

5. Any records required to be kept by statute or regulation of the department.

B. These records shall be kept by the operator of a facility at the facility or at an alternate location approved by the department for a period of five years unless otherwise indicated.

C. Upon request, each operator shall make these records available to the department and to the director or coordinator of emergency services for the locality in which the facility is located or to any political subdivision within one mile of the facility.

§ 10. Notices to the Department of Environmental Quality - Water Division

All written communications to the Department of Environmental Quality - Water Division related to the requirements of this regulation shall be addressed as follows:

Mailing Address:
Department of Environmental Quality - Water Division
Office of Spill Response and Remediation
P.O. Box 11143
Richmond, VA 23230-1143

Location Address:
Department of Environmental Quality - Water Division
Office of Spill Response and Remediation
4900 Cox Road
Glen Allen, VA 23060

§ 11. Delegation of Authority

The director, or a designee, may perform any act of the State Water Control Board under this regulation, except as limited by § 62.1-44.14 of the Code of Virginia.

APPENDIX I- WEEKLY INSPECTION CHECKLIST

Aboveground Storage Tank Systems

____ 1. Containment dike or berm in satisfactory condition.

____ 2. Containment area free of excess standing water or oil.

____ 3. Gate valves used for emptying containment areas secured.

____ 4. Containment area/base of tank free of high grass, weeds, and debris.

____ 5. Tank shell surface, including any peeling areas, welds, rivets/bolts, seams, and foundation, visually inspected for areas of rust and other deterioration.

____ 6. Ground surface around tanks and containment structures and transfer areas checked for signs of leakage.

____ 7. Leak detection equipment in satisfactory condition.

____ 8. Separator or drainage tank in satisfactory condition.

____ 9. Tank water bottom drawoffs not in use are secured.

____ 10. Tank fill valves not in use are secured.

____ 11. Valves inspected for signs of leakage or deterioration.

____ 12. Inlet and outlet piping and flanges inspected for leakage.

APPENDIX II - GROUNDWATER AND VAPOR MONITORING GUIDELINE FOR ABOVEGROUND STORAGE TANKS (ASTs)
(required by VR-680-14-13 § 6 A 4 c through § 6 A 4 e)

This guidance document contains procedures for AST facility operators who are required to conduct groundwater and vapor monitoring. Operators must use these guidelines as a basic framework to conduct monthly, quarterly, and annual groundwater monitoring and submit an annual AST Groundwater Monitoring Report. Report any proposed deviations from these guidelines in writing prior to conducting any groundwater sampling to:

Department of Environmental Quality (DEQ) - Water Division
AST Groundwater Monitoring Program
P.O. Box 11143
Richmond, VA 23230.

A comprehensive groundwater monitoring report must be submitted annually. The first annual groundwater report must be submitted by July 1, 1994. The annual groundwater monitoring report consists of three sections and must be submitted in the reporting format outlined below.

ANNUAL AST GROUNDWATER MONITORING REPORT FORMAT

Section I. Monthly Gauging of Groundwater Monitoring Wells

1. Summary of measurement procedures.

2. Table of static water levels recorded from monitoring wells.

Section II. Quarterly Groundwater and Vapor Monitoring

1. Summary of groundwater and vapor collection procedures.

2. Table of groundwater monitoring well visual inspection results.

3. Table of vapor measurements from monitoring well headspaces.

Section III. Annual Groundwater Quality Evaluation

1. Summary of groundwater collection methods.

2. Summary of groundwater analytical results and interpretation.

3. Table of analytical methods used.

4. Table of analytical results.

5. Table of field and trip blank results.

Appendix A - Groundwater Laboratory Data including Chain-of-Custody forms

Appendix B - Laboratory Quality Assurance Review

Section 1.0 - Facilities Required to Report

Facilities with an aggregate capacity of 1,000,000 gallons or greater of oil/petroleum or oil/petroleum by-product are required to conduct groundwater and vapor monitoring at the facility and submit an annual report to the DEQ-Water Division, AST Groundwater Monitoring Program.

Facilities who conduct periodic groundwater monitoring for oil/petroleum constituents under an approved corrective action or remediation investigation do not have to report results from monitoring wells subject to use in these investigations.

Groundwater monitoring required by VR 680-14-13 for monitoring wells used in corrective action or remediation investigations begins when corrective action monitoring or other monitoring programs concludes. Verification of groundwater monitoring currently conducted at the facility must be sent to DEQ-Water Division, AST Groundwater Monitoring Program. This documentation should include the name and address of the facility, facility contact person, agency name requiring groundwater monitoring, an individual contact within that agency, identification of wells being monitored, and constituents analyzed.

Section 2.0 - Groundwater and Vapor Monitoring Schedule

2.1 Monthly Gauging of Groundwater Monitoring Wells

Measure and record static water levels monthly. Reference all water-level measurements, including total well-depth measurements, from an established and documented point on the top of the well casing. Measurements should be correlated with mean sea level datum and measured to the nearest 0.01 ft.

2.2 Quarterly Vapor Monitoring

Quarterly vapor monitoring of all wells identified in the Oil Discharge Contingency Plan (ODCP) Groundwater Characterization Study shall be conducted prior to collecting quarterly groundwater samples. Quarterly vapor monitoring consists of collecting one monitoring-well head-space measurement. Record measurements for each well sampled.

2.2.1 Vapor Monitoring System Design

The two major components used for a vapor-monitoring system in this program are the groundwater monitoring well and the vapor monitoring device or sensor. A vapor monitoring device is placed in the well on a permanent or temporary basis to collect vapor samples.

2.2.2 Maintenance and Calibration of Vapor Sampling Equipment

Calibrate equipment properly to specifically detect vapors from product stored at the facility. Calibrations consists of exposing the monitor to a pure gas standard to ensure the monitor correctly responds to vapors. Calibrations for portable monitors should be performed on a quarterly basis before quarterly vapor measurements are taken.

Maintenance of vapor monitoring sensors includes cleaning, calibration and operations checks. Maintenance consists of recharging the electrical component and keeping the device clean. Some systems may require periodic replacement of a filament or a lamp. Additional information concerning vapor monitoring can be obtained from *Detecting Leaks, Successful Methods, Step-by-Step*, EPA Document No EPA/530/UST-89/012.

2.3 Quarterly Groundwater Sampling (Visual Inspection)

Quarterly groundwater sampling of all wells installed or identified in the ODCP Groundwater Characterization Study shall be conducted. Quarterly groundwater sampling consists of: (1) measuring for free product on top of groundwater, and (2) collecting groundwater samples for visual inspection.

Measure the thickness of the hydrocarbon layer floating on groundwater if present. Measuring devices must be able to detect at least .01 ft. of free product on top of the groundwater. This can be done using an electronic measuring device, chemically-sensitive paste, or a clear acrylic bailer designed to collect a liquid sample where free product and groundwater meet. A graduated scale on the bailer is helpful for determining the thickness of free product. Record the thickness of free product in each well.

If free product or a sheen is encountered in a monitoring well, immediately report the release to DEQ - Water Division at (804) 527-5200. Take immediate action to prevent any further release of the oil/petroleum into the environment; and identify and mitigate fire, explosion, and vapor hazards. Detection of at least .01 ft. of free product on the top of groundwater indicates a reportable discharge. Any corrective action conducted must be approved in accordance with DEQ regional office guidance.

If sheen or product vapor is detected in the groundwater sample, collect a groundwater sample for BTEX and TPH laboratory

analysis. Groundwater samples should be collected and analyzed as outlined in the ODCP Groundwater Characterization Study and referenced under paragraph 2.5 of this guidance. If 0.01 ft. or more of free product is measured, then groundwater samples should not be submitted for laboratory analysis since a discharge is evident. Record all results of visual groundwater monitoring.

2.4 Annual Groundwater Monitoring for Laboratory Analysis

Annual groundwater sampling of all wells identified in the ODCP Groundwater Characterization Study shall be conducted. Annual groundwater monitoring consists of collecting groundwater samples for laboratory analysis. Groundwater samples should be collected and analyzed for BTEX and TPH from each well. Procedures for sampling groundwater for laboratory analysis are outlined in paragraphs 2.5 of this guidance.

2.5 Procedures for Groundwater Sampling

All groundwater monitoring wells shall be sampled according to the procedures described below, unless 0.01 ft. or more of free product is encountered. In cases where free product is greater than 0.01 ft., groundwater sampling under this program shall not be required. However, thickness of free product must be recorded.

2.5.1 Groundwater Sample Collection

Groundwater samples should be collected in a manner that reduces or eliminates the possibility of loss of volatile constituents from the sample. For collecting samples, a gas-actuated positive displacement pump or a submersible pump is preferred if pumping is required to sample. Dedicated or disposable PVC, teflon, or stainless steel bailers are acceptable for sample collection. Peristaltic pumps or airlift pumps should not be used. In order to keep agitation of the sample to a minimum, lower the bailer slowly into the water column. When transferring the sample from the bailer to the sample container minimize agitation. When collecting volatile organic samples completely fill the sample container so no air bubbles are trapped inside. All sample containers should be pre-cleaned and sealed by the distributor or laboratory. Each sample should be preserved with the proper preservative (i.e., HCL).

Cross-contamination from transferring pumps (or bailers) from well to well can occur and should be avoided by a meticulous cleaning between sampling episodes. Dedicated (i.e., permanent installation) well pumps, while expensive, are often cost effective in the long term (quarterly sampling requirements) and ensure data reliability relative to cross-contamination.

Upon collection, label and immediately place all samples in a

cooler and chill to approximately 4°C or less. The samples should be maintained at 4°C or less until they are delivered to the laboratory for analysis.

2.5.2 Chain-of-Custody

A completed chain-of-custody form should accompany each groundwater sample. This form should be signed by the person collecting the sample, the laboratory receiving the sample, and all intermediary persons with possession of the sample. Sample security shall be maintained during all phases of transport.

2.6 Groundwater Analytical Methods

Laboratory analysis of Benzene, Toluene, Ethylbenzene and Total Xylenes (BTEX), Methyl-tert-butyl-ether (MTBE), and Total Petroleum Hydrocarbons commonly referred to as TPH, for groundwater samples is required. Selection of the analytical method for TPH is more involved than selection of methods for other analytes. To avoid the need for variances of methods used for TPH analyses, specific analytical methods are recommended below for TPH constituents. Other state acceptable methods are listed in Table I.

2.6.1 Selection of analytical methods for BTEX Analysis

Groundwater samples should be quantitatively analyzed for BTEX using EPA Method 8020 with Purge and Trap Method 5030. The practical quantitation limit (PQL) is .002 mg/L for water samples.

2.6.2 Selection of analytical methods for TPH Analysis for Gasoline

For analysis of hydrocarbons that correspond to a range of C_6 to C_{10} and a boiling point range between 60° and 220°F, the Wisconsin Modified Gasoline Range Organics (GRO) Method or California GC/FID Method should be used. The PQL of the GRO method is 0.1 mg/L for water. The PQL for the California method is .5 mg/L for water.

2.6.3 Selection of analytical methods for TPH Analysis for Nos. 1 and 2 Fuel Oil, Nos. 1 and 2 Diesel, Kerosene, and Jet Fuel

For analysis of hydrocarbons that correspond to a range of C_{10} to C_{28} and a boiling point range between approximately 170° and 430°F, the Wisconsin Modified Diesel Range Organics (DRO) Method or California GC/FID Method should be used. The PQL of the DRO method is 0.1 mg/L for water. The PQL for the California method is .5 mg/L for water.

2.6.4 Selection of analytical methods for TPH Analysis for Heavy Hydrocarbons (Crude Oil, Nos. 5 and 6 Fuel Oil, Used Oil, and Hydraulic Oil)

For analysis of heavy hydrocarbon mixtures that have a boiling

point greater than 430°F the Wisconsin Modified Total Recoverable Petroleum Hydrocarbons (TRPH) or Method 418.1 should be used. The PQL for TRPH is 1.0 mg/L or less in water samples. The PQL for Method 418.1 is 1.0 mg/L for water samples.

2.6.5 Field Quality Assurance

All sampling must be conducted in accordance with the documented field QA plan included in the QAPP for the ODCP Groundwater Characterization Study. Field QA samples should be handled in an identical manner to actual samples. Results of the analysis of field and trip blanks must be included in the monitoring report, and should be evaluated in the data assessment portions of the report.

2.6.6 Field QA Groundwater Samples

One field blank with every 20 samples (or less) must be collected. One temperature blank and one trip blank must be collected per cooler.

2.6.7 Laboratory Quality Assurance Review

This review consists of an examination of analytical methods, analytical results, QA/QC results for surrogate recovery, matrix spike recovery, relative percentage differences, laboratory control samples and method blanks. The purposes of the QA review are to verify that QA/QC performance criteria established for the relevant standard methods is met and assess the potential error associated with the analytical results due to nonconformances with QA/QC performance criteria.

TABLE I
Acceptable Analytical Methods For Petroleum Contaminated Sites

Parameter	Analytical Methods *1	Practical Quantitation Limit	
		Soil	Water
BTEX	EPA 503.1		*3
	EPA 524.1		*3
	EPA 624		*3
	SW-846 8020	.005 mg/kg	.002 mg/L
	SW-846 8021	*3	*3
	SW-846 8240	.005 mg/kg	.005 mg/L
TPH Gasoline (C_6-C_{10}, 60°F < BP < 220°F)	California Method	10.0 mg/kg	.5 mg/L
	Wisconsin Modified GRO*2	10.0 mg/kg	.1 mg/L
Diesel, Nos. 1 & 2 Fuel Oil, Jet Fuel, Kerosene (C_{10}-C_{28}, 170°F < BP < 430°F)	California Method	10.0 mg/kg	.5 mg/L
	Wisconsin Modified DRO*2	10.0 mg/kg	.1 mg/L
Crude Oil, Nos. 5 & 6 Fuel Oil, Used Oil, Hydraulic Oil (BP > 430°F)	EPA 413.2		1.0 mg/L
	EPA 418.1		1.0 mg/L
	Wisconsin TRPH*2	10.0 mg/kg	
PAHs/PNAs Polycyclic Aromatic HCs/ Poly-Nucleic Aromatic HCs	EPA 525		*3
	EPA 610		*3
	EPA 625		*3
	SW-846 8100	*3	*3
	SW-846 8270	1.0 mg/kg	.01 mg/L
	SW-846 8310	*3	*3
MTBE	EPA 602 (mod) SW-846 8020 (mod)		
Lead	SW-846 7421		.001 mg/L

*1 - Sample matrix is method dependent
*2 - Gasoline Range Organics, Diesel Range Organics, Total Recoverable Petroleum Hydrocarbons - Wisconsin DNR, 1992
*3 - See method summary for PQLs/MDLs of individual constituents. Substitute MDLs for PQLs when PQLs are not listed in the method.

References:

EPA 100-400 Series - Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020, March, 1983
EPA 500 Series - Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88/039, December 1988
EPA 600 Series - 40 CFR, Part 136, 1992
Test Methods for Evaluating Solid Waste Physical/Chemical, Third Edition, Revision 1, November 1990
PUBL-SW-140 Wisconsin Department of Natural Resources, 1992
PUBL-SW-141 Wisconsin Department of Natural Resources, 1992
PUBL-SW-143 Wisconsin Department of Natural Resources, 1992

APPENDIX B

Environmental Protection Agency Regulations
"Oil Pollution Prevention"
(40 CFR 112)

Oil Pollution Prevention Regulations (SPCC)

Title 40 —Protection of Environment; Revised as of July 1, 1989

Chapter 1—Environmental Protection Agency
Subchapter D—Water Programs

Part 112—Oil Pollution Prevention

Sec.

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SOURCE: 38 FR 34165, Dec. 11, 1973, as amended at 41 FR 12657, Mar. 26, 1976

AUTHORITY: Secs. 311(j)(1)(C), 311(j)(2), 501(a), Federal Water Pollution Control Act (Sec. 2, Pub. L. 92-500, 86 Stat. 816 et seq. (33 U.S.C. 1251 et seq.)); Sec. 4(b), Pub. L. 92-500, 86 Stat. 897; 5 U.S.C. Reorg. Plan of 1970 No. 3 (1970), 35 FR 15623, 3 CFR 1966-1970 Comp.; E.O. 11735, 38 FR 21243, 3 CFR.

§112.1 General applicability.

(a) This part establishes procedures, methods and equipment and other requirements for equipment to prevent the discharge of oil from non-transportation-related onshore and offshore facilities into or upon the navigable waters of the United States or adjoining shorelines.

(b) Except as provided in paragraph (d) of this section, this part applies to owners or operators of non-transportation-related onshore and offshore facilities engaged in drilling, producing, gathering, storing, processing, refining, transferring, distributing or consuming oil and oil products, and which, due to their location, could reasonably be expected to discharge oil in harmful quantities, as defined in Part 110 of this chapter, into or upon the navigable waters of the United States or adjoining shorelines.

(c) As provided in section 313 (86 Stat. 875) departments, agencies, and instrumentalities of the Federal government are subject to these regulations to the same extent as any person, except for the provisions of §112.6.

(d) This part does not apply to:

(1) Facilities, equipment or operations which are not subject to the jurisdiction of the Environmental Protection Agency, as follows:

(i) Onshore and offshore facilities, which, due to their location, could not reasonably be expected to discharge oil into or upon the navigable waters of the United States or adjoining shorelines. This determination shall be based solely upon a consideration of the geographical, locational aspects of the facility (such as proximity to navigable waters or adjoining shorelines, land contour, drainage, etc.) and shall exclude consideration of manmade features such as dikes, equipment or other structures which may serve to restrain, hinder, contain, or otherwise prevent a discharge of oil from reaching navigable waters of the United States or adjoining shorelines; and

(ii) Equipment or operations of vessels or transportation-related onshore and offshore facilities which are subject to authority and control of the Department of Transportation, as defined in the Memorandum of Understanding between the Secretary of Transportation and the Administrator of the Environmental Protection Agency, dated November 24, 1971, 36 FR 24000.

(2) Those facilities which, although otherwise subject to the jurisdiction of the Environmental Protection Agency, meet both of the following requirements:

(i) The underground buried storage capacity of the facility is 42,000 gallons or less of oil, and

(ii) The storage capacity, which is not buried, of the facility is 1,320 gallons or less of oil, provided no single container has a capacity in excess of 660 gallons.

(e) This part provides for the preparation and implementation of Spill Prevention, Control and Countermeasure Plans prepared in accordance with §112.7, designed to complement existing laws, regulations, rules, standards, policies and procedures pertaining to safety standards, fire prevention and pollution prevention rules, so as to form a comprehensive balanced Federal/State spill prevention program to minimize the potential for oil discharges. Compliance with this part does not in any way relieve the owner or operator of an onshore or an offshore facility from compliance with other Federal, State or local laws.

§112.2 Definitions.

For the purposes of this part:

(a) "Oil" means oil of any kind or in any form, including, but not limited to petroleum, fuel oil, sludge, oil refuse and oil mixed with wastes other than dredged spoil.

(b) "Discharge" includes but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying or dumping. For purposes of this part, the term "discharge" shall not include any discharge of oil which is authorized by a permit issued pursuant to Section 13 of the River and Harbor Act of 1899 (30 Stat. 1121, 33 U.S.C. 407), or sections 402 or 405 of the FWPCA Amendments of 1972 (86 Stat. 816 et seq., 33 U.S.C. 1251 et seq.).

(c) "Onshore facility" means any facility of any kind located in, on, or under any land within the United States, other than submerged lands, which is not a transportation-related facility.

(d) "Offshore facility" means any facility of any kind located in, on, or under any of the navigable waters of the United States, which is not a transportation-related facility.

(e) "Owner or operator" means 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 such facility immediately prior to such abandonment.

(f) "Person" includes an individual, firm, corporation, association, and a partnership.

(g) "Regional Administrator", means the Regional Administrator of the Environmental Protection Agency, or his designee, in and for the Region in which the facility is located.

(h) "Transportation-related" and "non-transportation-related" as applied to an onshore or offshore facility, are defined in the Memorandum of Understanding between the Secretary of Transportation and the Administrator of the Environmental Protection Agency, dated November 24, 1971, 36 FR 24080.

(i) "Spill event" means a discharge of oil into or upon the navigable waters of the United States or adjoining shorelines in harmful quantities, as defined at 40 CFR Part 110.

(j) "United States" means the States, the District of Columbia, the Commonwealth of Puerto Rico, the Canal Zone, Guam, American Samoa, the Virgin Islands, and the Trust Territory of the Pacific Islands.

(k) The term "navigable waters" of the United States means "navigable waters" as defined in section 502(7) of the FWPCA, and includes:

(1) All navigable waters of the United States, as defined in judicial decisions prior to passage of the 1972 Amendments to the FWPCA (Pub. L. 92-500), and tributaries of such waters;

(2) Interstate waters;

(3) Intrastate lakes, rivers, and streams which are utilized by interstate travelers for recreational or other purposes; and

(4) Intrastate lakes, rivers, and streams from which fish or shellfish are taken and sold in interstate commerce.

(l) "Vessel" means every description of watercraft or other artificial contrivance used, or capable of being used as a means of transportation on water, other than a public vessel.

§112.3 Requirements for preparation and implementation of Spill Prevention Control and Countermeasure Plans.

(a) Owners or operators of onshore and offshore facilities in operation on or before the effective date of this part that have discharged or, due to their location, could reasonably be expected to discharge oil in harmful quantities, as defined in 40 CFR Part 110, into or upon the navigable waters of the United States or adjoining shorelines, shall prepare a Spill Prevention, Control and Countermeasure Plan (hereinafter "SPCC Plan"), in writing and in accordance with §112.7. Except as provided for in paragraph (f) of this section, such SPCC Plan shall be prepared within six months after the effective date of this part and shall be fully implemented as soon as possible, but not later than one year after the effective date of this part.

(b) Owners or operators of onshore and offshore facilities that become operational after the effective date of this part, and that have discharged or could reasonably be expected to discharge oil in harmful quantities, as defined in 40 CFR Part 110, into or upon the navigable waters of the United States or adjoining shorelines, shall prepare an SPCC Plan in accordance with §112.7. Except as

provided for in paragraph (f) of this section, such SPCC Plan shall be prepared within six months after the date such facility begins operations and shall be fully implemented as soon as possible, but not later than one year after such facility begins operations.

(c) Owners or operators of onshore and offshore mobile or portable facilities, such as onshore drilling or workover rigs, barge mounted offshore drilling or workover rigs, and portable fueling facilities shall prepare and implement an SPCC Plan as required by paragraphs (a), (b) and (d) of this section. The owners or operators of such facility need not prepare a new SPCC Plan each time the facility is moved to a new site. The SPCC Plan may be a general plan, prepared in accordance with §112.7, using good engineering practice. When the mobile or portable facility is moved, it must be located and installed using the spill prevention practices outlined in the SPCC Plan for the facility. No mobile or portable facility subject to this regulation shall operate unless the SPCC Plan has been implemented. The SPCC Plan shall only apply while the facility is in a fixed (non-transportation) operating mode.

(d) No SPCC Plan shall be effective to satisfy the requirements of this part unless it has been reviewed by a Registered Professional Engineer and certified to by such Professional Engineer. By means of this certification the engineer, having examined the facility and being familiar with the provisions of this part, shall attest that the SPCC Plan has been prepared in accordance with good engineering practices. Such certification shall in no way relieve the owner or operator of an onshore or offshore facility of his duty to prepare and fully implement such Plan in accordance with §112.7, as required by paragraphs (a), (b) and (c) of this section.

(e) Owners or operators of a facility for which an SPCC Plan is required pursuant to paragraph (a), (b) or (c) of this section shall maintain a complete copy of the Plan at such facility if the facility is normally attended at least 8 hours per day, or at the nearest field office if the facility is not so attended, and shall make such Plan available to the Regional Administrator for on-site review during normal working hours.

(f) Extensions of time.

(1) The Regional Administrator may authorize an extension of time for the preparation and full implementation of an SPCC Plan beyond the time permitted for the preparation and implementation of an SPCC Plan pursuant to paragraph (a), (b) or (c) of this section where he finds that the owner or operator of a facility subject to paragraphs (a), (b) or (c) of this section cannot fully comply with the requirements of this part as a result of either nonavailability of qualified personnel, or delays in construction or equipment delivery beyond the control and without the fault of such owner or operator or their respective agents or employees.

(2) Any owner or operator seeking an extension of time pursuant to paragraph (f)(1) of this section may submit a letter of request to the Regional Administrator. Such letter shall include:

(i) A complete copy of the SPCC Plan, if completed;

(ii) A full explanation of the cause for any such delay and the specific aspects of the SPCC Plan affected by the delay;

(iii) A full discussion of actions being taken or contemplated to minimize or mitigate such delay;

(iv) A proposed time schedule for the implementation of any corrective actions being taken or contemplated, including interim dates for completion of tests or studies, installation and operation of any necessary equipment or other preventive measures.

In addition, such owner or operator may present additional oral or written statements in support of his letter of request.

(3) The submission of a letter of request for extension of time pursuant to paragraph (f)(2) of this section shall in no way relieve the owner or operator from his obligation to comply with the requirements of §112.3 (a), (b) or (c). Where an extension of time is authorized by the Regional Administrator for particular equipment or other specific aspects of the SPCC Plan, such extension shall in no way affect the owner's or operator's obligation to comply with the requirements of §112.3 (a), (b) or (c) with respect to other equipment or other specific aspects of the SPCC Plan for which an extension of time has not been expressly authorized.

SOURCE: 38 FR 34165, Dec. 11, 1973, as amended at 41 FR 12657, Mar. 26, 1976

§112.4 Amendment of SPCC Plans by Regional Administrator.

(a) Notwithstanding compliance with §112.3, whenever a facility subject to §112.3 (a), (b) or (c) has: Discharged more than 1,000 U.S. gallons of oil into or upon the navigable waters of the United States or adjoining shorelines in a single spill event, or discharged oil in harmful quantities, as defined in 40 CFR Part 110, into or upon the navigable waters of the United States or adjoining shorelines in two spill events, reportable under section 311(b)(5) of the FWPCA, occurring within any twelve months period, the owner or operator of such facility shall submit to the Regional Administrator, within 60 days from the time such facility becomes subject to this section, the following:

(1) Name of the facility;

(2) Name(s) of the owner or operator of the facility;

(3) Location of the facility;

(4) Date and year of initial facility operation;

(5) Maximum storage or handling capacity of the facility and normal daily throughput;

(6) Description of the facility, including maps, flow diagrams, and topographical maps;

(7) A complete copy of the SPCC Plan with any amendments;

(8) The cause(s) of such spill, including a failure analysis of system or subsystem in which the failure occurred;

(9) The corrective actions and/or countermeasures taken, including an adequate description of equipment repairs and/or replacements;

(10) Additional preventive measures taken or contemplated to minimize the possibility of recurrence;

(11) Such other information as the Regional Administrator may reasonably require pertinent to the Plan or spill event.

(b) Section 112.4 shall not apply until the expiration of the time permitted for the preparation and implementation of an SPCC Plan pursuant to §112.3 (a), (b), (c) and (f).

(c) A complete copy of all information provided to the Regional Administrator pursuant to paragraph (a) of this section shall be sent at the same time to the State agency in charge of water pollution control activities in and for the State in which the facility is located. Upon receipt of such information such State agency may conduct a review and make recommendations to the Regional Administrator as to further procedures, methods, equipment and other requirements for equipment necessary to prevent and to contain discharges of oil from such facility.

(d) After review of the SPCC Plan for a facility subject to paragraph (a) of this section, together with all other information submitted by the owner or operator of such facility, and by the State agency under paragraph (c) of this section, the Regional Administrator may require the owner or operator of such facility to amend the SPCC Plan if he finds that the Plan does not meet the requirements of this part or that the amendment of the Plan is necessary to prevent and to contain discharges of oil from such facility.

(e) When the Regional Administrator proposes to require an amendment to the SPCC Plan, he shall notify the facility operator by certified mail addressed to, or by personal delivery to, the facility owner or operator, that he proposes to require an amendment to the Plan, and shall specify the terms of such amendment. If the facility owner or operator is a corporation, a copy of such notice shall also be mailed to the registered agent, if any, of such corporation in the State where such facility is located. Within 30 days from receipt of such notice, the facility owner or operator may submit written information, views, and arguments on the amendment. After considering all relevant material presented, the Regional Administrator shall notify the facility owner or operator of any amendment required or shall rescind the notice. The amendment required by the Regional Administrator shall become part of the Plan 30 days after such notice, unless the Regional Administrator, for good cause, shall specify another effective date. The owner or operator of the facility shall implement the amendment of the Plan as soon as possible, but not later than six months after the amendment becomes part of the Plan, unless the Regional Administrator specifies another date.

(f) An owner or operator may appeal a decision made by the Regional Administrator requiring an amendment to an SPCC Plan. The appeal shall be made to the Administrator of the United States Environmental Protection Agency and must be made in writing within 30 days of receipt of the notice from the Regional Administrator requiring the amendment. A complete copy of the appeal must be sent to the Regional Administrator at the time the appeal is made. The appeal shall contain a clear and concise statement of the issues and points of fact in the case. It may also contain additional information from the owner or operator, or from any other person. The Administrator or his designee may request additional information from the owner or operator, or from any other person. The Administrator or his designee shall render a decision within 60 days of receiving the appeal and shall notify the owner or operator of his decision.

SOURCE: 38 FR 34165, Dec. 11, 1973, as amended at 41 FR 12658, Mar. 26, 1976

§112.5 Amendment of Spill Prevention Control and Countermeasure Plans by owners or operators.

(a) Owners or operators of facilities subject to §112.3 (a), (b) or (c) shall amend the SPCC Plan for such facility in accordance with §112.7 whenever there is a change in facility design, construction, operation or maintenance which materially affects the facility's potential for the discharge of oil into or upon the navigable waters of the United States or adjoining shore lines. Such amendments shall be fully implemented as soon as possible, but not later than six months after such change occurs.

(b) Notwithstanding compliance with paragraph (a) of this section, owners and operators of facilities subject to §112.3 (a), (b) or (c) shall complete a review and evaluation of the SPCC Plan at least once every three years from the date such facility becomes subject to this part. As a result of this review and evaluation, the owner or operator shall amend the SPCC Plan within six months of the review to include more effective prevention and control technology if: (1) Such technology will significantly reduce the likelihood of a spill event from the facility, and (2) if such technology has been field-proven at the time of the review.

(c) No amendment to an SPCC Plan shall be effective to satisfy the requirements of this section unless it has been certified by a Professional Engineer in accordance with §112.3(d).

§112.6 Civil penalties for violation of Oil Pollution Prevention Regulations.

Owners or operators of facilities subject to §112.3 (a), (b) or (c) who violate the requirements of this Part 112 by failing or refusing to comply with any of the provisions of §112.3, §112.4 or §112.5 shall be liable for a civil penalty of not more than 5,000 for each day such violation continues. Civil penalties shall be imposed in accordance with procedures set out in Part 114 of this Subchapter D.

SOURCE: 39 FR 31602, Aug. 29, 1974

AUTHORITY: Secs. 311(j), 501(a), Pub. L. 92-500, 86 Stat. 868, 885 (33 U.S.C. 1321(j), 1361(a))

§112.7 Guidelines for the preparation and implementation of a Spill Prevention Control and Countermeasure Plan.

The SPCC Plan shall be a carefully thought-out plan, prepared in accordance with good engineering practices, and which has the full approval of management at a level with authority to commit the necessary resources. If the plan calls for additional facilities or procedures, methods, or equipment not yet fully operational, these items should be discussed in separate paragraphs, and the details of installation and operational start-up should be explained separately. The complete SPCC Plan shall follow the sequence outlined below, and include a discussion of the facility's conformance with the appropriate guidelines listed:

(a) A facility which has experienced one or more spill events within twelve months prior to the effective date of this part should include a written description of each such spill, corrective action taken and plans for preventing recurrence.

(b) Where experience indicates a reasonable potential for equipment failure (such as tank overflow, rupture, or leakage), the plan should include a prediction of the direction, rate of flow, and total quantity of oil which could be discharged from the facility as a result of each major type of failure.

(c) Appropriate containment and/or diversionary structures or equipment to prevent discharged oil from reaching a navigable water course should be provided. One of the following preventive systems or its equivalent should be used as a minimum:

(1) Onshore facilities.

(i) Dikes, berms or retaining walls sufficiently impervious to contain spilled oil

(ii) Curbing

(iii) Culverting, gutters or other drainage systems

(iv) Weirs, booms or other barriers

(v) Spill diversion ponds

(vi) Retention ponds

(vii) Sorbent materials

(2) Offshore facilities.

(i) Curbing, drip pans

(ii) Sumps and collection systems

(d) When it is determined that the installation of structures or equipment listed in §112.7(c) to prevent discharged oil from reaching the navigable waters is not practicable from any onshore or offshore facility, the owner or operator should clearly demonstrate such impracticability and provide the following:

(1) A strong oil spill contingency plan following the provision of 40 CFR Part 109.

(2) A written commitment of manpower, equipment and materials required to expeditiously control and remove any harmful quantity of oil discharged.

(e) In addition to the minimal prevention standards listed under §112.7(c), sections of the Plan should include a complete discussion of conformance with the following applicable guidelines, other effective spill prevention and containment procedures (or, if more stringent, with State rules, regulations and guidelines):

(1) Facility drainage (onshore); (excluding production facilities).

(i) Drainage from diked storage areas should be restrained by valves or other positive means to prevent a spill or other excessive leakage of oil into the drainage system or inplant effluent treatment system, except where plan systems are designed to handle such leakage. Diked areas

may be emptied by pumps or ejectors; however, these should be manually activated and the condition of the accumulation should be examined before starting to be sure no oil will be discharged into the water.

(ii) Flapper-type drain valves should not be used to drain diked areas. Valves used for the drainage of diked areas should, as far as practical, be of manual, open-and-closed design. When plant drainage drains directly into water courses and not into wastewater treatment plants, retained storm water should be inspected as provided in paragraphs (B), (C) and (D) (e)(2)(iii) before drainage.

(iii) Plant drainage systems from undiked areas should, if possible, flow into ponds, lagoons or catchment basins, designed to retain oil or return it to the facility. Catchment basins should not be located in areas subject to periodic flooding.

(iv) If plant drainage is not engineered as above, the final discharge of all in-plant ditches should be equipped with a diversion system that could, in the event of an uncontrolled spill, return the oil to the plant.

(v) Where drainage waters are treated in more than one treatment unit, natural hydraulic flow should be used. If pump transfer is needed, two "lift" pumps should be provided, and at least one of the pumps should be permanently installed when such treatment is continuous. In any event, whatever techniques are used facility drainage systems should be adequately engineered to prevent oil from reaching navigable waters in the event of equipment failure or human error at the facility.

(2) Bulk storage tanks (onshore); (excluding production facilities).

(i) No tank should be used for the storage of oil unless its material and construction are compatible with the material stored and conditions of storage such as pressure and temperature, etc.

(ii) All bulk storage tank installations should be constructed so that a secondary means of containment is provided for the entire contents of the largest single tank plus sufficient freeboard to allow for precipitation. Diked areas should be sufficiently impervious to contain spilled oil. Dikes, containment curbs, and pits are commonly employed for this purpose, but they may not always be appropriate. An alternative system could consist of a complete drainage trench enclosure arranged so that a spill could terminate and be safely confined in an inplant catchment basin or holding pond.

(iii) Drainage of rainwater from the diked area into a storm drain or an effluent discharge that empties into an open water course, lake, or pond, and bypassing the in-plant treatment system may be acceptable if:

(A) The bypass valve is normally sealed closed.

(B) Inspection of the run-off rainwater ensures compliance with applicable water quality standards and will not cause a harmful discharge as defined in 40 CFR Part 110.

(C) The bypass valve is opened, and resealed following drainage under responsible supervision.

(D) Adequate records are kept of such events.

(iv) Buried metallic storage tanks represent a potential for undetected spills. A new buried installation should be protected from corrosion by coatings, cathodic protection or other effective methods compatible with local soil conditions. Such buried tanks should at least be subjected to regular pressure testing.

(v) Partially buried metallic tanks for the storage of oil should be avoided, unless the buried section of the shell is adequately coated, since partial burial in damp earth can cause rapid corrosion of metallic surfaces, especially at the earth/air interface.

(vi) Aboveground tanks should be subject to periodic integrity testing, taking into account tank design (floating roof, etc.) and using such techniques as hydrostatic testing, visual inspection or a system of non-destructive shell thickness testing. Comparison records should be kept where appropriate, and tank supports and foundations should be included in these inspections. In addition, the outside of the tank should frequently be observed by operating personnel for signs of deterioration, leaks which might cause a spill, or accumulation of oil inside diked areas.

(vii) To control leakage through defective internal heating coils, the following factors should be considered and applied, as appropriate.

(A) The steam return or exhaust lines from internal heating coils which discharge into an open water course should be monitored for contamination, or passed through a settling tank, skimmer, or other separation or retention system.

(B) The feasibility of installing an external heating system should also be considered.

(viii) New and old tank installations should, as far as practical, be fail-safe engineered or updated into a fail-safe engineered installation to avoid spills. Consideration should be given to providing one or more of the following devices:

(A) High liquid level alarms with an audible or visual signal at a constantly manned operation or surveillance station; in smaller plants an audible air vent may suffice.

(B) Considering size and complexity of the facility, high liquid level pump cutoff devices set to stop flow at a predetermined tank content level.

(C) Direct audible or code signal communication between the tank gauger and the pumping station.

(D) A fast response system for determining the liquid level of each bulk storage tank such as digital computers, telepulse, or direct vision gauges or their equivalent.

(E) Liquid level sensing devices should be regularly tested to insure proper operation.

(ix) Plant effluents which are discharged into navigable waters should have disposal facilities observed frequently enough to detect possible system upsets that could cause an oil spill event.

(x) Visible oil leaks which result in a loss of oil from tank seams, gaskets, rivets and bolts sufficiently large to cause the accumulation of oil in diked areas should be promptly corrected.

(xi) Mobile or portable oil storage tanks (onshore) should be positioned or located so as to prevent spilled oil from reaching navigable waters. A secondary means of containment, such as dikes or catchment basins, should be furnished for the largest single compartment or tank. These facilities should be located where they will not be subject to periodic flooding or washout.

(3) Facility transfer operations, pumping, and in-plant process (onshore); (excluding production facilities). (i) Buried piping installations should have a protective wrapping and coating and should be cathodically protected if soil conditions warrant. If a section of buried line is exposed for any reason, it should be carefully examined for deterioration. If corrosion damage is found, additional examination and corrective action should be taken as indicated by the magnitude of the damage. An alternative would be the more frequent use of exposed pipe corridors or galleries.

(ii) When a pipeline is not in service, or in standby service for an extended time the terminal connection at the transfer point should be capped or blank-flanged, and marked as to origin.

(iii) Pipe supports should be properly designed to minimize abrasion and corrosion and allow for expansion and contraction.

(iv) All aboveground valves and pipelines should be subjected to regular examinations by operating personnel at which time the general condition of items, such as flange joints, expansion joints, valve glands and bodies, catch pans, pipeline supports, locking of valves, and metal surfaces should be assessed. In addition, periodic pressure testing may be warranted for piping in areas where facility drainage is such that a failure might lead to a spill event.

(v) Vehicular traffic granted entry into the facility should be warned verbally or by appropriate signs to be sure that the vehicle, because of its size, will not endanger above ground piping.

(4) Facility tank car and tank truck loading/unloading rack (onshore). (i) Tank car and tank truck loading/unloading procedures should meet the minimum requirements and regulation established by the Department of Transportation.

(ii) Where rack area drainage does not flow into a catchment basin or treatment facility designed to handle spills, a quick drainage system should be used for tank truck loading and unloading areas. The containment system should be designed to hold at least maximum capacity of any single compartment of a tank car or tank truck loaded or unloaded in the plant.

(iii) An interlocked warning light or physical barrier system, or warning signs, should be provided in loading/unloading areas to prevent vehicular departure before complete disconnect of flexible or fixed transfer lines.

(iv) Prior to filling and departure of any tank car or tank truck, the lower-most drain and all outlets of such vehicles should be closely examined for leakage, and if necessary, tightened, adjusted, or replaced to prevent liquid leakage while in transit.

(5) Oil production facilities (onshore). (i) Definition. An onshore production facility may include all wells, flowlines, separation equipment, storage facilities, gathering lines, and auxiliary non-transportation-related equipment and facilities in a single geographical oil or gas field operated by a single operator.

(ii) Oil production facility (onshore) drainage. (A) At tank batteries and central treating stations where an accidental discharge of oil would have a reasonable possibility of reaching navigable waters, the dikes or equivalent required under §112.7(c)(1) should have drains closed and sealed at all times except when rainwater is being drained. Prior to drainage, the diked area should be inspected as provided in paragraphs (e)(2)(iii) (B), (C), and (D). Accumulated oil on the rainwater should be picked up and returned to storage or disposed of in accordance with approved methods.

(B) Field drainage ditches, road ditches, and oil traps, sumps or skimmers, if such exist, should be inspected at regularly scheduled intervals for accumulation of oil that may have escaped from small leaks. Any such accumulations should be removed.

(iii) Oil production facility (onshore) bulk storage tanks. (A) No tank should be used for the storage of oil unless its material and construction are compatible with the material stored and the conditions of storage.

(B) All tank battery and central treating plant installations should be provided with a secondary means of containment for the entire contents of the largest single tank if feasible, or alternate systems such as those outlined in §112.7(c)(1). Drainage from undiked areas should be safely confined in a catchment basin or holding pond.

(C) All tanks containing oil should be visually examined by a competent person for condition and need for maintenance on a scheduled periodic basis. Such examination should include the foundation and supports of tanks that are above the surface of the ground.

(D) New and old tank battery installations should, as far as practical, be fail-safe engineered or updated into a fail-safe engineered installation to prevent spills. Consideration should be given to one or more of the following:

(1) Adequate tank capacity to assure that a tank will not overfill should a pumper/gauger be delayed in making his regular rounds.

(2) Overflow equalizing lines between tanks so that a full tank can overflow to an adjacent tank.

(3) Adequate vacuum protection to prevent tank collapse during a pipeline run.

(4) High level sensors to generate and transmit an alarm signal to the computer where facilities are a part of a computer production control system.

(iv) Facility transfer operations, oil production facility (onshore). (A) All aboveground valves and pipelines should be examined periodically on a scheduled basis for general condition of items such as flange joints, valve glands and bodies, drip pans, pipeline supports, pumping well polish rod stuffing boxes, bleeder and gauge valves.

(B) Salt water (oil field brine) disposal facilities should be exained often, particularly following a sudden change in atmospheric temperature to detect possible system upsets that could cause an oil discharge.

(C) Production facilities should have a program of flowline maintenance to prevent spills from this source. The program should include periodic examinations, corrosion protection, flowline replacement, and adequate records, as appropriate, for the individual facility.

(6) Oil drilling and workover facilities (onshore). (i) Mobile drilling or workover equipment should be positioned or located so as to prevent spilled oil from reaching navigable waters.

(ii) Depending on the location, catchment basins or diversion structures may be necessary to intercept and contain spills of fuel, crude oil, or oily drilling fluids.

(iii) Before drilling below any casing string or during workover operations, a blowout prevention (BOP) assembly and well control system should be installed that is capable of controlling any well head pressure that is expected to be encountered while that BOP assembly is one the well. Casing and BOP installations should be in accordance with State regulatory agency requirements.

(7) Oil drilling, production, or workover facilities (offshore). (i) Definition: "An oil drilling, production or workover facility (offshore)" may include all drilling or workover equipment, wells, flowlines, gathering lines, platforms, and auxiliary nontransportation-related equipment and facilities in a single geographical oil or gas field operated by a single operator.

(ii) Oil drainage collection equipment should be used to prevent and control small oil spillage around pumps, glands, valves, flanges, expansion joints, hoses, drain lines, separators, treaters, tanks, and allied equipment. Drains on the facility should be controlled and directed toward a central collection sump or equivalent collection system sufficient to prevent discharges of oil into the navigable waters of the United States. Where drains and sumps are not practicable oil contained in collection equipment should be removed as often as necessary to prevent overflow.

(iii) For facilities employing a sump system, sump and drains should be adequately sized and a spare pump or equivalent method should be available to remove liquid from the sump and assure that oil does not escape. A regular scheduled preventive maintenance inspection and testing program should be employed to assure reliable operation of the liquid removal system and pump start-up device. Redundant automatic sump pumps and control devices may be required on some installations.

(iv) In areas where separators and treaters are equipped with dump valves whose predominant mode of failure is in the closed position and pollution risk is high, the facility should be specially equipped to prevent the escape of oil. This could be accomplished by extending the flare line to a diked area if the separator is near shore, equipping it with a high liquid level sensor that will automatically shut-in wells producing to the separator, parallel redundant dump valves, or other (v) Atmospheric storage or surge tanks should be equipped with high liquid level sensing devices or other acceptable alternatives to prevent oil discharges.

(vi) Pressure tanks should be equipped with high and low pressure sensing devices to activate an alarm and/or control the flow or other acceptable alternatives to prevent oil discharges.

(vii) Tanks should be equipped with suitable corrosion protection.

(viii) A written procedure for inspecting and testing pollution prevention equipment and systems should be prepared and maintained at the facility. Such procedures should be included as part of the SPCC Plan.

(ix) Testing and inspection of the pollution prevention equipment and systems at the facility should be conducted by the owner or operator on a scheduled periodic basis commensurate with the complexity, conditions and circumstances of the facility or other appropriate regulations.

(x) Surface and subsurface well shut-in valves and devices in use at the facility should be sufficiently described to determine method of activation or control, e.g., pressure differential, change in fluid or flow conditions, combination of pressure and flow, manual or remote control mechanisms. Detailed records for each well, while not necessarily part of the plan should be kept by the owner or operator.

(xi) Before drilling below any casing string, and during workover operations a blowout preventer (BOP) assembly and well control system should be installed that is capable of controlling any well-head pressure that is expected to be encountered while that BOP assembly is on the well. Casing and BOP installations should be in accordance with State regulatory agency requirements.

(xii) Extraordinary well control measures should be provided should emergency conditions, including fire, loss of control and other abnormal conditions, occur. The degree of control system redundancy should vary with hazard exposure and probable consequences of failure. It is recommended that surface shut-in systems have redundant or "fail close" valving. Subsurface safety valves may not be needed in producing wells that will not flow but should be installed as required by applicable State regulations.

(xiii) In order that there will be no misunderstanding of joint and separate duties and obligations to perform work in a safe and pollution free manner, written instructions should be prepared by the owner or operator for contractors and subcontractors to follow whenever contract activities include servicing a well or systems appurtenant to a well or pressure vessel. Such instructions and procedures should be maintained at the offshore production facility. Under certain circumstances and conditions such contractor activities may require the presence at the facility of an authorized representative of the owner or operator who would intervene when necessary to prevent a spill event.

(xiv) All manifolds (headers) should be equipped with check valves on individual flowlines.

(xv) If the shut-in well pressure is greater than the working pressure of the flowline and manifold valves up to and including the header valves associated with that individual flowline, the flowline should be equipped with a high pressure sensing device and shutin valve at the wellhead unless provided with a pressure relief system to prevent over pressuring.

(xvi) All pipelines appurtenant to the facility should be protected from corrosion. Methods used, such as protective coatings or cathodic protection, should be discussed.

(xvii) Sub-marine pipelines appurtenant to the facility should be adequately protected against environmental stresses and other activities such as fishing operations.

(xviii) Sub-marine pipelines appurtenant to the facility should be in good operating condition at all times and inspected on a scheduled periodic basis for failures. Such inspections should be documented and maintained at the facility.

(8) Inspections and records. Inspections required by this part should be in accordance with written procedures developed for the facility by the owner or operator. These written procedures and a record of the inspections, signed by the appropriate supervisor or inspector, should be made part of the SPCC Plan and maintained for a period of three years.

(9) Security (excluding oil production facilities). (i) All plants handling, processing, and storing oil should be fully fenced, and entrance gates should be locked and/or guarded when the plant is not in production or is unattended.

(ii) The master flow and drain valves and any other valves that will permit direct outward flow of the tank's content to the surface should be securely locked in the closed position when in non-operating or non-standby status.

(iii) The starter control on all oil pumps should be locked in the "off" position or located at a site accessible only to authorized personnel when the pumps are in a non-operating or non-standby status.

(iv) The loading/unloading connections of oil pipelines should be securely capped or blank-flanged when not in servive or standby service for an extended time. This security practice should also apply to pipelines that are emptied of liquid content either by draining or by inert gas pressure.

(v) Facility lighting should be commensurate with the type and location of the facility. Consideration should be given to: (A) Discovery of spills occurring during hours of darkness, both by operating personnel, if present, and by non-operating personnel (the general public, local police, etc.) and (B) prevention of spills occurring through acts of vandalism.

(10) Personnel, training and spill prevention procedures. (i) Owners or operators are responsible for properly instructing their personnel in the operation and maintenance of equipment to prevent the discharges of oil and applicable pollution control laws, rules and regulations.

(ii) Each applicable facility should have a designated person who is accountable for oil spill prevention and who reports to line management.

(iii) Owners or operators should schedule and conduct spill prevention briefings for their operating personnel at intervals frequent enough to assure adequate understanding of the SPCC Plan for that facility. Such briefings should highlight and describe known spill events or failures, malfunctioning components, and recently developed precautionary measures.

§112. Appendix

MEMORANDUM OF UNDERSTANDING BETWEEN THE SECRETARY OF TRANSPORTATION AND THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY

Section II—DEFINITIONS

The Environmental Protection Agency and the Department of Transportation agree that for the purposes of Executive Order 11548, the term:

(1) "Non-transportation-related onshore and offshore facilities" means:

(A) Fixed onshore and offshore oil well drilling facilities including all equipment and appurtenances related thereto used in drilling operations for exploratory or development wells, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(B) Mobile onshore and offshore oil well drilling platforms, barges, trucks, or other mobile facilities including all equipment and appurtenances related thereto when such mobile facilities are fixed in position for the purpose of drilling operations for exploratory or development wells, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(C) Fixed onshore and offshore oil production structures, platforms, derricks, and rigs including all equipment and appurtenances related thereto, as well as completed wells and the wellhead separators, oil separators, and storage facilities used in the production of oil, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(D) Mobile onshore and offshore oil production facilities including all equipment and appurtenances related thereto as well as completed wells and wellhead equipment, piping from wellheads to oil separators, oil separators, and storage facilities used in the production of oil when such mobile facilities are fixed in position for the purpose of oil production operations, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(E) Oil refining facilities including all equipment and appurtenances related thereto as well as in-plant processing units, storage units, piping, drainage systems and waste treatment units used in the refining of oil, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(F) Oil storage facilities including all equipment and appurtenances related thereto as well as fixed bulk plant storage, terminal oil storage facilities, consumer storage, pumps and drainage systems used in the storage of oil, but excluding inline or breakout storage tanks needed for the continuous operation of a pipeline system and any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(G) Industrial, commercial, agricultural or public facilities which use and store oil, but excluding any terminal facility, unit or process integrally associated with the handling or transferring of oil in bulk to or from a vessel.

(H) Waste treatment facilities including in-plant pipelines, effluent discharge lines, and storage tanks, but excluding waste treatment facilities located on vessels and terminal storage tanks and appurtenances for the reception of oily ballast water or tank washings from vessels and associated systems used for off-loading vessels.

(I) Loading racks, transfer hoses, loading arms and other equipment which are appurtenant to a nontransportation-related facility or terminal facility and which are used to transfer oil in bulk to or from highway vehicles or railroad cars.

(J) Highway vehicles and railroad cars which are used for the transport of oil exclusively within the confines of a nontransportation-related facility and which are not intended to transport oil in interstate or intrastate commerce.

(K) Pipeline systems which are used for the transport of oil exclusively within the confines of a nontransportation-related facility or terminal facility and which are not intended to transport oil in interstate or intrastate commerce, but excluding pipeline systems used to transfer oil in bulk to or from a vessel.

(2) "Transportation-related onshore and offshore facilities" means:

(A) Onshore and offshore terminal facilities including transfer hoses, loading arms and other equipment and appurtenances used for the purpose of handling or transferring oil in bulk to or from a vessel as well as storage tanks and appurtenances for the reception of oily ballast water or tank washings from vessels, but excluding terminal waste treatment facilities and terminal oil storage facilities.

(B) Transfer hoses, loading arms and other equipment appurtenant to a nontransportation-related facility which is used to transfer oil in bulk to or from a vessel.

(C) Interstate and intrastate onshore and offshore pipeline systems including pumps and appurtenances related thereto as well as in-line or breakout storage tanks needed for the continuous operation of a pipeline system, and pipelines from onshore and off-shore oil production facilities, but excluding onshore and offshore piping from wellheads to oil separators and pipelines which are used for the transport of oil exclusively within the confines of a nontransportation-related facility or terminal facility and which are not intended to transport oil in interstate or intrastate commerce or to transfer oil in bulk to or from a vessel.

(D) Highway vehicles and railroad cars which are used for the transport of oil in interstate or intrastate commerce and the equipment and appurtenances related thereto, and equipment used for the fueling of locomotive units, as well as the rights-of-way on which they operate. Excluded are highway vehicles and railroad cars and motive power used exclusively within the confines of a nontransportation-related facility or terminal facility and which are not intended for use in interstate or intrastate commerce.

APPENDIX C

National Fire Protection Association Standard
"Flammable and Combustible Liquids Code"
(NFPA 30)

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NFPA 30

Flammable and Combustible Liquids Code

1993 Edition

This edition of NFPA 30, *Flammable and Combustible Liquids Code*, was prepared by the Technical Committee on Flammable and Combustible Liquids, released by the Correlating Committee on Flammable Liquids, and acted on by the National Fire Protection Association, Inc. at its Annual Meeting held May 24-27, 1993 in Orlando, FL. It was issued by the Standards Council on July 23, 1993, with an effective date of August 20, 1993, and supersedes all previous editions.

The 1993 edition of this document has been approved by the American National Standards Institute.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

Origin and Development of NFPA 30

From 1913 to 1957, this document was written in the form of a municipal ordinance known as the *Suggested Ordinance for the Storage, Handling, and Use of Flammable Liquids*. In 1957, the format was changed from a municipal ordinance to a code, although the technical provisions were retained. During the 71-year existence of NFPA 30, numerous editions have been published as conditions and experiences have dictated.

A brief review of the major changes adopted with recent previous editions of NFPA 30 follows: In 1984, the chapter on automotive and marine service stations was removed from NFPA 30 and was used as the basis for a separate code, NFPA 30A, *Automotive and Marine Service Station Code*. In 1987, Chapter 5 ("Industrial Plants"), Chapter 6 ("Bulk Plants and Terminals"), Chapter 7 ("Process Plants"), and Chapter 8 ("Refineries, Chemical Plants, and Distilleries") were combined into a single chapter entitled "Operations." In 1990, a new Section 4-9 was added to provide requirements for hazardous materials storage lockers and more detailed guidance was added to Subsection 5-3.3.1 for the ventilation of process areas and for the estimation of fugitive emissions.

This 1993 edition incorporates the following major changes:

- An exception has been added to the spill control requirements of 2-3.4 to allow the installation of secondary containment-type tanks without either remote impounding or diking, if certain conditions are met.
- Additional requirements have been added to 2-3.4.2 to allow the combined use of remote impounding and diking for spill control systems.
- A provision has been added to the emergency relief venting calculation procedure (2-3.6) to allow a 50-percent reduction in the multiplication factors for certain liquids (those whose heats of combustion and rates of burning are no greater than those of ethyl alcohol).
- The requirements for installation of tanks inside buildings, Section 2-5, have been completely rewritten. The new requirements are far more comprehensive and are based on Tentative Interim Amendment 90-2 to the 1990 edition of NFPA 30. The new requirements also apply to buildings used exclusively to house storage tanks.
- Chapter 4, "Container and Portable Tank Storage," has been completely rewritten so that its requirements are more logically and more clearly presented. In addition, a flow chart has been added to Appendix A to assist the user in determining which subsections of Chapter 4 are applicable in any given case.
- Table 4-2.3 has been amended to allow the use of certain fiber drums for storage of Class II and Class III liquids.
- Subsection 4-3.6, covering mercantile occupancies, has been completely revised to state more clearly the requirements for storage of liquids, including a doubling of the allowable storage density and imposition of a more reasonable maximum allowable total quantity. The revision reflects current trends in retail merchandising.
- A new Section 5-5 has been added to provide appropriate requirements for vapor recovery and vapor processing equipment. This addition addresses the increasing use of such systems to meet requirements of the Clean Air Act.
- New protection recommendations and background information have been added to Appendix D and Appendix E to incorporate recent fire test results.

Committee on Flammable Liquids

Correlating Committee

Leon C. Schaller, *Chair*
The DuPont Company, DE

Robert P. Benedetti, *Secretary*
National Fire Protection Assn., MA
(Nonvoting)

Byron L. Briese, Professional Loss Control, Inc., TN
G. E. Cain, G. E. Cain & Co., DE
Edward Hildebrandt, Village of Morton Grove, IL
Rep. Illinois Fire Inspectors Assn.
C. L. Kingsbaker, Atlanta, GA
Steven Landon, Trophy Club Roanoke, TX
Joyce A. Rizzo, Lexicon Environmental Assoc., Inc., PA
Eugene S. Schmitt, Dept. of State Police, MI
Peter J. Gore Willse, Industrial Risk Insurers, CT
Rep. Industrial Risk Insurers

Committee Scope: To direct the activities of the Technical Committees assigned to it that have primary responsibility for the development and revision of NFPA codes, standards, recommended practices, and manuals pertaining to the storage, transportation, handling, and use of flammable and combustible liquids.

Technical Committee on

Flammable and Combustible Liquids

Edward Hildebrandt, *Chair*
Village of Morton Grove, IL
Rep. Illinois Fire Inspectors Assn.

David L. Blomquist, Chevron Corp., CA
Rep. American Petroleum Inst.
Jon V. Brannan, Underwriters Laboratories Inc., IL
Weldon L. Brundrett, M&M Protection Consultants, TX
Michael T. Castellano, Joseph E. Seagram & Sons Inc., NY
Rep. Distilled Spirits Council of U.S.
Robert H. Christopher, The DuPont Company, DE
Rep. Nat'l Paint & Coatings Assn.
Jack T. Cranefield, Factory Mutual Research Corp., MA
John A. Davenport, Industrial Risk Insurers, CT
Wayne Geyer, Steel Tank Inst., IL
Donald L. Hierman, Rhone-Poulenc, Inc., NJ
Rep. Chemical Manufacturers Assn.
Donald M. Johnson, San Bruno, CA
Rep. Western States Petroleum Assn.
Joshy Paul Kallungal, Ontario Fire Marshals Office, Canada
Russell J. Kerlin, Dow Corning Corp., MI
Rep. NFPA Industrial Fire Protection Section
James D. Kieffer, Hiram Walker & Sons Ltd, Canada
Richard S. Kraus, Mobile Oil Corp. - U.S., VA
Rep. American Petroleum Inst.
Wallace D. Malmstedt, American Ins. Services Group Inc., NY
Robert E. McClay, Indiana University of Pennsylvania, PA
Rep. American Society of Safety Engineers
Navin D. Mehta, Defense Logistics Agency - WIR, VA
Joseph R. Natale, Mobil Research & Development, NJ
Rep. Nat'l Petroleum Refiners Assn.
William E. Rehr, City of Wheaton, IL
Rep. Fire Marshals Assn. of North America
Robert N. Renkes, Petroleum Equipment Inst., OK
Douglas A. Rivers, 3M Co., MN
Gerald J. Rosicky, General Motors Corp., MI
Rep. NFPA Industrial Fire Protection Section
Eugene S. Schmitt, Dept. of State Police, Fire Marshal Division, MI
Rep. Fire Marshals Assn. of North America
Brooke B. Smith, Aspen Engineering Inc., CO
Thomas K. Terrebonne, Kemper Group, HPR Dept., KS
Rep. The Alliance of American Insurers
Harold S. Wass, IRM Insurance, NC
Jack Woycheese, Gage-Babcock & Assoc., Inc., CA

Alternates

William S. Anderson, 3M Co., MN
(Alt. to D. A. Rivers)
Brian H. Bender, ICI Americas Inc., DE
(Alt. to G. J. Rosicky)
J. W. Cragun, Phillips Petroleum Co., OK
(Alt. to D. L. Jeffries)
Robert D. Grausam, Kemper Group, NY
(Alt. to T. A. Terrebonne)

William R. Heitzig, The Dow Chemical Co., MI
(Alt. to R. J. Kerlin)
Lomer G. Johnson, Brown-Forman Corp., KY
(Alt. to M. T. Castellano)
David C. Kirby, Union Carbide Corp., WV
(Alt. to D. L. Hierman)
Martin E. Magera, Underwriters Laboratories Inc., IL
(Alt. to J. V. Brannan)
David G. Mahoney, M&M Protection Consultants, IL
(Alt. to W. L. Brundrett)
Lee Paige, IRM Insurance, NC
(Alt. to H. S. Wass)
Leon C. Schaller, The DuPont Company, DE
(Alt. to R. H. Christopher)
William A. Thornberg, Industrial Risk Insurers, IL
(Alt. to J. A. Davenport)

Voting Alternate

David L. Hodgden, Owens-Illinois Inc., OH
(Alt. to W. R. Heitzig)

Nonvoting

Michael B. Moore, U.S. Occupational Safety & Health Admin., DC
Richard F. Murphy, Exxon Research & Engr Co., NJ
Orville M. Slye, Loss Control Assoc. Inc., PA
Terence P. Smith, U.S. Department of Labor, DC
(Alt. to M. B. Moore)

Robert P. Benedetti, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time changes in the membership may have occurred.

NOTE: Membership on a Committee shall not in and of itself constitute an endorsement of the Association or any document developed by the Committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on criteria for safeguarding against fire and explosion hazards associated with the general storage, handling, and use of flammable and combustible liquids; and also for documents presenting criteria for the storage of flammable and combustible liquids on farms and isolated construction projects.

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NFPA 30

Flammable and Combustible Liquids Code

1993 Edition

NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates explanatory material on that paragraph in Appendix A.

Information on referenced publications can be found in Chapter 6 and Appendix G.

Foreword

This code, known as the *Flammable and Combustible Liquids Code*, is recommended for use as the basis for legal regulations. Its provisions are intended to reduce the hazard to a degree consistent with reasonable public safety, without undue interference with public convenience and necessity, of operations that require the use of flammable and combustible liquids. Thus, compliance with this standard does not eliminate all hazards in the use of flammable and combustible liquids. (*See the Flammable and Combustible Liquids Code Handbook for additional explanatory information.*)

Chapter 1 General Provisions

1-1 Scope and Application.

1-1.1 This code shall apply to all flammable and combustible liquids, including waste liquids, except those that are solid at 100°F (37.8°C) or above and those that are liquefied gases or cryogenic liquids.

1-1.2 Requirements for the safe storage and use of the great variety of flammable and combustible liquids commonly available depend primarily on their fire characteristics, particularly the flash point, which is the basis for the several classifications of liquids as defined in Section 1-2. It shall be noted that the classification of a liquid can be changed by contamination. For example, placing a Class II liquid into a tank that last contained a Class I liquid can alter its classification, as can exposing a Class II liquid to the vapors of a Class I liquid via an interconnecting vapor line (*see 2-3.7.4 and 2-4.5.6*). Care shall be exercised in such cases to apply the requirements appropriate to the actual classification. (NFPA 325M, *Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids*, contains flash point and other fire hazard data. NFPA 49, *Hazardous Chemicals Data*, and NFPA 321, *Standard on Basic Classification of Flammable and Combustible Liquids*, also contain information regarding this subject.)

1-1.3 The volatility of liquids is increased by heating. Where Class II or Class III liquids are exposed to storage conditions, use conditions, or process operations where they are naturally or artificially heated to or above their flash points, additional requirements might be necessary. These requirements include consideration for such items as ventilation, exposure to ignition sources, diking, and electrical area classification.

1-1.4 Additional requirements might be necessary for the safe storage and use of liquids that have unusual burning characteristics, that are subject to self-ignition when exposed to the air, that are highly reactive with other substances, that are subject to explosive decomposition, or that have other special properties that dictate safeguards over and above those specified for a normal liquid of similar flash point classification.

1-1.5 Equivalency.

1-1.5.1 Nothing in this code is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this code, provided technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency and the system, method, or device is approved for the intended purpose.

1-1.5.2 In certain installations the provisions of this code shall be permitted to be altered at the discretion of the authority having jurisdiction after consideration of special features such as topographical conditions, barricades, walls, adequacy of building exits, nature of occupancies, proximity to buildings or adjoining property, and character of construction of such buildings, capacity and construction of proposed tanks, and character of liquids to be stored, the nature of the process, the degree of private fire protection to be provided, and the adequacy of the facilities of the fire department to cope with flammable or combustible liquid fires.

1-1.5.3 Other regulations, such as for environmental protection, may impose requirements that are not anticipated by this code. Where acceptable to the authority having jurisdiction, alternate arrangements affording protection at least equivalent to that required by this code shall be permitted to be used.

1-1.6 Existing plants, equipment, buildings, structures, and installations for the storage, handling, or use of flammable or combustible liquids that are not in strict compliance with the terms of this code shall be permitted to be continued in use at the discretion of the authority having jurisdiction provided they do not constitute a recognized hazard to life or adjoining property. The existence of a situation that might result in an explosion or sudden escalation of a fire, such as inadequate ventilation of confined spaces, lack of adequate emergency venting of a tank, failure to fireproof the supports of elevated tanks, or lack of drainage or dikes to control spills, might constitute such a hazard.

1-1.7 This code shall not apply to:

1-1.7.1 Transportation of flammable and combustible liquids. These requirements are contained in the U.S. Department of Transportation regulations or in NFPA 385, *Standard for Tank Vehicles for Flammable and Combustible Liquids.*

1-1.7.2 Storage, handling, and use of fuel oil tanks and containers connected with oil burning equipment. These requirements are covered separately in NFPA 31, *Standard for the Installation of Oil-Burning Equipment.*

1-1.7.3 Liquefied gases. (*See definition.*)

1-1.7.4 Cryogenic liquids. (*See definition.*)

1-1.7.5 Storage of flammable and combustible liquids on farms and isolated construction projects. These requirements are covered separately in NFPA 395, *Standard for the Storage of Flammable and Combustible Liquids at Farms and Isolated Sites.*

1-1.7.6 Liquids without flash points that can be flammable under some conditions, such as certain halogenated hydrocarbons and mixtures containing halogenated hydrocarbons. (*See NFPA 321, Standard on Basic Classification of Flammable and Combustible Liquids.*)

1-1.7.7 Storage and handling of aerosol products. These requirements are covered separately in NFPA 30B, *Code for the Manufacture and Storage of Aerosol Products.*

1-1.7.8 Mists, sprays, or foams.

1-1.8 Installations made in accordance with the applicable requirements of standards of the National Fire Protection Association: NFPA 30A, *Automotive and Marine Service Station Code*; NFPA 32, *Standard for Drycleaning Plants*; NFPA 33, *Standard for Spray Application Using Flammable and Combustible Materials*; NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*; NFPA 35, *Standard for the Manufacture of Organic Coatings*; NFPA 36, *Standard for Solvent Extraction Plants*; NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*; NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*; and Chapter 10 of NFPA 99, *Standard for Health Care Facilities*, shall be deemed to be in compliance with this code.

1-1.9 Metrication. If a value for measurement as given in this standard is followed by an equivalent value in other units, the first stated shall be regarded as the requirement. The given equivalent value is approximate.

1-2 Definitions.

Apartment House. A building or that portion of a building containing more than two dwelling units.

Approved. Acceptable to the "authority having jurisdiction."

NOTE: The National Fire Protection Association does not approve, inspect or certify any installations, procedures, equipment, or materials nor does it approve or evaluate testing laboratories. In determining the acceptability of installations or procedures, equipment or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations which is in a position to determine compliance with appropriate standards for the current production of listed items.

Assembly Occupancy. All buildings or portions of buildings used for gathering 50 or more persons for such purposes as deliberation, worship, entertainment, dining, amusement, or awaiting transportation.

Atmospheric Tank. A storage tank that has been designed to operate at pressures from atmospheric through 0.5 psig (760 mm Hg through 786 mm Hg) measured at the top of the tank.

Authority Having Jurisdiction. The "authority having jurisdiction" is the organization, office or individual responsible for "approving" equipment, an installation or a procedure.

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a broad manner since jurisdictions and "approval" agencies vary as do their responsibilities. Where public safety is primary, the "authority having jurisdiction" may be a federal, state, local or other regional department or individual such as a fire chief, fire marshal, chief of a fire prevention bureau, labor department, health department, building official, electrical inspector, or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the "authority having jurisdiction." In many circumstances the property owner or his designated agent assumes the role of the "authority having jurisdiction"; at government installations, the commanding officer or departmental official may be the "authority having jurisdiction."

Barrel. A volume of 42 U.S. gal (158.9 L).

Basement. A story of a building or structure having ½ or more of its height below ground level and to which access for fire fighting purposes is unduly restricted.

Boiling Point. The temperature at which a liquid exerts a vapor pressure of 14.7 psia (760 mm Hg). Where an accurate boiling point is unavailable for the material in question, or for mixtures that do not have a constant boiling point, for purposes of this code the 10 percent point of a distillation performed in accordance with ASTM D 86-82, *Standard Method of Test for Distillation of Petroleum Products*, can be used as the boiling point of the liquid.

Boil-Over. An event in the burning of certain oils in an open top tank when, after a long period of quiescent burning, there is a sudden increase in fire intensity associated with expulsion of burning oil from the tank. Boil-over occurs when the residues from surface burning become more dense than the unburned oil and sink below the surface to form a hot layer, which progresses downward much faster than the regression of the liquid surface. When this hot layer, called a "heat wave," reaches water or water-in-oil emulsion in the bottom of the tank, the water is first superheated and subsequently boils almost explosively, overflowing the tank. Oils subject to boil-over consist of components having a wide range of boiling points, including both light ends and viscous residues. These characteristics are present in most crude oils and can be produced in synthetic mixtures.

NOTE: A boil-over is an entirely different phenomenon from a slop-over or froth-over. Slop-over involves a minor frothing that occurs when water is sprayed onto the hot surface of a burning oil. Froth-over is not associated with a fire but results when water is present or enters a tank containing hot viscous oil. Upon mixing, the sudden conversion of water to steam causes a portion of the tank contents to overflow.

Bulk Plant or Terminal. That portion of a property where liquids are received by tank vessel, pipelines, tank car, or tank vehicle and are stored or blended in bulk for the purpose of distributing such liquids by tank vessel, pipeline, tank car, tank vehicle, portable tank, or container.

Chemical Plant. A large integrated plant or that portion of such a plant other than a refinery or distillery where liquids are produced by chemical reactions or used in chemical reactions.

Closed Container. A container as herein defined, so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at ordinary temperatures.

Combustible Liquids. (*See definition of Liquid.*)

Container. Any vessel of 60 U.S. gal (227 L) or less capacity used for transporting or storing liquids.

Crude Petroleum. Hydrocarbon mixtures that have a flash point below 150°F (65.6°C) and that have not been processed in a refinery.

Cryogenic Liquid. A refrigerated liquid gas having a boiling point below m-130°F (m-90°C) at atmospheric pressure.

Distillery. A plant or that portion of a plant where liquids produced by fermentation are concentrated and where the concentrated products may also be mixed, stored, or packaged.

Dwelling. A building occupied exclusively for residence purposes and having not more than two dwelling units or as a boarding or rooming house serving not more than 15 persons with meals or sleeping accommodations or both.

Dwelling Unit. One or more rooms arranged for the use of one or more individuals living together as a single housekeeping unit, with cooking, living, sanitary, and sleeping facilities.

Educational Occupancy. The occupancy or use of a building or structure or any portion thereof by persons assembled for the purpose of learning or of receiving educational instruction.

Fire Area. An area of a building separated from the remainder of the building by construction having a fire resistance of at least 1 hr and having all communicating openings properly protected by an assembly having a fire resistance rating of at least 1 hr.

Flash Point. The minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitible mixture with air near the surface of the liquid within the vessel as specified by appropriate test procedure and apparatus as follows:

(a) The flash point of a liquid having a viscosity less than 45 SUS at 100°F (37.8°C) and a flash point below 200°F (93°C) shall be determined in accordance with ASTM D 56, *Standard Method of Test for Flash Point by the Tag Closed Cup Tester.*

(b) The flash point of a liquid having a viscosity of 45 SUS or more at 100°F (37.8°C) or a flash point of 200°F (93°C) or higher shall be determined in accordance with ASTM D 93, *Standard Method of Test for Flash Point by the Pensky-Martens Closed Tester.*

(c) As an alternate, ASTM D 3278, *Standard Method of Tests for Flash Point of Liquids by Setaflash Closed Tester*, may be used for paints, enamels, lacquers, varnishes, and related products and their components having flash points between 32°F (0°C) and 230°F (110°C) and having a viscosity lower than 150 stokes at 77°F (25°C).

(d) As an alternate, ASTM D 3828, *Standard Test Methods for Flash Point by Setaflash Closed Tester*, may be used for materials other than those for which specific Setaflash Methods exist.

Fugitive Emissions. Releases of flammable vapor that continuously occur from process equipment during normal operations. These include leaks from pump seals, valve packing, flange gaskets, compressor seals, process drains, etc.

Hazardous Material or Hazardous Chemical. Material presenting dangers beyond the fire problems relating to flash point and boiling point. These dangers can arise from but are not limited to toxicity, reactivity, instability, or corrosivity.

Hazardous Materials Storage Locker. A relocatable prefabricated structure, manufactured primarily at a site other than the final location of the structure and transported completely assembled or in a ready-to-assemble package to the final location. It is intended to meet local, state, and federal requirements for outside storage of hazardous materials.

Hazardous Reaction or Hazardous Chemical Reaction. Reactions that result in dangers beyond the fire problems relating to flash point and boiling point of either the reactants or of the products. These dangers might include but are not limited to toxic effects, reaction speed (including detonation), exothermic reaction, or production of unstable or reactive materials.

Hotel. Buildings or groups of buildings under the same management in which there are sleeping accommodations for hire, primarily used by transients who are lodged with or without meals, including but not limited to inns, clubs, motels, and apartment hotels.

Incidental Liquid Use or Storage. Use or storage as a subordinate activity to that which established the occupancy or area classification.

Inside Liquid Storage Area. A room or building used for the storage of liquids in containers or portable tanks, separated from other types of occupancies. Such areas include:

Inside Room. A room totally enclosed within a building and having no exterior walls.

Cut-Off Room. A room within a building and having at least one exterior wall.

Attached Building. A building having only one common wall with another building having other types of occupancies.

Liquid Warehouse. A separate, detached building or attached building used for warehousing-type operations for liquids.

Institutional Occupancy. The occupancy or use of a building or structure or any portion thereof by persons harbored or detained to receive medical, charitable, or other care or treatment or by persons involuntarily detained.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials and by whose labeling the manufacturer

indicates compliance with appropriate standards or performance in a specified manner.

Liquefied Gas. A gas that, under its charged pressure, is partially liquid at 70°F (21°C).

Liquid. For the purpose of this code, any material that has a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM D 5, *Test for Penetration for Bituminous Materials*. **When not otherwise identified, the term *liquid* shall mean both flammable and combustible liquids.**

Combustible Liquid. A liquid having a closed cup flash point at or above 100°F (37.8°C).

Combustible liquids shall be subdivided as follows:

Class II liquids shall include those having flash points at or above 100°F (37.8°C) and below 140°F (60°C).

Class IIIA liquids shall include those having flash points at or above 140°F (60°C) and below 200°F (93°C).

Class IIIB liquids shall include those having flash points at or above 200°F (93°C).

Flammable Liquid. A liquid having a closed cup flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psia (2068 mm Hg) at 100°F (37.8°C) shall be known as a Class I liquid.

Class I liquids shall be subdivided as follows:

Class IA shall include those having flash points below 73°F (22.8°C) and having a boiling point below 100°F (37.8°C).

Class IB shall include those having flash points below 73°F (22.8°C) and having a boiling point at or above 100°F (37.8°C).

Class IC shall include those having flash points at or above 73°F (22.8°C) and below 100°F (37.8°C).

Listed. Equipment or materials included in a list published by an organization acceptable to the "authority having jurisdiction" and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The "authority having jurisdiction" should utilize the system employed by the listing organization to identify a listed product.

Low-Pressure Tank. A storage tank designed to withstand an internal pressure above 0.5 psig (3.5 kPa) but not more than 15 psig (103.4 kPa) measured at the top of the tank.

Mercantile Occupancy. The occupancy or use of a building or structure or any portion thereof for the wholesale or retail displaying, selling, or buying of goods, wares, or merchandise.

Occupancy Classification. The system of defining the predominant operating characteristic of a portion of a building or plant for purposes of applying relevant sections of this code. This may include but is not limited to distillation, oxidation, cracking, and polymerization.

Office Occupancy. The occupancy or use of a building or structure or any portion thereof for the transaction of business or the rendering or receiving of professional services.

Operating Unit (Vessel) or Process Unit (Vessel). The equipment in which a unit operation or unit process is conducted. (*See also definition of Unit Operation or Unit Process.*)

Operations. A general term that includes but is not limited to the use, transfer, storage, and processing of liquids.

Outdoor Occupancy Classification. Similar to occupancy classification except that it applies to outdoor operations not enclosed in a building or shelter.

Portable Tank. Any closed vessel having a liquid capacity over 60 U.S. gallons (227 L) and not intended for fixed installation.

Pressure Vessel. Any fired or unfired vessel within the scope of the applicable section of the ASME *Boiler and Pressure Vessel Code*.

Process or Processing. An integrated sequence of operations. The sequence can be inclusive of both physical and chemical operations, unless the term is modified to restrict it to one or the other. The sequence can involve, but is not limited to, preparation, separation, purification, or change in state, energy content, or composition.

Protection for Exposures. Fire protection for structures on property adjacent to liquid storage. Fire protection for such structures shall be acceptable when located either within the jurisdiction of any public fire department or adjacent to plants having private fire brigades capable of providing cooling water streams on structures on property adjacent to liquid storage.

Refinery. A plant in which flammable or combustible liquids are produced on a commercial scale from crude petroleum, natural gasoline, or other hydrocarbon sources.

Safety Can. An approved container, of not more than 5 gal (18.9 L) capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

Secondary Containment Tank. A tank having an inner and an outer wall with an interstitial space (annulus) between the walls and having means for monitoring the interstitial space for a leak. Underground secondary containment tanks are of either Type I or Type II construction.

Type I. A primary tank wrapped by an exterior shell that is in direct contact with it. The exterior shell might or might not wrap the full 360 degree circumference of the primary tank.

Type II. A primary tank wrapped by an exterior shell that is physically separated from it by stand-offs and wraps the full 360 degree circumference of the primary tank.

Stable Liquid. Any liquid not defined as unstable.

Storage Tank. Any vessel having a liquid capacity that exceeds 60 gal (227 L), is intended for fixed installation and is not used for processing.

Storage Tank Building. A roofed structure that contains storage tanks and that limits the dissipation of heat or the dispersion of flammable vapors or restricts fire fighting

access and control and that is installed in accordance with the requirements of Section 2-5.

Unit Operation or Unit Process. A segment of a physical or chemical process that may or may not be integrated with other segments to constitute the manufacturing sequence.

Unstable Liquid. A liquid that, in the pure state or as commercially produced or transported, will vigorously polymerize, decompose, undergo condensation reaction, or become self-reactive under conditions of shock, pressure, or temperature.

Vapor Pressure. The pressure, measured in psia, exerted by a volatile liquid as determined by ASTM D 323, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)*.

Vapor Processing Equipment. Those components of a vapor processing system designed to process vapors or liquids captured during transfer operations.

Vapor Processing System. A system designed to capture and process vapors displaced during transfer operations by use of mechanical or chemical means. Examples are systems using blower-assist for capturing vapors and refrigeration, absorption, and combustion systems for processing vapors.

Vapor Recovery System. A system designed to capture and retain, without processing, vapors displaced during transfer operations. Examples are balanced-pressure vapor displacement systems and vacuum assist systems without vapor processing.

Ventilation. As specified in this code, ventilation is for the prevention of fire and explosion. It is considered adequate if it is sufficient to prevent accumulation of significant quantities of vapor-air mixtures in concentrations over one-fourth of the lower flammable limit.

Warehouses.

General-Purpose Warehouse. A separate, detached building or portion of a building used only for warehousing-type operations.

NOTE: Warehousing operations referred to above are those operations not accessible to the public and include general purpose, merchandise, distribution, and industrial warehouse-type operations.

Liquid Warehouse. (*See definition under Inside Storage Area.*)

Wharf. Any dock, pier, bulkhead, or other structure over or contiguous to navigable water with direct physical access from land, the primary function of which is the transfer of liquid cargo in bulk between shore installations and any tank vessel, such as a ship, barge, lighter boat, or other mobile floating craft.

1-3 Storage. Liquids shall be stored in tanks or in containers in accordance with Chapter 2 or Chapter 4.

1-4 Pressure Vessel. All new pressure vessels containing liquids shall comply with 1-4.1, 1-4.2, or 1-4.3, as applicable.

1-4.1 Fired pressure vessels shall be designed and constructed in accordance with Section I (Power Boilers), or Section VIII, Division 1 or Division 2 (Pressure Vessels), as applicable, of the ASME *Boiler and Pressure Vessel Code*.

1-4.2 Unfired pressure vessels shall be designed and constructed in accordance with Section VIII, Division 1 or Division 2, of the ASME *Boiler and Pressure Vessel Code*.

1-4.3 Fired and unfired pressure vessels that do not conform to 1-4.1 or 1-4.2 may be used provided approval has been obtained from the state or other governmental jurisdiction in which they are to be used. Such pressure vessels are generally referred to as "State Special."

1-5 Exits. Egress from buildings and areas covered by this code shall be in accordance with NFPA *101®, Life Safety Code®*.

Chapter 2 Tank Storage

2-1 Scope. This chapter shall apply to aboveground, underground, and inside storage of liquids in fixed tanks and in portable tanks whose capacity exceeds 660 gal (2500 L).

2-2 Design and Construction of Tanks.

2-2.1 Materials. Tanks shall be designed and built in accordance with recognized good engineering standards for the material of construction being used and shall be of steel or approved noncombustible material, with the following limitations and exceptions:

(a) The material of tank construction shall be compatible with the liquid to be stored. In case of doubt about the properties of the liquid to be stored, the supplier, producer of the liquid, or other competent authority shall be consulted.

(b) Tanks constructed of combustible materials shall be subject to the approval of the authority having jurisdiction and limited to:

1. Installation underground, or
2. Use where required by the properties of the liquid stored, or
3. Storage of Class IIIB liquids aboveground in areas not exposed to a spill or leak of Class I or Class II liquid, or
4. Storage of Class IIIB liquids inside a building protected by an approved automatic fire extinguishing system.

(c) Unlined concrete tanks shall be permitted to be used for storing liquids having a gravity of 40 degrees API or heavier. Concrete tanks with special linings shall be permitted to be used for other services provided the design is in accordance with sound engineering practice.

(d) Tanks shall be permitted to have combustible or noncombustible linings. The choice of a suitable protective lining shall depend upon the properties of the liquid stored.

(e) Special engineering consideration might be required if the specific gravity of the liquid to be stored exceeds that of water or if the tank is designed to contain liquids at a liquid temperature below 0°F (m-17.8°C).

2-2.2 Fabrication.

2-2.2.1 Tanks shall be permitted to be of any shape or type consistent with sound engineering design.

2-2.2.2 Metal tanks shall be welded, riveted and caulked, or bolted, or constructed by use of a combination of these methods.

2-2.3 Atmospheric Tanks.

2-2.3.1 Atmospheric tanks, including those incorporating secondary containment, shall be built in accordance with recognized standards of design *or* approved equivalents. Atmospheric tanks shall be built, installed, and used within the scopes of their approvals or within the scopes of any of the following:

(a) Underwriters Laboratories Inc., *Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids*, UL 142; *Standard for Steel Underground Tanks for Flammable and Combustible Liquids*, UL 58; or *Standard for Steel Inside Tanks for Oil Burner Fuel*, UL 80.

(b) American Petroleum Institute Standard No. 650, *Welded Steel Tanks for Oil Storage*, Eighth Edition.

(c) American Petroleum Institute Specifications 12B, *Bolted Tanks for Storage of Production Liquids*, Twelfth Edition; 12D, *Field Welded Tanks for Storage of Production Liquids*, Eighth Edition; or 12F, *Shop Welded Tanks for Storage of Production Liquids*, Seventh Edition.

(d) American Society for Testing and Materials, *Standard Specification for Glass-Fiber Reinforced Polyester Underground Petroleum Storage Tanks*, ASTM D 4021.

(e) Underwriters Laboratories Inc., *Standard for Glass-Fiber Reinforced Plastic Underground Storage Tanks for Petroleum Products*, UL 1316.

2-2.3.2 Low-pressure tanks and pressure vessels shall be permitted to be used as atmospheric tanks.

2-2.3.3 Atmospheric tanks shall not be used for the storage of a liquid at a temperature at or above its boiling point.

2-2.4 Low-Pressure Tanks.

2-2.4.1 The normal operating pressure of the tank shall not exceed the design pressure of the tank.

2-2.4.2 Low-pressure tanks shall be built in accordance with recognized standards of design. Low-pressure tanks shall be permitted to be built in accordance with:

(a) American Petroleum Institute Standard No. 620, *Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks*, Fifth Edition.

(b) The principles of the *Code for Unfired Pressure Vessels*, Section VIII, Division 1 of the ASME *Boiler and Pressure Vessel Code*.

2-2.4.3 Tanks built according to Underwriters Laboratories Inc. requirements in 2-2.3.1 shall be permitted to be used for operating pressures not exceeding 1 psig (6.9 kPa) and shall be limited to 2.5 psig (17.2 kPa) under emergency venting conditions.

2-2.4.4 Pressure vessels shall be permitted to be used as low-pressure tanks.

2-2.5 Pressure Vessels.

2-2.5.1 The normal operating pressure of the vessel shall not exceed the design pressure of the vessel.

2-2.5.2 Storage tanks designed to withstand pressures above 15 psig (103.4 kPa) shall meet the requirements of Section 1-4.

2-2.6 Provisions for Internal Corrosion. Where tanks are not designed in accordance with the American Petroleum Institute, American Society of Mechanical Engineers, or the Underwriters Laboratories Inc. standards, or if corrosion is anticipated beyond that provided for in the design formulas used, additional metal thickness or suitable protective coatings or linings shall be provided to compensate for the corrosion loss expected during the design life of the tank.

2-3 Installation of Outside Aboveground Tanks.

2-3.1 This section shall include installations in which tanks are above, at, or below grade and are without backfill.

2-3.2 Location with Respect to Property Lines, Public Ways, and Important Buildings on the Same Property.

2-3.2.1 Every aboveground tank for the storage of Class I, Class II, or Class IIIA liquids (except as provided in 2-3.2.2), and those liquids with boil-over characteristics and unstable liquids, operating at pressures not in excess of 2.5 psig (17.2 kPa) and designed with a weak roof-to-shell seam (*see 2-3.6.3*), or equipped with emergency venting devices that will not permit pressures to exceed 2.5 psig (17.2 kPa), shall be located in accordance with Table 2-1. Where tank spacing is contingent on a weak roof-to-shell seam design, the user shall present evidence certifying such construction to the authority having jurisdiction, upon request.

(a) For the purpose of Section 2-3, a floating roof tank is defined as one that incorporates either:

1. A pontoon or double-deck metal floating roof in an open-top tank in accordance with API Standard 650, or

2. A fixed metal roof with ventilation at the top and roof eaves in accordance with API Standard 650 and containing a metal floating roof or cover meeting any one of the following requirements:

(i) A pontoon or double-deck metal floating roof meeting the requirements of API Standard 650

(ii) A metal floating cover supported by liquidtight metal floating devices that provide sufficient buoyancy to prevent the liquid surface from being exposed when half of the flotation is lost.

(b) An internal metal floating pan, roof, or cover that does not meet the requirements of item 2 in (a) above, or one that uses plastic foam (except for seals) for flotation, even if encapsulated in metal or fiberglass, shall be considered a fixed roof tank.

2-3.2.2 Vertical tanks having a weak roof-to-shell seam (*see 2-3.6.3*) and storing Class IIIA liquids may be located at one-half the distances specified in Table 2-1, provided the tanks are not within a diked area or drainage path for a tank storing a Class I or Class II liquid.

Table 2-1 Stable Liquids [Operating Pressure 2.5 psig (17.2 kPa) or Less]

Type of Tank	Protection	Minimum Distance in Ft from Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way and Shall Be Not Less than 5 Ft	Minimum Distance in Ft from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property and Shall Be Not Less than 5 Ft
Floating Roof [See 2-3.1.1(a)]	Protection for exposures*	½ times diameter of tank	⅙ times diameter of tank
	None	Diameter of tank but need not exceed 175 ft	⅙ times diameter of tank
Vertical with Weak Roof-to-Shell Seam (See 2-3.5.3)	Approved foam or inerting system** on tanks not exceeding 150 ft in diameter***	½ times diameter of tank	⅙ times diameter of tank
	Protection for exposures*	Diameter of tank	⅓ times diameter of tank
	None	2 times diameter of tank but need not exceed 350 ft	⅓ times diameter of tank
Horizontal and Vertical with Emergency Relief Venting to Limit Pressures to 2.5 psig	Approved inerting system** on the tank or approved foam system on vertical tanks	½ times Table 2-6	½ times Table 2-6
	Protection for exposures*	Table 2-6	Table 2-6
	None	2 times Table 2-6	Table 2-6

SI Units: 1 ft = 0.3 m.
*See definition of "Protection for Exposures."
**See NFPA 69, *Standard on Explosion Prevention Systems.*
***For tanks over 150 ft in diameter, use "Protection for Exposures" or "None," as applicable.

2-3.2.3 Every aboveground tank for the storage of Class I, Class II, or Class IIIA liquids, except those liquids with boil-over characteristics and unstable liquids, operating at pressures exceeding 2.5 psig (17.2 kPa) or equipped with emergency venting that will permit pressures to exceed 2.5 psig (17.2 kPa), shall be located in accordance with Table 2-2.

2-3.2.4 Every aboveground tank for storage of liquids with boil-over characteristics shall be located in accordance with Table 2-3. Liquids with boil-over characteristics shall not be stored in fixed roof tanks larger than 150 ft (45.7 m) in diameter, unless an approved inerting system is provided on the tank.

2-3.2.5 Every aboveground tank for the storage of unstable liquids shall be located in accordance with Table 2-4.

2-3.2.6 Every aboveground tank for the storage of Class IIIB liquids, excluding unstable liquids, shall be located in accordance with Table 2-5, except where located within a diked area or drainage path for a tank(s) storing a Class I or Class II liquid. Where a Class IIIB liquid storage tank is within the diked area or drainage path for a Class I or Class II liquid, 2-3.2.1 or 2-3.2.2 shall apply.

2-3.2.7 Where two tank properties of diverse ownership have a common boundary, the authority having jurisdiction shall be permitted, with the written consent of the owners of the two properties, to substitute the distances provided in 2-3.3.1 through 2-3.3.6 for the minimum distances set forth in 2-3.2.

2-3.2.8 Where end failure of horizontal pressure tanks and vessels can expose property, the tank shall be placed with the longitudinal axis parallel to the nearest important exposure.

Table 2-2 Stable Liquids [Operating Pressure Greater than 2.5 psig (17.2 kPa)]

Type of Tank	Protection	Minimum Distance in Ft from Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way	Minimum Distance in Ft from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property
Any Type	Protection for exposures*	1½ times Table 2-6 but shall not be less than 25 ft	1½ times Table 2-6 but shall not be less than 25 ft
	None	3 times Table 2-6 but shall not be less than 50 ft	1½ times Table 2-6 but shall not be less than 25 ft

SI Units: 1 ft = 0.3 m.
*See definition of "Protection for Exposures."

Table 2-3 Boil-Over Liquids

Type of Tank	Protection	Minimum Distance in Ft from Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way, and Shall Be Not Less than 5 Ft	Minimum Distance in Ft from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property and Shall Be Not Less than 5 Ft
Floating Roof [See 2-3.1.1(a)]	Protection for exposures*	½ times diameter of tank	⅙ times diameter of tank
	None	Diameter of tank	⅙ times diameter of tank
Fixed Roof (See 2-3.1.4)	Approved foam or inerting system**	Diameter of tank	⅓ times diameter of tank
	Protection for exposures*	2 times diameter of tank	⅔ times diameter of tank
	None	4 times diameter of tank but need not exceed 350 ft	⅔ times diameter of tank

SI Units: 1 ft = 0.3 m.
*See definition of "Protection for Exposures."
**See NFPA 69, *Standard on Explosion Prevention Systems*.

Table 2-4 Unstable Liquids

Type of Tank	Protection	Minimum Distance in Ft from Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way	Minimum Distance in Ft from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property
Horizontal and Vertical Tanks with Emergency Relief Venting to Permit Pressure Not in Excess of 2.5 psig	Tank protected with any one of the following: approved water spray, approved inerting,* approved insulation and refrigeration, approved barricade	Table 2-6 but not less than 25 ft	Not less than 25 ft
	Protection for exposures**	2½ times Table 2-6 but not less than 50 ft	Not less than 50 ft
	None	5 times Table 2-6 but not less than 100 ft	Not less than 100 ft
Horizontal and Vertical Tanks with Emergency Relief Venting to Permit Pressure over 2.5 psig	Tank protected with any one of the following: approved water spray, approved inerting,* approved insulation and refrigeration, approved barricade	2 times Table 2-6 but not less than 50 ft	Not less than 50 ft
	Protection for exposures**	4 times Table 2-6 but not less than 100 ft	Not less than 100 ft
	None	8 times Table 2-6 but not less than 150 ft	Not less than 150 ft

SI Units: 1 ft = 0.3 m.
*See NFPA 69, *Standard on Explosion Prevention Systems*.
**See definition of "Protection for Exposures."

Table 2-5 Class IIIB Liquids

Capacity Gallons	Minimum Distance in Ft from Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way	Minimum Distance in Ft from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property
12,000 or less	5	5
12,001 to 30,000	10	5
30,001 to 50,000	10	10
50,001 to 100,000	15	10
100,001 or more	15	15

SI Units: 1 ft = 0.3 m; 1 gal = 3.8 L.

Table 2-6 Reference Table for Use in Tables 2-1 to 2-4

Capacity Tank Gallons	Minimum Distance in Ft from Property Line that Is or Can Be Built Upon, Including the Opposite Side of a Public Way	Minimum Distance in Ft from Nearest Side of Any Public Way or from Nearest Important Building on the Same Property
275 or less	5	5
276 to 750	10	5
751 to 12,000	15	5
12,001 to 30,000	20	5
30,001 to 50,000	30	10
50,001 to 100,000	50	15
100,001 to 500,000	80	25
500,001 to 1,000,000	100	35
1,000,001 to 2,000,000	135	45
2,000,001 to 3,000,000	165	55
3,000,001 or more	175	60

SI Units: 1 ft = 0.3 m; 1 gal = 3.8 L.

2-3.3 Spacing (Shell-to-Shell) between Any Two Adjacent Aboveground Tanks.

2-3.3.1 Tanks storing Class I, II, or IIIA stable liquids shall be separated in accordance with Table 2-7, except as provided in 2-3.3.2.

2-3.3.2 Crude petroleum tanks having individual capacities not exceeding 126,000 gal (3000 barrels), where located at production facilities in isolated locations, need not be separated by more than 3 ft (0.9 m).

2-3.3.3 Tanks used only for storing Class IIIB liquids shall be permitted to be spaced no less than 3 ft (0.9 m) apart unless within a diked area or drainage path for a tank storing a Class I or II liquid, in which case the provisions of Table 2-7 shall apply.

2-3.3.4 For unstable liquids, the distance between such tanks shall not be less than one-half the sum of their diameters.

2-3.3.5 Where tanks are in a diked area containing Class I or Class II liquids, or in the drainage path of Class I or Class II liquids, and are compacted in three or more rows or in an irregular pattern, greater spacing or other means shall be permitted to be required by the authority having jurisdiction to make tanks in the interior of the pattern accessible for fire fighting purposes.

2-3.3.6 The minimum horizontal separation between an LP-Gas container and a Class I, Class II, or Class IIIA liquid storage tank shall be 20 ft (6 m), except in the case of a Class I, Class II, or Class IIIA liquid tank operating at pressures exceeding 2.5 psig (17.2 kPa) or equipped with emergency venting that will permit pressures to exceed 2.5 psig (17.2 kPa), in which case the provisions of 2-3.3.1 and 2-3.3.2 shall apply. Suitable measures shall be taken to prevent the accumulation of Class I, Class II, or Class IIIA liquids under adjacent LP-Gas containers such as by dikes, diversion curbs, or grading. Where flammable or combustible liquid storage tanks are within a diked area, the LP-Gas containers shall be outside the diked area and at least 10 ft (3 m) away from the centerline of the wall of the diked area. The foregoing provisions shall not apply where LP-Gas containers of 125 gal (475 L) or less capacity are installed adjacent to fuel oil supply tanks of 660 gal (2498 L) or less capacity. No horizontal separation is required between aboveground LP-Gas containers and underground flammable and combustible liquid tanks installed in accordance with Section 2-4.

2-3.4 Control of Spillage from Aboveground Tanks.

2-3.4.1 Facilities shall be provided so that any accidental discharge of any Class I, II, or IIIA liquids will be prevented from endangering important facilities, and adjoining property, or reaching waterways, as provided for in 2-3.4.2 or 2-3.4.3.

Exception No. 1: Tanks storing Class IIIB liquids do not require special drainage or diking provisions for fire protection purposes.

Exception No. 2: Aboveground secondary containment-type tanks need not meet the requirements of 2-3.4 if all of the following conditions are met:

(a) The capacity of the tank shall not exceed 12,000 gal (45,420 L).

(b) All piping connections to the tank shall be made above the normal maximum liquid level.

(c) Means shall be provided to prevent the release of liquid from the tank by siphon flow.

Table 2-7 Minimum Tank Spacing (Shell-to-Shell)

		Fixed or Horizontal Tanks	
	Floating Roof Tanks	Class I or II Liquids	Class IIIA Liquids
All tanks not over 150 ft in diameter	1/6 sum of adjacent tank diameters but not less than 3 ft	1/6 sum of adjacent tank diameters but not less than 3 ft	1/6 sum of adjacent tank diameters but not less than 3 ft
Tanks larger than 150 feet in diameter			
If remote impounding is in accordance with 2-3.3.2	1/6 sum of adjacent tank diameters	1/4 sum of adjacent tank diameters	1/6 sum of adjacent tank diameters
If impounding is around tanks in accordance with 2-3.3.3	1/4 sum of adjacent tank diameters	1/3 sum of adjacent tank diameters	1/4 sum of adjacent tank diameters

SI Units: 1 ft = 0.3 m.

(d) Means shall be provided for determining the level of liquid in the tank. This means shall be accessible to the delivery operator.

(e) Means shall be provided to prevent overfilling by sounding an alarm when the liquid level in the tank reaches 90 percent of capacity and by automatically stopping delivery of liquid to the tank when the liquid level in the tank reaches 95 percent of capacity. In no case shall these provisions restrict or interfere with the proper functioning of the normal vent or the emergency vent.

(f) Spacing between adjacent tanks shall be not less than 3 ft (0.9 m).

(g) The tank shall be capable of resisting the damage from the impact of a motor vehicle or suitable collision barriers shall be provided.

(h) Where the interstitial space is enclosed, it shall be provided with emergency venting in accordance with 2-3.6.

2-3.4.2 Remote Impounding. Where protection of adjoining property or waterways is by means of drainage to a remote impounding area, so that impounded liquid will not be held against tanks, such systems shall comply with the following:

(a) A slope of not less than 1 percent away from the tank shall be provided for at least 50 ft (15 m) toward the impounding area.

(b) The impounding area shall have a capacity not less than that of the largest tank that can drain into it. Where it is not possible because there is not enough open area around the tanks or it is impractical to provide 100 percent capacity remote impounding, it shall be permitted to provide "partial" remote impounding for some percentage of the required capacity remote from any tank or adjoining property. The required volume exceeding the capacity of the partial remote impoundment shall be provided for by diking meeting the requirements of 2-3.4.3.

(c) The route of the drainage system shall be so located that, if the liquids in the drainage systems are ignited, the fire will not seriously expose tanks or adjoining property.

(d) The confines of the impounding area shall be located so that, when filled to capacity, the liquid level will not be closer than 50 ft (15 m) from any property line that is or can be built upon, or from any tank. Where "partial" remote impounding is used, the liquid level in the partial impound shall meet the requirement of this section. The excess volume shall meet the requirements of impounding by diking as provided or in 2-3.4.3. Tank spacing shall be determined as for tanks impounded in accordance with 2-3.4.3.

2-3.4.3 Impounding around Tanks by Diking. Where protection of adjoining property or waterways is by means of impounding by diking around the tanks, such system shall comply with the following:

(a) A slope of not less than 1 percent away from the tank shall be provided for at least 50 ft (15 m) or to the dike base, whichever is less.

(b) The volumetric capacity of the diked area shall not be less than the greatest amount of liquid that can be released from the largest tank within the diked area, assuming a full tank. To allow for volume occupied by tanks, the capacity of the diked area enclosing more than one tank shall be calculated after deducting the volume of the tanks, other than the largest tank, below the height of the dike.

(c) To permit access, the outside base of the dike at ground level shall be no closer than 10 ft (3 m) to any property line that is or can be built upon.

(d) Walls of the diked area shall be of earth, steel, concrete, or solid masonry designed to be liquidtight and to withstand a full hydrostatic head. Earthen walls 3 ft (0.9 m) or more in height shall have a flat section at the top not less than 2 ft (0.6 m) wide. The slope of an earthen wall shall be consistent with the angle of repose of the material of which the wall is constructed. Diked areas for tanks containing Class I liquids located in extremely porous soils may require special treatment to prevent seepage of hazardous quantities of liquids to low-lying areas or waterways in case of spills.

(e) Except as provided in (f) below, the walls of the diked area shall be restricted to an average interior height of 6 ft (1.8 m) above interior grade.

(f) Dikes shall be permitted to be higher than an average of 6 ft (1.8 m) above interior grade where provisions are made for normal access and necessary emergency access to tanks, valves, and other equipment, and safe egress from the diked enclosure.

1. Where the average height of the dike containing Class I liquids is over 12 ft (3.6 m) high, measured from interior grade, or where the distance between any tank and the top inside edge of the dike wall is less than the height of the dike wall, provisions shall be made for normal operation of valves and for access to tank roof(s) without entering below the top of the dike. These provisions shall be permitted to be met through the use of remote-operated valves, elevated walkways, or similar arrangements.

2. Piping passing through dike walls shall be designed to prevent excessive stresses as a result of settlement or fire exposure.

3. The minimum distance between tanks and toe of the interior dike walls shall be 5 ft (1.5 m).

(g) Each diked area containing two or more tanks shall be subdivided, preferably by drainage channels or at least by intermediate dikes, in order to prevent spills from endangering adjacent tanks within the diked area as follows:

1. Where storing normally stable liquids in vertical cone roof tanks constructed with weak roof-to-shell seam or floating roof tanks, or when storing crude petroleum in producing areas in any type of tank, one subdivision for each tank in excess of 10,000 bbl (1,590,000 L) and one subdivision for each group of tanks [no tank exceeding 10,000 bbl (1,590,000 L) capacity] having an aggregate capacity not exceeding 15,000 bbl (2,385,000 L).

2. Where storing normally stable liquids in tanks not covered in subsection (1), one subdivision for each tank in excess of 2,380 bbl (378,500 L) and one subdivision for each group of tanks [no tank exceeding 2,380 bbl (378,500 L) capacity] having an aggregate capacity not exceeding 3,570 bbl (567,750 L).

3. Where storing unstable liquids in any type of tank, one subdivision for each tank except that tanks installed in accordance with the drainage requirements of NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, shall require no additional subdivision. Since unstable liquids will react more rapidly when heated than

when at ambient temperatures, subdivision by drainage channels is the preferred method.

4. Whenever two or more tanks storing Class I liquids, any one of which is over 150 ft (45 m) in diameter, are located in a common diked area, intermediate dikes shall be provided between adjacent tanks to hold at least 10 percent of the capacity of the tank so enclosed, not including the volume displaced by the tank.

5. The drainage channels or intermediate dikes shall be located between tanks so as to take full advantage of the available space with due regard for the individual tank capacities. Intermediate dikes, where used, shall be not less than 18 in. (45 cm) in height.

(h) Where provision is made for draining water from diked areas, such drains shall be controlled in a manner so as to prevent flammable or combustible liquids from entering natural water courses, public sewers, or public drains, if their presence would constitute a hazard. Control of drainage shall be accessible under fire conditions from outside the dike.

(i) Storage of combustible materials, empty or full drums, or barrels, shall not be permitted within the diked area.

2-3.5 Normal Venting for Aboveground Tanks.

2-3.5.1 Atmospheric storage tanks shall be adequately vented to prevent the development of vacuum or pressure sufficient to distort the roof of a cone roof tank or exceeding the design pressure in the case of other atmospheric tanks, as a result of filling or emptying, and atmospheric temperature changes.

2-3.5.2 Normal vents shall be sized in accordance with either: (1) the American Petroleum Institute Standard No. 2000, *Venting Atmospheric and Low-Pressure Storage Tanks*, or (2) other accepted standard; or shall be at least as large as the filling or withdrawal connection, whichever is larger, but in no case less than 1¼ in. (3 cm) nominal inside diameter.

2-3.5.3 Low-pressure tanks and pressure vessels shall be adequately vented to prevent development of pressure or vacuum, as a result of filling or emptying and atmospheric temperature changes, from exceeding the design pressure of the tank or vessel. Protection shall also be provided to prevent overpressure from any pump discharging into the tank or vessel when the pump discharge pressure can exceed the design pressure of the tank or vessel.

2-3.5.4 If any tank or pressure vessel has more than one fill or withdrawal connection and simultaneous filling or withdrawal can be made, the vent size shall be based on the maximum anticipated simultaneous flow.

2-3.5.5 The outlet of all vents and vent drains on tanks equipped with venting to permit pressures exceeding 2.5 psig (17.2 kPa) shall be arranged to discharge in such a way as to prevent localized overheating of, or flame impingement on, any part of the tank, in the event vapors from such vents are ignited.

2-3.5.6 Tanks and pressure vessels storing Class IA liquids shall be equipped with venting devices that shall be normally closed except when venting to pressure or vacuum conditions. Tanks and pressure vessels storing Class IB and IC liquids shall be equipped with venting devices that shall be normally closed except when venting under pressure or vacuum conditions, or with listed flame arrestors. Tanks of 3,000 bbl (476,910 L) capacity or less containing crude petroleum in crude-producing areas, and outside above-ground atmospheric tanks under 23.8 bbl (3785 L) capacity containing other than Class IA liquids shall be permitted to have open vents. (*See 2-3.6.2.*)

2-3.5.7 Flame arrestors or venting devices required in 2-3.5.6 may be omitted for IB and IC liquids where conditions are such that their use may, in case of obstruction, result in tank damage. Liquid properties justifying the omission of such devices include, but are not limited to, condensation, corrosiveness, crystallization, polymerization, freezing, or plugging. When any of these conditions exist, consideration may be given to heating, use of devices employing special materials of construction, the use of liquid seals, or inerting (*see NFPA 69, Standard on Explosion Prevention Systems*).

2-3.6 Emergency Relief Venting for Fire Exposure for Aboveground Tanks.

2-3.6.1 Except as provided in 2-3.6.2, every aboveground storage tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires.

2-3.6.2 Tanks larger than 285 bbl (45,306 L) capacity storing Class IIIB liquids and not within the diked area or the drainage path of Class I or Class II liquids do not require emergency relief venting.

2-3.6.3 In a vertical tank, the construction referred to in 2-3.6.1 may take the form of a floating roof, lifter roof, a weak roof-to-shell seam, or other approved pressure-relieving construction. The weak roof-to-shell seam shall be constructed to fail preferential to any other seam. Design methods that will provide a weak roof-to-shell seam construction are contained in API 650, *Welded Steel Tanks for Oil Storage*, and UL 142, *Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids*.

2-3.6.4 Where entire dependence for emergency relief is placed upon pressure-relieving devices, the total venting capacity of both normal and emergency vents shall be enough to prevent rupture of the shell or bottom of the tank if vertical, or of the shell or heads if horizontal. If unstable liquids are stored, the effects of heat or gas resulting from polymerization, decomposition, condensation, or self-reactivity shall be taken into account. The total capacity of both normal and emergency venting devices shall be not less than that derived from Table 2-3 except as provided in 2-3.6.6 or 2-3.6.7. Such device may be a self-closing manhole cover, or one using long bolts that permit the cover to lift under internal pressure, or an additional or larger relief valve or valves. The wetted area of the tank shall be calculated on the basis of 55 percent of the total exposed area of a sphere or spheroid, 75 percent of the total exposed area of a horizontal tank, and the first 30 ft (9 m) above grade of the exposed shell area of a vertical tank. (*See Appendix B for the square footage of typical tank sizes.*)

Table 2-8 Wetted Area versus Cubic Feet Free Air per Hour* [14.7 psia and 60°F (101.3 kPa and 15.6°C)]

Sq Ft	CFH	Sq Ft	CFH	Sq Ft	CFH
20	21,100	200	211,000	1,000	524,000
30	31,600	250	239,000	1,200	557,000
40	42,100	300	265,000	1,400	587,000
50	52,700	350	288,000	1,600	614,000
60	63,200	400	312,000	1,800	639,000
70	73,700	500	354,000	2,000	662,000
80	84,200	600	392,000	2,400	704,000
90	94,800	700	428,000	2,800	742,000
100	105,000	800	462,000	and over	
120	126,000	900	493,000		
140	147,000	1,000	524,000		
160	168,000				
180	190,000				
200	211,000				

SI Units: 10 ft² = 0.93 m²; 36 ft³ = 1.0 m³.
*Interpolate for intermediate values.

2-3.6.5 For tanks and storage vessels designed for pressures over 1 psig (6.9 kPa), the total rate of venting shall be determined in accordance with Table 2-8, except that when the exposed wetted area of the surface is greater than 2800 sq ft (260 m²), the total rate of venting shall be in accordance with Table 2-9 or calculated by the following formula:

$$CFH = 1107\ A^{0.82}$$

Where:

CFH = venting requirement, in cubic feet of free air per hour

A = exposed wetted surface, in square feet

The foregoing formula is based on $Q = 21{,}000\ A^{0.82}$

Table 2-9 Wetted Area Over 2,800 sq ft and Pressures Over 1 psig

Sq Ft	CFH	Sq Ft	CFH
2,800	742,000	9,000	1,930,000
3,000	786,000	10,000	2,110,000
3,500	892,000	15,000	2,940,000
4,000	995,000	20,000	3,720,000
4,500	1,100,000	25,000	4,470,000
5,000	1,250,000	30,000	5,190,000
6,000	1,390,000	35,000	5,900,000
7,000	1,570,000	40,000	6,570,000
8,000	1,760,000		

SI Units: 10 ft² = 0.93 m²; 36 ft³ = 1.0 m³.

2-3.6.6 The total emergency relief venting capacity for any specific stable liquid can be determined by the following formula:

$$\text{Cubic feet of free air per hour} = V\frac{1337}{L\sqrt{M}}$$

Where:

V = cubic feet of free air per hour from Table 2-8

L = latent heat of vaporization of specific liquid in Btu per pound

M = molecular weight of specific liquids

2-3.6.7 For tanks containing stable liquids, the required airflow rate of 2-3.6.4 or 2-3.6.6 may be multiplied by the appropriate factor listed in the following schedule when protection is provided as indicated. Only one of the following factors shall be used for any one tank:

0.5 for drainage in accordance with 2-3.4.2 for tanks over 200 sq ft (18.6 m²) of wetted area;

0.3 for water spray in accordance with NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, and drainage in accordance with 2-3.4.2;

0.3 for insulation in accordance with 2-3.6.7(a);

0.15 for water spray with insulation in accordance with 2-3.6.7(a) and drainage in accordance with 2-3.4.2 (*see Appendix B*).

*Exception:** *Where water-miscible liquids whose heats of combustion and rates of burning are equal to or less than those of ethyl alcohol (ethanol) are stored, processed, or handled and where there is no potential fire exposure from liquids other than these liquids, the above factors shall be permitted to be reduced by 50 percent. Drainage shall not be required to obtain this reduction. In no case shall the above factors be reduced to less than 0.15.*

(a) Insulation systems for which credit is taken shall meet the following performance criteria:

1. Remain in place under fire exposure conditions.

2. Withstand dislodgment when subjected to hose stream impingement during fire exposure. This requirement may be waived where use of solid hose streams is not contemplated or would not be practical.

3. Maintain a maximum conductance value of 4.0 Btu per hr per sq ft per degree Fahrenheit (Btu/hr/sq ft/°F) when the outer insulation jacket or cover is at a temperature of 1660°F (904.4°C) and when the mean temperature of the insulation is 1000°F (537.8°C).

2-3.6.8 The outlet of all vents and vent drains on tanks equipped with emergency venting to permit pressures exceeding 2.5 psig (17.2 kPa) shall be arranged to discharge in such a way as to prevent localized overheating of or flame impingement on any part of the tank, in the event vapors from such vents are ignited.

2-3.6.9 Each commercial tank venting device shall have stamped on it the opening pressure, the pressure at which the valve reaches the full open position, and the flow capacity at the latter pressure. If the start to open pressure is less than 2.5 psig (17.2 kPa) and the pressure at full open position is greater than 2.5 psig (17.2 kPa), the flow capacity at 2.5 psig (17.2 kPa) shall also be stamped on the venting device. The flow capacity shall be expressed in cubic feet per hour of air at 60°F (15.6°C) and 14.7 psia (760 mm Hg).

(a) The flow capacity of tank venting devices under 8 in. (20 cm) in nominal pipe size shall be determined by actual test of each type and size of vent. These flow tests may be conducted by the manufacturer if certified by a qualified, impartial observer or may be conducted by a qualified, impartial outside agency. The flow capacity of tank venting devices 8 in. (20 cm) nominal pipe size and larger, including manhole covers with long bolts or equivalent, may be calculated provided that the opening pressure is actually measured, the rating pressure and corresponding free orifice area are stated, the word "calculated" appears on the nameplate, and the computation is based on a flow coefficient of 0.5 applied to the rated orifice area.

(b) A suitable formula for this calculation is:

$$CFH = 1667\ C_c\ A\ \sqrt{P_t - P_a}$$

Where:

CFH = venting requirement in cubic feet of free air per hour
C_c = 0.5 (the flow coefficient)
A = the orifice area in sq in.
P_t = the absolute pressure inside the tank in inches of water
P_a = the absolute atmospheric pressure outside the tank in inches of water

2-3.7 Vent Piping for Aboveground Tanks.

2-3.7.1 Vent piping shall be constructed in accordance with Chapter 3.

2-3.7.2 Where vent pipe outlets for tanks storing Class I liquids are adjacent to buildings or public ways, they shall be located so that the vapors are released at a safe point outside of buildings and not less than 12 ft (3.6 m) above the adjacent ground level. In order to aid their dispersion, vapors shall be discharged upward or horizontally away from closely adjacent walls. Vent outlets shall be located so that flammable vapors will not be trapped by eaves or other obstructions and shall be at least 5 ft (1.5 m) from building openings.

2-3.7.3 The manifolding of tank vent piping shall be avoided except where required for special purposes such as vapor recovery, vapor conservation, or air pollution control. Where tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they are required to handle when manifolded tanks are subject to the same fire exposure.

2-3.7.4 Vent piping for tanks storing Class I liquids shall not be manifolded with vent piping for tanks storing Class II or Class III liquids unless positive means are provided to prevent the vapors from Class I liquids from entering tanks storing Class II or Class III liquids, to prevent contamination (*see 1-1.2*) and possible change in classification of the less volatile liquid.

2-3.8 Tank Openings Other than Vents for Aboveground Tanks.

2-3.8.1 Each connection to an aboveground tank through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank.

2-3.8.2 Each connection below the liquid level through which liquid does not normally flow shall be provided with a liquidtight closure. This may be a valve, plug, or blind, or a combination of these.

2-3.8.3 Openings for gaging on tanks storing Class I liquids shall be provided with a vaportight cap or cover. Such covers shall be closed when not gaging.

2-3.8.4 Fill pipes that enter the top of a tank shall terminate within 6 in. (15 cm) of the bottom of the tank. Fill pipes shall be installed or arranged so that vibration is minimized.

Exception: Fill pipes in tanks handling liquids that have a minimum potential for the accumulation of static electricity or fill pipes in tanks whose vapor space, under normal operating conditions, is not in the flammable range or is inerted need not meet this requirement. (Examples include most crude oils, residual oils, asphalts, and water-miscible liquids.)

2-3.8.5 Filling and emptying connections for Class I, Class II, and Class IIIA liquids that are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than 5 ft (1.5 m) away from any building opening. Such connections for any liquid shall be closed and liquidtight when not in use and shall be properly identified.

2-3.9 Abandonment or Reuse of Aboveground Tanks.

2-3.9.1 Tanks taken out of service or abandoned shall be emptied of liquid, rendered vapor-free, and safeguarded against trespassing. (*For further information see API 2015, Cleaning Petroleum Storage Tanks; API 2015A, A Guide for Controlling the Lead Hazard Associated with Tank Entry and Cleaning; and API 2015B, Cleaning Open Top and Covered Floating Roof Tanks.*)

2-3.9.2 Only those used tanks that comply with the applicable sections of this code and are approved by the authority having jurisdiction shall be installed for flammable or combustible liquids service.

2-4 Installation of Underground Tanks.

2-4.1 Location. Excavation for underground storage tanks shall be made with due care to avoid undermining of foundations of existing structures. Underground tanks or tanks under buildings shall be so located with respect to existing building foundations and supports that the loads carried by the latter cannot be transmitted to the tank. The distance from any part of a tank storing Class I liquids to the nearest wall of any basement or pit shall be not less than 1 ft (0.3 m), and to any property line that can be built upon, not less than 3 ft (0.9 m). The distance from any part of a tank storing Class II or Class III liquids to the nearest wall of any basement, pit, or property line shall be not less than 1 ft (0.3 m).

2-4.2 Burial Depth and Cover.

2-4.2.1 All underground tanks shall be installed in accordance with the manufacturer's instructions, where available, and shall be set on firm foundations and surrounded with at least 6 in. (15 cm) of noncorrosive inert material such as clean sand or gravel well tamped in place. The tank shall be placed in the hole with care, since dropping or rolling the tank into the hole can break a weld, puncture or damage the tank, or scrape off the protective coating of coated tanks.(*See PEIRP100-90, Recommended Practices for Installation of Underground Liquid Storage Systems, for further information.*)

2-4.2.2 All underground tanks shall be covered with a minimum of 2 ft (0.6 m) of earth, or shall be covered with not less than 1 ft (0.3 m) of earth on top of which shall be placed a slab of reinforced concrete not less than 4 in. (10 cm) thick. Where they are, or are likely to be, subjected to traffic, they shall be protected against damage from vehicles passing over them by at least 3 ft (0.9 m) of earth cover, or 18 in. (45.7 cm) of well-tamped earth plus either 6 in. (15 cm) of reinforced concrete or 8 in. (20 cm) of asphaltic concrete. When asphaltic or reinforced concrete paving is used as part of the protection, it shall extend at least 1 ft (0.3 m) horizontally beyond the outline of the tank in all directions.

2-4.2.3 For underground tanks built in accordance with 2-2.3.1, the burial depth shall be such that the static head imposed at the bottom of the tank will not exceed 10 psig (68.9 kPa) if the fill or vent pipe are filled with liquid. If the depth of cover is greater than the tank diameter, the tank manufacturer shall be consulted to determine if reinforcement is required.

2-4.3 External Corrosion Protection. Tanks and their piping shall be protected by either:

(a) A properly engineered, installed, and maintained cathodic protection system in accordance with recognized standards of design, such as:

1. American Petroleum Institute Publication 1632, *Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems.*

2. Underwriters Laboratories of Canada ULC-S603.1 M, *Standard for Galvanic Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids.*

3. Steel Tank Institute Standard No. sti-P_3®, *sti-P_3® Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks.*

4. National Association of Corrosion Engineers Standard RP-01-69 (1983 Rev.), Recommended Practice, *Control of External Corrosion of Underground or Submerged Metallic Piping Systems.*

5. National Association of Corrosion Engineers Standard RP-02-85, Recommended Practice, *Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems.*

(b) Approved or listed corrosion-resistant materials or systems, which may include special alloys, fiberglass reinforced plastic, or fiberglass reinforced plastic coatings.

2-4.3.1 Selection of the type of protection to be employed shall be based upon the corrosion history of the area and the judgement of a qualified engineer. The authority having jurisdiction may waive the requirements for corrosion protection where evidence is provided that such protection is not necessary. (*See API Publication 1615, Installation of Underground Petroleum Storage Systems, for further information.*)

2-4.4 Abandonment, Reuse, or Change of Service of Underground Tanks.

2-4.4.1 Underground tanks taken out of service shall be safeguarded or disposed of in a safe manner. (*See Appendix C.*)

2-4.4.2 Only those used tanks that comply with the applicable sections of this code and are approved by the authority having jurisdiction shall be installed for flammable or combustible liquids service.

2-4.4.3 Tanks that undergo any change of stored product shall meet the requirements of Section 2-2.

2-4.5 Vents for Underground Tanks.

2-4.5.1 Location and Arrangement of Vents for Class I Liquids. Vent pipes from underground storage tanks storing Class I liquids shall be so located that the discharge point is outside of buildings, higher than the fill pipe opening, and not less than 12 ft (3.6 m) above the adjacent ground level. Vent pipes shall not be obstructed by devices provided for vapor recovery or other purposes unless the tank and associated piping and equipment are otherwise protected to limit back-pressure development to less than the maximum working pressure of the tank and equipment by the provision of pressure-vacuum vents, rupture discs, or other tank venting devices installed in the tank vent lines. Vent outlets and devices shall be protected to minimize the possibility of blockage from weather, dirt, or insect nests, shall be so located and directed that flammable vapors will not accumulate or travel to an unsafe location, enter building openings, or be trapped under eaves, and shall be at least 5 ft (1.5 m) from building openings. Tanks containing Class IA liquids shall be equipped with pressure and vacuum venting devices that shall be normally closed except when venting under pressure or vacuum conditions. Tanks storing Class IB or Class IC liquids shall be equipped with pressure-vacuum vents or with listed flame arrestors. Tanks storing gasoline are exempt from the requirements for pressure and vacuum venting devices, except as required to prevent excessive back pressure, or flame arrestors, provided the vent does not exceed 3-in. (7.6-cm) nominal inside diameter. (*See also 2-1.1 of NFPA 30A, Automotive and Marine Service Station Code.*)

2-4.5.2 Vent Capacity. Tank venting systems shall be provided with sufficient capacity to prevent blowback of vapor or liquid at the fill opening while the tank is being filled. Vent pipes shall not be less than 1¼-in. (3-cm) nominal inside diameter. The required venting capacity depends upon the filling or withdrawal rate, whichever is greater, and the vent line length. Unrestricted vent piping sized in accordance with Table 2-10 will prevent back-pressure development in tanks from exceeding 2.5 psig (17.2 kPa). Where tank venting devices are installed in vent lines, their flow capacities shall be determined in accordance with 2-3.6.9.

Table 2-10 Vent Line Diameters

Maximum Flow GPM	Pipe Length* 50 Ft	100 Ft	200 Ft
100	1¼-inch	1¼-inch	1¼-inch
200	1¼-inch	1¼-inch	1¼-inch
300	1¼-inch	1¼-inch	1½-inch
400	1¼-inch	1½-inch	2-inch
500	1½-inch	1½-inch	2-inch
600	1½-inch	2-inch	2-inch
700	2-inch	2-inch	2-inch
800	2-inch	2-inch	3-inch
900	2-inch	2-inch	3-inch
1,000	2-inch	2-inch	3-inch

SI Units: 1 in. = 2.5 cm; 1 ft = 0.3 m; 1 gal = 3.8 L

*Vent lines of 50 ft, 100 ft, and 200 ft of pipe plus 7 ells.

2-4.5.3 Location and Arrangement of Vents for Class II or Class IIIA Liquids. Vent pipes from tanks storing Class II or Class IIIA liquids shall terminate outside of the building and higher than the fill pipe opening. Vent outlets shall be above normal snow level. They shall be permitted to be fitted with return bends, coarse screens, or other devices to minimize ingress of foreign material.

2-4.5.4 Vent piping shall be constructed in accordance with Chapter 3. Tank vent pipes and vapor return piping

shall be installed without sags or traps in which liquid can collect. Condensate tanks, if utilized, shall be installed and maintained so as to preclude the blocking of the vapor return piping by liquid. The vent pipes and condensate tanks shall be located so that they will not be subjected to physical damage. The tank end of the vent pipe shall enter the tank through the top.

2-4.5.5 Where tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they can be required to handle when manifolded tanks are filled simultaneously. Float-type check valves installed in tank openings connected to manifolded vent piping to prevent product contamination shall be permitted to be used provided that the tank pressure will not exceed that permitted by 2-4.2.3 when the valves close.

Exception: For service stations, the capacity of manifolded vent piping shall be sufficient to discharge vapors generated when two manifolded tanks are simultaneously filled.

2-4.5.6 Vent piping for tanks storing Class I liquids shall not be manifolded with vent piping for tanks storing Class II or Class III liquids unless positive means are provided to prevent the vapors from Class I liquids from entering tanks storing Class II or Class III liquids, to prevent contamination (*see 1-1.2*) and possible change in classification of the less volatile liquid.

2-4.6 Tank Openings Other than Vents for Underground Tanks.

2-4.6.1 Connections for all tank openings shall be liquidtight.

2-4.6.2 Openings for manual gaging, if independent of the fill pipe, shall be provided with a liquidtight cap or cover. Covers shall be kept closed when not gaging. If inside a building, each such opening shall be protected against liquid overflow and possible vapor release by means of a spring-loaded check valve or other approved device.

2-4.6.3 Fill and discharge lines shall enter tanks only through the top. Fill lines shall be sloped toward the tank. Underground tanks for Class I liquids having a capacity of more than 1000 gal (3785 L) shall be equipped with a tight fill device for connecting the fill hose to the tank.

2-4.6.4 Fill pipes that enter the top of a tank shall terminate within 6 in. (15 cm) of the bottom of the tank. Fill pipes shall be installed or arranged so that vibration is minimized.

Exception: Fill pipes in tanks handling liquids that have a minimum potential for the accumulation of static electricity or fill pipes in tanks whose vapor space, under normal operating conditions, is not in the flammable range or is inerted need not meet this requirement. (Examples include most crude oils, residual oils, asphalts, and water-miscible liquids.)

2-4.6.5 Filling and emptying and vapor recovery connections for Class I, Class II, or Class IIIA liquids that are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than 5 ft (1.5 m) away from any building opening. Such connections shall be closed and liquidtight when not in use and shall be properly identified.

2-4.6.6 Tank openings provided for purposes of vapor recovery shall be protected against possible vapor release by means of a spring-loaded check valve or dry-break connection, or other approved device, unless the opening is pipe-connected to a vapor processing system. Openings designed for combined fill and vapor recovery shall also be protected against vapor release unless connection of the liquid delivery line to the fill pipe simultaneously connects the vapor recovery line. All connections shall be vaportight.

2-5* Storage Tank Buildings. Tank installations storing Class I, II, and IIIA liquids shall be permitted inside buildings where in compliance with this section. Tanks storing Class IIIB liquids shall not be required to comply with the provisions of this section. A tank installation that has a canopy or roof that does not limit the dissipation of heat or dispersion of flammable vapors and does not restrict fire fighting access and control shall be treated as an outside aboveground tank in accordance with Section 2-3.

2-5.1 Location. Tanks and any associated equipment within the storage tank building shall be so located that a fire in the area shall not constitute an exposure hazard to adjoining buildings or tanks for a period of time consistent with the response and suppression capabilities of the fire fighting operations available to the location. Compliance with 2-5.1.1 through 2-5.1.5 shall be deemed as meeting the requirements of 2-5.1.

2-5.1.1 The minimum distance from exposed property lines and buildings for tank installations within structures having walls with a fire-resistance rating of less than 2 hr shall be in accordance with Table 2-5.1.1.

Exception: As modified by 2-5.1.2.

2-5.1.2 Where a storage tank building has an exterior wall facing an exposure, the distances in Table 2-5.1.1 may be modified as follows:

(a) Where the wall is a blank wall having a fire-resistance rating of not less than 2 hr, separation distance between the storage tank building and its exposure need not be greater than 25 ft (7.6 m).

(b) Where a blank wall having a fire-resistance rating of not less than 4 hr is provided, the distance requirements of Table 2-5.1.1 shall not apply. In addition, where Class IA or unstable liquids are stored, the exposing wall shall have explosion resistance in accordance with good engineering practice and adequate deflagration venting shall be provided in the non-exposing walls and roof. (*See NFPA 68, Guide for Venting of Deflagrations, for information on deflagration venting.*)

2-5.1.3 Other equipment associated with tanks, such as pumps, heaters, filters, exchangers, etc., shall not be located closer than 25 ft (7.6 m) to property lines where the adjoining property is or can be built upon or the nearest important building on the same property that is not an integral part of the storage tank building.

Exception: This spacing requirement shall not apply where exposures are protected as outlined in 2-5.1.2.

2-5.1.4 Tanks in which unstable liquids are stored shall be separated from potential fire exposures by a clear space of at least 25 ft (7.6 m) or by a wall having a fire resistance rating of not less than 2 hr.

Table 2-5.1.1 Location of Storage Tank Buildings with Respect to Property Lines, Public Ways, and the Nearest Important Building on the Same Property[1]

	Minimum Distance from Property Line that Is or Can Be Built Upon, Including Opposite Side of Public Way (ft)				Minimum Distance from Nearest Side of Any Public Way or from Nearest Important Building on Same Property (ft)			
	Stable Liquid		Unstable Liquid		Stable Liquid		Unstable Liquid	
	Emergency Relief		Emergency Relief		Emergency Relief		Emergency Relief	
Largest Tank[2] — Operating Liquid Capacity (gal)	Not over 2.5 psig	Over 2.5 psig	Not over 2.5 psig	Over 2.5 psig	Not over 2.5 psig	Over 2.5 psig	Not over 2.5 psig	Over 2.5 psig
Up to 12,000	15	25	40	60	5	10	15	20
12,001 to 30,000	20	30	50	80	5	10	15	20
30,001 to 50,000	30	45	75	120	10	15	25	40
50,001 to 100,000	50	75	125	200	15	25	40	60

SI Units: 1 gal = 3.8 L; 1 ft = 0.3 m; 1 psig = 6.9 kPa.
[1]Double all distances shown if protection for exposures is not provided. Distances need not exceed 300 ft.
[2]Capacity of any individual tank shall not exceed 100,000 gal without the approval of the authority having jurisdiction.

2-5.1.5 Each storage tank building and each tank within the building shall be accessible from at least two sides for fire fighting and fire control.

2-5.2 Construction.

2-5.2.1 Storage tank buildings shall be constructed so as to maintain structural integrity for 2 hr under fire exposure conditions and to provide adequate access and egress for unobstructed movement of all personnel and fire protection equipment. Compliance with 2-5.2.2 through 2-5.2.8 shall be deemed as meeting the requirements of 2-5.2.1.

2-5.2.2 Buildings or structures shall be of at least 2-hr fire-resistance rating except that noncombustible or combustible construction is permitted when protected by automatic sprinklers or equivalent protection subject to the approval of the authority having jurisdiction. (*See NFPA 220, Standard on Types of Building Construction.*)

2-5.2.3 Class I liquids and Class II or Class IIIA liquids heated above their flash points shall not be stored in basements. Means shall be provided to prevent liquid spills from running into basements. Where Class I liquids are stored above grade within buildings with basements or other below grade areas into which flammable vapors may travel, such below-grade areas shall be provided with mechanical ventilation designed to prevent the accumulation of flammable vapors. Enclosed storage tank pits shall not be considered basements.

2-5.2.4 Storage tanks shall be separated from other occupancies within the building by construction having at least a 2-hr fire-resistance rating. As a minimum, each opening shall be protected by either a listed, self-closing fire door or a listed fire damper having a minimum 1½-hr fire protection rating and installed in accordance with NFPA 80, *Standard for Fire Doors and Fire Windows*; NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*; or NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*; whichever is applicable. Where Class IA or unstable liquids are being stored, deflagration vents shall be provided to the exterior of the building and any walls separating this storage from other occupancies shall have explosion resistance in accordance with good engineering practice. Adequate deflagration venting shall be provided for the nonexposing walls. (*See NFPA 68, Guide for Venting of Deflagrations, for information on deflagration venting.*)

2-5.2.5 Consideration shall be given to provisions for smoke and heat venting to assist access for fire fighting. (*See NFPA 204M, Guide for Smoke and Heat Venting, for information on this subject.*)

2-5.2.6 Storage tank buildings shall have exit facilities arranged to prevent occupants from being trapped in the event of fire. Exits shall not be exposed by the drainage facilities described in 2-5.4. (NFPA *101, Life Safety Code*, provides information on the design of exit facilities.)

2-5.2.7 Access aisles of at least 3 ft (0.9 m) shall be maintained for movement of fire fighting personnel and fire protection equipment.

2-5.2.8 Clearance between the top of the tank and the building structure shall be a minimum of 3 ft (0.9 m) for buildings protected in accordance with 2-5.8.7.3. For buildings without fixed fire suppression systems, space shall be provided to allow for the application of hose streams to the top of the tank(s) for cooling purposes.

2-5.3 Ventilation.

2-5.3.1 Storage tank buildings storing Class I liquids or Class II or Class IIIA liquids at temperatures above their flash points shall be ventilated at a rate sufficient to maintain the concentration of vapors within the building at or below 25 percent of the lower flammable limit. Compliance with sections 2-5.3.2 through 2-5.3.5 shall be deemed as meeting the requirements of 2-5.3.1.

2-5.3.2 Ventilation requirements shall be confirmed by one of the following:

(a) Calculations based on the anticipated fugitive emissions. (*See Appendix F for calculation methods.*)

(b) Sampling of the actual vapor concentration under normal operating conditions. The sampling shall be conducted at a distance of 5 ft (1.5 m) radius from each potential vapor source extending to or toward the bottom and the top of the enclosed storage area. The vapor concentration used to determine the required ventilation rate shall be the highest measured concentration during the sampling procedure.

(c) An acceptable alternative is to provide ventilation at a rate of not less than 1 cu ft per min per sq ft of solid floor area (0.3 m^3 per min per m^2).

NOTE: Equipment in enclosed storage areas may deteriorate over time and periodic sampling should be conducted to assure that leakage rates have not increased or that the ventilation rate is adequate for any increase in leakage rates.

2-5.3.3 Ventilation shall be accomplished by natural or mechanical ventilation, with discharge or exhaust to a safe location outside the building, without recirculation of the exhaust air.

Exception: Recirculation is permitted where it is monitored continuously using a fail-safe system that is designed to automatically sound an alarm, stop recirculation, and provide full exhaust to the outside in the event that vapor-air mixtures having concentrations over 25 percent of the lower flammable limit are detected.

2-5.3.4 Provision shall be made for introduction of make-up air in such a manner as to avoid short-circuiting the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors may collect. Where natural ventilation is inadequate, mechanical ventilation shall be provided and shall be kept in operation while flammable liquids are being handled. Local or spot ventilation might be needed for the control of special fire or health hazards. Such ventilation, if provided, shall be permitted to be used for up to 75 percent of the required ventilation. NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*, and NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, provide information on this subject.

2-5.3.5 For storage tank buildings with the interior grade more than 1 ft (30 cm) below the average exterior grade, continuous mechanical ventilation in accordance with 2-5.3.2(c) shall be provided or a vapor detection system shall be provided and set to give a warning alarm at 25 percent of the lower flammable limit and to start the mechanical ventilation system. The alarm shall sound at a constantly attended location.

2-5.4 Drainage.

2-5.4.1 Drainage systems shall be designed to minimize fire exposure to other tanks and adjacent properties or waterways. Compliance with 2-5.4.2 through 2-5.4.6 shall be deemed as meeting the requirements of 2-5.4.1.

2-5.4.2 A facility shall be designed and operated to prevent the normal discharge of flammable or combustible liquids to public waterways, public sewers, or adjoining property.

2-5.4.3 Except for drains, solid floors shall be liquidtight and the room shall be liquidtight where the walls join the floor and for at least 4 in. (10 cm) above the floor.

2-5.4.4 Openings in interior walls to adjacent rooms or buildings shall be provided with noncombustible, liquidtight raised sills or ramps at least 4 in. (10 cm) in height or shall be otherwise designed to prevent the flow of liquids to the adjoining areas. A permissible alternative to the sill or ramp is an open-grated trench (across the width of the opening inside of the room) that drains to a safe location.

2-5.4.5 The containment area shall have a capacity not less than that of the largest tank that can drain into it. Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location. This might require curbs, scuppers, or special drainage systems to control the spread of fire (*see 2-3.4*). (Appendix A of NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, provides information on this subject.)

2-5.4.6 Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators.

2-5.5 Vents.

2-5.5.1 Vents from tanks inside buildings shall be designed to ensure that flammable vapors are not released inside the building. Compliance with 2-5.5.2 and 2-5.5.3 shall be deemed as meeting the requirements of 2-5.5.1.

2-5.5.2 Vents for tanks inside buildings shall be as required in 2-3.5 and 2-3.6, except that emergency venting by the use of weak roof-to-shell seam shall not be permitted. Automatic sprinkler systems designed in accordance with the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems*, shall be accepted by the authority having jurisdiction as equivalent to water spray systems for purposes of calculating the required airflow rates for emergency vents in 2-3.6.7, provided the density and coverage requirements of NFPA 15, 4-4.4.2 are met. Vents shall terminate outside the building.

2-5.5.3 Vent piping shall be in accordance with 2-3.7.

2-5.6 Tank Openings Other than Vents.

2-5.6.1 Tank openings other than vents from tanks inside buildings shall be designed to ensure that flammable liquids or vapors are not released inside the building. Compliance with 2-5.6.2 through 2-5.6.9 shall be deemed as meeting the requirements of 2-5.6.1.

2-5.6.2 All tank openings:

(a) located at or below the maximum liquid level shall be liquid tight; and

(b) located above the maximum liquid level shall be normally closed and shall be mechanically secured to prevent release of vapors.

2-5.6.3 Each connection through which liquid can gravity flow from a tank inside a building shall be provided with an internal or an external valve located as close as practical to the shell of the tank.

2-5.6.4 Each liquid transfer connection on any tank storing Class I or Class II liquids inside buildings shall be provided with:

(a) a normally closed remotely activated valve; or

(b) an automatic-closing heat-activated valve; or

(c) another approved device.

Exception: Connections used for emergency disposal or to provide for quick cutoff of flow in the event of fire in the vicinity of the tank need not meet this requirement.

2-5.6.4.1 The requirements of 2-5.6.4 shall be permitted to be met by the valve required in 2-5.6.3. If a separate valve is used, it shall be located adjacent to the valve required in 2-5.6.3.

2-5.6.5 Openings for manual gauging of Class I or Class II liquids, if independent of the fill pipe, shall be provided with a vaportight cap or cover. Openings shall be kept closed when not in use. Each such opening for any liquid shall be protected against liquid overflow and possible vapor release by means of a spring-loaded check valve or other approved device. Substitutes for manual gauging include, but are not limited to, heavy-duty flat gauge glasses, magnetic, hydraulic, or hydrostatic remote reading devices, and sealed float gauges.

2-5.6.6 Fill pipes that enter the top of a tank shall terminate within 6 in. (15 cm) of the bottom of the tank. Fill pipes shall be installed or arranged so that vibration is minimized.

Exception: Fill pipes in tanks handling liquids that have a minimum potential for the accumulation of static electricity or fill pipes in tanks whose vapor space, under normal operating conditions, is not in the flammable range or is inerted need not meet this requirement. (Examples include most crude oils, residual oils, asphalts, and water-miscible liquids.)

2-5.6.7 The inlet of the fill pipe and the outlet of a vapor recovery line for which connections are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than 5 ft (1.5 m) away from any building opening. Such connections shall be closed tight and protected against tampering when not in use and shall be identified.

2-5.6.8 Tanks storing Class I, Class II, or Class IIIA liquids inside buildings shall be equipped with a device, or other means shall be provided, to prevent overflow into the building. Suitable devices include, but are not limited to, a float valve, a pre-set meter on the fill line, a low head pump incapable of producing overflow, or a liquidtight overflow pipe, at least one pipe size larger than the fill pipe, that discharges by gravity back to the outside source of liquid or to an approved location.

2-5.6.9 Tank openings provided for purposes of vapor recovery shall be protected against possible vapor release by means of a spring-loaded check valve or dry-break connection or other approved device, unless the opening is pipe-connected to a vapor processing system. Openings designed for combined fill and vapor recovery shall also be protected against vapor release unless connection of the liquid delivery line to the fill pipe simultaneously connects the vapor recovery line. All connections shall be vapor tight.

2-5.7 Electrical Equipment.

2-5.7.1 This section shall apply to areas where Class I liquids are stored and to areas where Class II or Class IIIA liquids are stored at temperatures above their flash points (*see 1-1.3*). Any electrical equipment provided shall not constitute a source of ignition for the flammable vapor that might be present under normal operations or during a spill. Compliance with 2-5.7.2 through 2-5.7.6 shall be deemed as meeting the requirements of 2-5.7.1.

2-5.7.2 All electrical equipment and wiring shall be of a type specified by and installed in accordance with NFPA 70, *National Electrical Code*®.

2-5.7.3 So far as it applies, Table 2-5.7.3 shall be used to delineate and classify areas for the purpose of installation of electrical equipment under normal conditions. In the application of classified areas, a classified area shall not extend beyond a floor, wall, roof, or other solid partition that has no communicating openings. The designation of classes and divisions is defined in Chapter 5, Article 500, of NFPA 70, *National Electrical Code*. [*See NFPA 497A, Recommended Practice for Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, and 497M, Manual for Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations, for guidance.*]

2-5.7.4 The area classifications listed in Table 2-5.7.3 are based on the premise that the installation meets the applicable requirements of this code in all respects. Should this not be the case, the authority having jurisdiction shall have the authority to classify the extent of the area.

2-5.7.5 Where the provisions of 2-5.7.2 through 2-5.7.4 require the installation of electrical equipment suitable for Class I, Division 1 or Division 2 locations, ordinary electrical equipment, including switchgear, shall be permitted to be used if installed in a room or enclosure that is maintained under positive pressure with respect to the classified area. Ventilation make-up air shall not be contaminated. NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, provides details for these types of installations.

2-5.8 Fire Prevention and Control.

2-5.8.1 General. Storage tank buildings shall have fire prevention control systems and methods, for life safety, for minimizing property loss, and for reducing fire exposure to adjoining operations and property resulting from fire and explosion. Compliance with Sections 2-5.8.1.1 through 2-5.8.7.4 shall be deemed as meeting the requirements of 2-5.8.1.

2-5.8.1.1 This section covers the commonly recognized management control systems and methods used to prevent or minimize the loss from fire or explosion in tank storage facilities. The wide range in size, design, and location of tank storage facilities precludes the inclusion of detailed fire prevention and control systems and methods applicable to all such facilities. The authority having jurisdiction can be consulted on specific cases, where applicable; otherwise, qualified engineering judgment shall be exercised in accordance with 2-5.8.1.2.

2-5.8.1.2 The extent of fire prevention and control provided for the tank storage facility shall be determined by an engineering evaluation of the operation, followed by the application of sound fire protection and process engineering principles. The evaluation shall include, but not be limited to:

(a) analysis of fire and explosion hazards of the liquid operations;

Table 2-5.7.3 Electrical Area Classification

Location	NEC Class I Division	Extent of Classified Area
Tank storage installation	1	All equipment located below grade level.
	2	Any equipment located above grade level.
Tank openings installed in accordance with 2-5.5 and 2-5.6 where flammable vapor-air mixtures might exist under normal operation	1	Area within 5 ft of any tank opening, extending in all directions.
	2	Area between 5 ft and 8 ft of any tank opening, extending in all directions. Also, area up to 3 ft above floor or grade level within 5 ft to 25 ft horizontally from any tank opening.[1]
Vents extending to the outside, discharging upward	1	Within 3 ft of open end of vent, extending in all directions.
	2	Area between 3 ft and 5 ft of open end of vent, extending in all directions.
Pumps, bleeders, withdrawal fittings, meters, and similar devices indoors	2	Within 5 ft of any edge of such devices, extending in all directions. Also up to 3 ft above floor or grade level within 25 ft horizontally from any edge of such devices.[1]
Sumps & drainage trenches		
Without mechanical ventilation	1	Entire area within pit, if any part is within a Division 1 or 2 classified area.
With adequate mechanical ventilation	2	Entire area within pit, if any part is within a Division 1 or 2 classified area.
Containing valves, fittings, or piping and not within a Division 1 or 2 Classified area	2	Entire pit.

SI Units: 1 ft = 0.3 m.
[1]The release of Class I liquids can generate vapors to the extent that the entire building and, possibly, a zone surrounding it might have to be considered a Class I, Division 2 location.

(b) analysis of local conditions, such as exposure to and from adjacent properties, flood potential, or earthquake potential;

(c) fire department or mutual aid response.

2-5.8.2 Control of Ignition Sources.

2-5.8.2.1 Precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include, but are not limited to:

(a) open flames

(b) lightning

(c) hot surfaces

(d) radiant heat

(e) smoking

(f) cutting and welding

(g) spontaneous ignition

(h) frictional heat or sparks

(i) static electricity

(j) electrical sparks

(k) stray currents

(l) ovens, furnaces, and heating equipment.

2-5.8.2.2 Smoking shall be permitted only in designated and properly identified areas.

2-5.8.2.3 Welding, cutting, and similar spark-producing operations shall not be permitted in areas containing flammable liquids until a written permit authorizing such work has been issued. The permit shall be issued by a person in authority following inspection of the area to assure that proper precautions have been taken and will be followed until the job is completed. (*See NFPA 51B, Standard for Fire Prevention in Use of Cutting and Welding Processes.*)

2-5.8.2.4 Static Electricity. All equipment such as tanks, machinery, and piping where an ignitable mixture might be present shall be bonded or connected to a ground. The bond or ground or both shall be physically applied or shall be inherently present by the nature of the installation. Electrically isolated sections of metallic piping or equipment shall be bonded to the other portions of the system or individually grounded to prevent hazardous accumulation of static electricity. (NFPA 77, *Recommended Practice on Static Electricity*, provides information on this subject.)

2-5.8.3 Inspection and Maintenance.

2-5.8.3.1 All fire protection equipment shall be properly maintained and periodic inspections and tests shall be done in accordance with both standard practice and equipment manufacturer's recommendations.

2-5.8.3.2 Maintenance and operating practices shall control leakage and prevent spillage of flammable liquids.

2-5.8.3.3 Combustible waste material and residues in operating areas shall be kept to a minimum, stored in covered metal containers, and disposed of daily.

2-5.8.3.4 Storage of combustible materials and empty or full drums or barrels shall not be permitted within the storage tank building.

2-5.8.3.5 Ground areas around storage tank building shall be kept free of weeds, trash, or other unnecessary combustible materials.

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2-5.8.3.6 Aisles established for movement of personnel shall be maintained clear of obstructions to permit orderly evacuation and ready access for manual fire fighting activities.

2-5.8.4 Emergency Planning and Training.

2-5.8.4.1 An emergency action plan, consistent with the available equipment and personnel, shall be established to respond to fire or other emergencies. This plan shall include the following:

(a) Procedures to be used in case of fire, such as sounding the alarm, notifying the fire department, evacuating personnel, and controlling and extinguishing the fire.

(b) Appointment and training of persons to carry out fire safety duties.

(c) Maintenance of fire protection equipment.

(d) Holding fire drills.

(e) Shutdown or isolation of equipment to reduce the escape of liquid.

(f) Alternate measures for the safety of occupants while any fire protection equipment is shut down.

2-5.8.4.2 Personnel responsible for the use and operation of fire protection equipment shall be trained in the use of that equipment. Refresher training shall be conducted at least annually.

2-5.8.4.3 Planning of effective fire control measures shall be coordinated with local emergency response agencies. This shall include, but not be limited, to the identification of all tanks by location, contents, size, and hazard identification as required in 2-8.2.

2-5.8.4.4 Procedures shall be established to provide for safe shutdown of operations under emergency conditions. Provisions shall be made for periodic training, inspection, and testing of associated alarms, interlocks, and controls.

2-5.8.4.5 The emergency procedures shall be kept readily available in an operating area and updated regularly.

2-5.8.4.6 Where premises are likely to be unattended for considerable periods of time, a summary of the emergency plan shall be posted or located in a strategic and accessible location.

2-5.8.5 Detection and Alarm.

2-5.8.5.1 An approved means shall be provided to promptly notify those within the plant and the available public or mutual aid fire department of fire or other emergency.

2-5.8.5.2 Those areas, including buildings, where a potential exists for a flammable liquid spill shall be monitored as appropriate. Such methods include:

(a) Personnel observation or patrol;

(b) Monitoring equipment that indicates a spill or leak has occurred in an unattended area.

2-5.8.6 Portable Fire-Control Equipment.

2-5.8.6.1 Listed portable fire extinguishers shall be provided for facilities in such quantities, sizes, and types as might be needed for special storage hazards as determined in accordance with 2-5.8.1.3. (NFPA 10, *Standard for Portable Fire Extinguishers*, provides information on the suitability of various types of extinguishers.)

2-5.8.6.2 Where the need is indicated in accordance with 2-5.8.1.2, water shall be utilized through standpipe and hose systems (*see NFPA 14, Standard for the Installation of Standpipe and Hose Systems*), or through hose connections from sprinkler systems using combination spray and straight stream nozzles to permit effective fire control. (*See NFPA 13, Standard for the Installation of Sprinkler Systems.*)

2-5.8.6.3 Where the need is indicated in accordance with 2-5.8.1.2, mobile foam apparatus shall be provided. NFPA 11C, *Standard for Mobile Foam Apparatus*, provides information on the subject.

2-5.8.6.4 Automotive and trailer-mounted fire apparatus where determined necessary, shall not be used for any purpose other than fire fighting or training.

2-5.8.7 Fixed Fire Control Equipment.

2-5.8.7.1 A reliable water supply or other suitable fire control agent shall be available in pressure and quantity to meet the fire demands indicated by special storage hazards or exposure as determined by 2-5.8.1.2.

2-5.8.7.2 Hydrants, with or without fixed monitor nozzles, shall be provided in accordance with accepted practice. The number and placement will depend on the hazard of the storage, or exposure, as determined by 2-5.8.1.2. (*See NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances, for information on this subject.*)

2-5.8.7.3 Where the need is indicated by the hazards of storage or exposure as determined by 2-5.8.1.2, fixed protection shall be required utilizing approved foam-water sprinkler systems, sprinkler systems, water spray systems, deluge systems, fire resistive materials, or a combination of these. (*See NFPA 13, Standard for the Installation of Sprinkler Systems; NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection; and NFPA 16, Standard on the Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems, information on these subjects.*)

2-5.8.7.4 If provided, fire control systems shall be designed, installed, and maintained in accordance with the following NFPA standards:

(a) NFPA 11, *Standard for Low Expansion Foam and Combined Agent Systems*

(b) NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*

(c) NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*

(d) NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*

(e) NFPA 12B, *Standard on Halon 1211 Fire Extinguishing Systems*

(f) NFPA 13, *Standard for the Installation of Sprinkler Systems*

(g) NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*

(h) NFPA 16, *Standard on the Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems*

(i) NFPA 17, *Standard for Dry Chemical Extinguishing Systems*

(j) NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protecton Systems.*

See also NFPA 16A, *Recommended Practice for the Installation of Closed-Head Foam-Water Sprinkler Systems.*

2-6 Supports, Foundations, and Anchorage for All Tank Locations.

2-6.1 Tanks shall rest on the ground or on foundations made of concrete, masonry, piling, or steel. Tank foundations shall be designed to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation. (Appendix E of API Standard 650, *Welded Steel Tanks for Oil Storage*, and Appendix B of API Standard 620, *Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks*, provide information on tank foundations.)

2-6.2 Where tanks are supported above the foundations, tank supports shall be installed on firm foundations. Supports for tanks storing Class I, Class II, or Class IIIA liquids shall be of concrete, masonry, or protected steel. Single wood timber supports (not cribbing), laid horizontally, shall be permitted to be used for outside aboveground tanks if not more than 12 in. (0.3 m) high at their lowest point.

2-6.3 Steel supports or exposed piling for tanks storing Class I, Class II, or Class IIIA liquids shall be protected by materials having a fire resistance rating of not less than 2 hr, except that steel saddles need not be protected if less than 12 in. (0.3 m) high at their lowest point. At the discretion of the authority having jurisdiction, water spray protection in accordance with NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, or NFPA 13, *Standard for the Installation of Sprinkler Systems*, or equivalent may be used.

2-6.4 The design of the supporting structure for tanks such as spheres shall require special engineering consideration. (Appendix N of the API Standard 620, *Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks*, contains information regarding supporting structures.)

2-6.5 Every tank shall be so supported as to prevent the excessive concentration of loads on the supporting portion of the shell.

2-6.6 Tanks in Areas Subject to Flooding.

2-6.6.1 Where a tank is located in an area subject to flooding, provisions shall be taken to prevent tanks, either full or empty, from floating during a rise in water level up to the established maximum flood stage.

2-6.6.2 Aboveground Tanks.

2-6.6.2.1 Each vertical tank shall be located so that its top extends above the maximum flood stage by at least 30 percent of its allowable storage capacity.

2-6.6.2.2 Horizontal tanks located so that more than 70 percent of the tank's storage capacity will be submerged at the established flood stage shall be anchored; shall be attached to a foundation of concrete or of steel and concrete of sufficient weight to provide adequate load for the tank when filled with flammable or combustible liquid and submerged by flood water to the established flood stage; or shall be adequately secured from floating by other means. Tank vents or other openings that are not liquidtight shall be extended above maximum flood stage water level.

2-6.6.2.3 A dependable water supply shall be available for filling an empty or partially filled tank, except that where filling the tank with water is impractical or hazardous because of the tank's contents, tanks shall be protected by other means against movement or collapse.

2-6.6.2.4 Spherical or spheroid tanks shall be protected by applicable methods as specified for either vertical or horizontal tanks.

2-6.6.3 Underground Tanks.

2-6.6.3.1 At locations where there is an ample and dependable water supply available, underground tanks containing flammable or combustible liquids, so placed that more than 70 percent of their storage capacity will be sub- merged at the maximum flood stage, shall be so anchored, weighted, or secured as to prevent movement when filled or loaded with water and submerged by flood water to the established flood stage. Tank vents or other openings that are not liquidtight shall be extended above maximum flood stage water level.

2-6.6.3.2 At locations where there is no ample and dependable water supply or where filling of underground tanks with water is impractical because of the contents, each tank shall be safeguarded against movement when empty and submerged by high ground water or flood water by anchoring or by securing by other means. Each such tank shall be so constructed and installed that it will safely resist external pressures if submerged.

2-6.6.4 Water Loading. The filling of a tank to be protected by water loading shall be started as soon as flood waters are predicted to reach a dangerous flood stage. Where independently fueled water pumps are relied upon, sufficient fuel shall be available at all times to permit continuing operations until all tanks are filled. Tank valves shall be locked in a closed position when water loading has been completed.

2-6.6.5 Operating Instructions.

2-6.6.5.1 Operating instructions or procedures to be followed in a flood emergency shall be readily available.

2-6.6.5.2 Personnel relied upon to carry out flood emergency procedures shall be informed of the location and operation of valves and other equipment necessary to effect the intent of these requirements.

2-6.7 In areas subject to earthquakes, the tank supports and connections shall be designed to resist damage as a result of such shocks.

2-7 Sources of Ignition. In locations where flammable vapors may be present, precautions shall be taken to prevent ignition by eliminating or controlling sources of ignition. Sources of ignition may include open flames, lightning, smoking, cutting and welding, hot surfaces, frictional heat, sparks (static, electrical, and mechanical), spontaneous ignition, chemical and physicochemical reactions, and radiant heat. (NFPA 77, *Recommended Practice on Static Electricity*, and NFPA 780, *Lightning Protection Code*, provide information on such protection.)

2-8 Testing and Maintenance.

2-8.1 All tanks, whether shop-built or field-erected, shall be tested before they are placed in service in accordance with the applicable paragraphs of the code under which they were built. The ASME Code stamp or the Listing Mark of Underwriters Laboratories Inc. on a tank shall be evidence of compliance with this test. Tanks not marked in accordance with the above codes shall be tested before they are placed in service in accordance with good engineering principles and reference shall be made to the sections on testing in the codes listed in 2-2.3.1, 2-2.4.2, or 2-2.5.2.

2-8.2 Where the vertical length of the fill and vent pipes is such that when filled with liquid the static head imposed on the bottom of the tank exceeds 10 psi (68.9 kPa), the tank and related piping shall be tested hydrostatically to a pressure equal to the static head thus imposed. In special cases where the height of the vent above the top of the tank is excessive, the hydrostatic test pressure shall be determined by using recognized engineering practice.

2-8.3 In addition to the test called for in 2-8.1 and 2-8.2, all tanks and connections shall be tested for tightness. Except for underground tanks, this tightness shall be made at operating pressure with air, inert gas, or water prior to placing the tank in service. In the case of field-erected tanks, the test called for in 2-8.1 or 2-8.2 may be considered to be the test for tank tightness. Single wall underground tanks and piping, before being covered, enclosed, or placed in use, shall be tested for tightness hydrostatically or with air pressure at not less than 3 psi (20.6 kPa) and not more than 5 psi (34.5 kPa). For testing of secondary containment tanks, see 2-8.3.1. (*See Section 3-7 for testing pressure piping.*) Air pressure shall not be used to test tanks that contain flammable or combustible liquids or vapors.

2-8.3.1 Secondary containment tanks (Types I and II) shall have the primary (inner) tank tested according to 2-8.3 and the interstitial space (annulus) tested using air at 3 to 5 psig (20.6 to 34.5 kPa) or vacuum at 5.3 in. Hg (17.9 kPa). The pressure or vacuum shall be held for one hour. Care shall be taken to ensure that the interstitial space is not overpressured or subjected to excessive vacuum.

2-8.4 Before the tank is initially placed in service, all leaks or deformations shall be corrected in an acceptable manner. Mechanical caulking is not permitted for correcting leaks in welded tanks except pinhole leaks in the roof.

2-8.5 Tanks to be operated at pressures below their design pressure may be tested by the applicable provisions of 2-8.1 or 2-8.2 based upon the pressure developed under full emergency venting of the tank.

2-8.6 Each tank shall be maintained liquidtight. Each tank that is leaking shall be emptied of liquid or repaired in a manner acceptable to the authority having jurisdiction.

2-8.7 Each underground tank that has been repaired or altered, or is suspected of leaking, shall be tested in a manner approved by the authority having jurisdiction. (*See NFPA 329, Recommended Practice for Handling Underground Releases of Flammable and Combustible Liquids, for information on testing methods.*)

2-9 Fire Protection and Identification.

2-9.1 A fire extinguishing system in accordance with an applicable NFPA standard shall be provided or be available for vertical atmospheric fixed roof storage tanks larger than 50,000 gal (189,250 L) capacity, storing Class I liquids, if located in a congested area where there is an unusual exposure hazard to the tank from adjacent property or to adjacent property from the tank. Fixed roof tanks storing Class II or III liquids at temperatures below their flash points and floating roof tanks storing any liquid generally do not require protection when installed in compliance with Section 2-3.

2-9.2 The application of NFPA 704, *Standard System for the Identification of the Fire Hazards of Materials*, to storage tanks containing liquids shall not be required except where the contents have a health or reactivity degree of hazard of 2 or more or a flammability rating of 4. The marking need not be applied directly to the tank but shall be located where it can readily be seen, such as on the shoulder of an accessway or walkway to the tank or tanks or on the piping outside of the diked area. If more than one tank is involved, the markings shall be so located that each tank can readily be identified.

2-9.3 Unsupervised, isolated aboveground storage tanks shall be secured and marked in such a manner as to identify the fire hazards of the tank and its contents to the general public. The area in which the tank is located shall be protected from tampering or trespassing, where necessary.

2-10 Prevention of Overfilling of Tanks.

2-10.1 Aboveground tanks at terminals receiving transfer of Class I liquids from mainline pipelines or marine vessels shall follow formal written procedures to prevent overfilling of tanks utilizing one of the following methods of protection:

(a) Tanks gaged at frequent intervals by personnel continuously on the premises during product receipt with frequent acknowledged communication maintained with the supplier so that flow can be promptly shut down or diverted.

(b) Tanks equipped with a high-level detection device that is independent of any tank gaging equipment. Alarms shall be located where personnel who are on duty throughout product transfer can promptly arrange for flow stoppage or diversion.

(c) Tanks equipped with an independent high-level detection system that will automatically shut down or divert flow.

(d) Alternatives to instrumentation described in (b) and (c) where approved by the authority having jurisdiction as affording equivalent protection.

2-10.1.1 Instrumentation systems covered in 2-10.1(b) and (c) shall be electrically supervised or equivalent.

2-10.2 Formal written procedures required in 2-10.1 shall include:

(a) Instructions covering methods to check for proper line up and receipt of initial delivery to tank designated to receive shipment.

(b) Provision for training and monitoring the performance of operating personnel by terminal supervision.

(c) Schedules and procedures for inspection and testing of gaging equipment and high-level instrumentation and related systems. Inspection and testing intervals shall be acceptable to the authority having jurisdiction, but shall not exceed one year.

2-10.3 An underground storage tank shall be equipped with overfill prevention equipment that will:

(a) Automatically shut off the flow of liquid into the tank when the tank is no more than 95 percent full; or

(b) Alert the transfer operator when the tank is no more than 90 percent full by restricting the flow of liquid into the tank or triggering a high-level alarm;

(c) Or other methods approved by the authority having jurisdiction.

2-11 Leakage Detection and Inventory Records for Underground Tanks. Accurate inventory records or a leak detection program shall be maintained on all Class I liquid storage tanks for indication of possible leakage from the tanks or associated piping. (*See NFPA 329, Recommended Practice for Handling Underground Releases of Flammable and Combustible Liquids, for information on testing methods.*)

Chapter 3 Piping Systems

3-1 Scope.

3-1.1 This chapter shall apply to piping systems consisting of pipe, tubing, flanges, bolting, gaskets, valves, fittings, flexible connectors, the pressure containing parts of other components such as expansion joints and strainers, and devices that serve such purposes as mixing, separating, snubbing, distributing, metering, or controlling flow.

3-1.2 This chapter does not apply to any of the following:

(a) Tubing or casing on any oil or gas wells and any piping connected directly thereto.

(b) Motor vehicle, aircraft, boat, or portable or stationary engine.

(c) Piping within the scope of any applicable boiler and pressure vessel code.

3-2 General.

3-2.1 The design, fabrication, assembly, test, and inspection of piping systems containing liquids shall be suitable for the expected working pressures and structural stresses. Conformity with the applicable sections of ANSI B31, *American National Standard Code for Pressure Piping*, and the provisions of this chapter shall be considered prima facie evidence of compliance with the foregoing provisions.

3-2.2 Piping systems shall be maintained liquidtight. A piping system that has leaks that constitute a hazard shall be emptied of liquid or repaired in a manner acceptable to the authority having jurisdiction.

3-3 Materials for Piping, Valves, and Fittings.

3-3.1 Pipe, valves, faucets, fittings, and other pressure-containing parts as covered in 3-1.1 shall meet the material specifications and pressure and temperature limitations of ANSI B31.3, *Petroleum Refinery Piping*, or ANSI B31.4, *Liquid Petroleum Transportation Piping Systems*, except as provided by 3-3.2, 3-3.3, and 3-3.4. Plastic or similar materials, as permitted by 3-3.4, shall be designed to specifications embodying recognized engineering principles and shall be compatible with the fluid service.

3-3.2 Nodular iron shall conform to ASTM A 395, *Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures*.

3-3.3 Valves at storage tanks, as required by 2-3.8.1 and 2-5.6.3, and their connections to the tank shall be of steel or nodular iron except as provided in 3-3.3.1 or 3-3.3.2.

3-3.3.1 Valves at storage tanks shall be permitted to be other than steel or nodular iron where the chemical characteristics of the liquid stored are not compatible with steel or where installed internally to the tank. Where installed externally to the tank, the material shall have a ductility and melting point comparable to steel or nodular iron so as to withstand reasonable stresses and temperatures involved in fire exposure or otherwise be protected, such as by materials having a fire resistance rating of not less than 2 hours.

3-3.3.2 Cast iron, brass, copper, aluminum, malleable iron, and similar materials shall be permitted to be used on tanks described in 2-3.3.2 or for tanks storing Class IIIB liquids where the tank is located outdoors and not within a diked area or drainage path of a tank storing a Class I, Class II, or Class IIIA liquid.

3-3.4 Low melting point materials such as aluminum, copper, and brass, materials that soften on fire exposure such as plastics, or nonductile material such as cast iron shall be permitted to be used underground for all liquids within the pressure and temperature limits of ANSI B31, *American National Standard Code for Pressure Piping*. If such materials are used outdoors in aboveground piping systems handling Class I, Class II, or Class IIIA liquids or within buildings handling any liquid they shall be either: (a) suitably protected against fire exposure, (b) so located that any leakage resulting from the failure will not unduly expose persons, important buildings, or structures, or (c) located where leakage can readily be controlled by operation of an accessible remotely located valve(s).

3-3.5 Piping, valves, and fittings shall be permitted to have combustible or noncombustible linings.

3-4 Pipe Joints.

3-4.1 Joints shall be made liquidtight and shall be either welded, flanged, or threaded, except that listed flexible connectors shall be permitted to be used where installed in accordance with 3-4.2. Threaded joints shall be made up tight with a suitable thread sealant or lubricant. Joints in piping systems handling Class I liquids shall be welded when located in concealed spaces within buildings.

3-4.2 Pipe joints dependent upon the friction characteristics or resiliency of combustible materials for mechanical

continuity or liquidtightness of piping shall not be used inside buildings. They shall be permitted to be used outside of buildings above or below ground. If used aboveground outside of buildings, the piping shall either be secured to prevent disengagement at the fitting, or the piping system shall be so designed that any spill resulting from disengagement could not unduly expose persons, important buildings, or structures and could be readily controlled by remote valves.

3-5 Supports. Piping systems shall be substantially supported and protected against physical damage and excessive stresses arising from settlement, vibration, expansion, or contraction. The installation of nonmetallic piping shall be in accordance with the manufacturer's instructions.

3-6* Protection against Corrosion. All piping systems for liquids, both aboveground and underground, that are subject to external corrosion shall be protected. Underground piping systems shall be protected in accordance with 2-4.3.

3-7 Valves. Piping systems shall contain a sufficient number of valves to operate the system properly and to protect the plant. Piping systems in connection with pumps shall contain a sufficient number of valves to control properly the flow of liquid in normal operation and in the event of physical damage. Each connection to piping by which equipment such as tank cars, tank vehicles, or marine vessels discharge liquids into storage tanks shall be provided with a check valve for automatic protection against back-flow if the piping arrangement is such that back-flow from the system is possible. (*See also 2-3.8.1.*)

3-7.1 If loading and unloading is done through a common pipe system, a check valve is not required. However, a block valve shall be provided. This valve shall be located so that it is readily accessible or shall be remotely operable.

3-8 Testing. Unless tested in accordance with the applicable sections of ANSI B31, *American National Standard Code for Pressure Piping*, all piping, before being covered, enclosed, or placed in use, shall be hydrostatically tested to 150 percent of the maximum anticipated pressure of the system, or pneumatically tested to 110 percent of the maximum anticipated pressure of the system but not less than 5 psi (34.5 kPa) gage at the highest point of the system. This test shall be maintained for a sufficient time to complete visual inspection of all joints and connections, but for at least 10 min.

3-9* Identification. Each loading and unloading riser for liquid storage shall be identified by color code or marking to identify the product for which the tank is used.

Chapter 4 Container and Portable Tank Storage

4-1 Scope.

4-1.1 This chapter shall apply to the storage of liquids in drums or other containers that do not exceed 60 gal (227 L) individual capacity and in portable tanks that do not exceed 660 gal (2498 L) individual capacity and to limited transfers incidental thereto. For portable tanks that exceed 660 gal (2498 L), Chapter 2 shall apply.

4-1.2 This chapter shall not apply to the following:

(a) Storage of containers in bulk plants, service stations, refineries, chemical plants, and distilleries.

(b) Liquids in the fuel tanks of motor vehicles, aircraft, boats, or portable or stationary engines.

(c) Beverages, where packaged in individual containers that do not exceed 1 gal (3.8 L) capacity.

(d) Medicines, foodstuffs, cosmetics, and other consumer products that contain not more than 50 percent by volume of water-miscible liquids, with the remainder of the solution not being flammable where packaged in individual containers that do not exceed 1 gal (3.8 L) capacity.

(e) Liquids that have no fire point when tested by ASTM D 92, *Cleveland Open Cup Test Method*, up to the boiling point of the liquid or up to a temperature at which the sample being tested shows an obvious physical change.

(f) Distilled spirits and wines in wooden barrels or casks.

4-1.3 For the purpose of this chapter, unstable liquids shall be treated as Class IA liquids.

4-2 Design, Construction, and Capacity of Containers.

4-2.1 Only approved containers and portable tanks shall be used.

(a) Metal containers and metal portable tanks meeting the requirements of, and containing products authorized by, Chapter I, Title 49 of the *Code of Federal Regulations* (U.S. Department of Transportation Hazardous Materials Regulations), Chapter 9 of the United Nations Rules for the Transportation of Dangerous Goods, or NFPA 386, *Standard for Portable Shipping Tanks for Flammable and Combustible Liquids*, shall be acceptable.

(b) Plastic containers meeting the requirements of, and used for petroleum products within the scope of, one or more of the following specifications shall be acceptable:

1. ASTM/ANSI D3435, *Plastic Containers (Jerry Cans) for Petroleum Products*.

2. ASTM F 852, *Standard for Portable Gasoline Containers for Consumer Use*.

3. ASTM F 976, *Standard for Portable Kerosine Containers for Consumer Use*.

4. ANSI/UL 1313, *Nonmetallic Safety Cans for Petroleum Products*.

(c) Plastic drums meeting the requirements of and containing products authorized by Title 49 of the *Code of Federal Regulations* or by Chapter 9 of the United Nations' Recommendations on the Transport of Dangerous Goods shall be acceptable.

(d) Fiber drums that:

1. Meet the requirements of Item 296 of the National Motor Freight Classification (NMFC) or Rule 51 of the Uniform Freight Classification (UFC) for Types 2A, 3A, 3B-H, 3B-L, or 4A, and

2. Meet the requirements of and contain liquid products authorized either by Chapter I, Title 49 of the

Code of Federal Regulations (U.S. Department of Transportation Hazardous Materials Regulations) or by U. S. Department of Transportation exemption shall be acceptable.

4-2.2 Each portable tank shall be provided with one or more devices installed in the top with sufficient emergency venting capacity to limit internal pressure under fire exposure conditions to 10 psig (68.9 kPa) or 30 percent of the bursting pressure of the portable tank, whichever is greater. The total venting capacity shall be not less than that specified in 2-3.6.4 or 2-3.6.6. At least one pressure-actuated vent having a minimum capacity of 6000 cu ft (170 m^3) of free air per hour [14.7 psia (760 mm Hg) and 60°F (15.6°C)] shall be used. It shall be set to open at not less than 5 psig (34.5 kPa). If fusible vents are used, they shall be actuated by elements that operate at a temperature not exceeding 300°F (148.9°C). Where plugging of a pressure-actuated vent can occur, such as when used for paints, drying oils, and similar materials, fusible plugs or venting devices that soften to failure at a maximum of 300°F (148.9°C) under fire exposure shall be permitted to be used for the entire emergency venting requirement.

4-2.3 The maximum allowable size of a container or metal portable tank shall not exceed that specified in Table 4-2.3.

Exception: As provided for in 4-2.3.1, 4-2.3.2, and 4-2.3.3.

Table 4-2.3 Maximum Allowable Size of Containers and Portable Tanks

Liquids Container Type	Flammable Liquids Class IA	Class IB	Class IC	Combustible Class II	Class III
Glass	1 pt	1 qt	1 gal	1 gal	5 gal
Metal (other than DOT drums) or approved plastic	1 gal	5 gal	5 gal	5 gal	5 gal
Safety Cans	2 gal	5 gal	5 gal	5 gal	5 gal
Metal Drum (DOT Specification)	60 gal	60 gal	60 gal	60 gal	60 gal
Approved Metal Portable Tanks	660 gal	660 gal	660 gal	660 gal	660 gal
Polyethylene DOT Spec. 34, U.N. 1H1, or as authorized by DOT Exemption	1 gal	5 gal	5 gal	60 gal	60 gal
Fibre Drum NMFC or UFC Type 2A, Types 3A, 3B-H, or 3B-L, or Type 4A	—	—	—	60 gal	60 gal

SI Units: 1 pt = 0.473 L; 1 qt = 0.95 L; 1 gal = 3.8 L.

4-2.3.1 Medicines, beverages, foodstuffs, cosmetics, and other common consumer products, where packaged according to commonly accepted practices for retail sales, shall be exempt from the requirements of 4-2.1 and 4-2.3.

4-2.3.2 U.S. Department of Transportation (DOT) Type III nonreusable polyethylene containers, constructed and tested in accordance with DOT specification 2U and treated if necessary to prevent permeation, shall be permitted to be used for storage of Class II and Class III liquids, in any capacity that does not exceed 2½ gal (9.5 L).

4-2.3.3 Class IA and Class IB liquids shall be permitted to be stored in glass containers of not more than 1-gal (3.8-L) capacity, if the required liquid purity (such as ACS analytical reagent grade or higher) would be affected by storage in metal containers or if the liquid can cause excessive corrosion of the metal container.

4-3 Design, Construction, and Capacity of Storage Cabinets.

4-3.1 Not more than 120 gal (454 L) of Class I, Class II, and Class IIIA liquids shall be stored in a storage cabinet. Of this total, not more than 60 gal (227 L) shall be of Class I and Class II liquids. Not more than three such cabinets shall be located in a single fire area, except that, in an industrial occupancy, additional cabinets shall be permitted to be located in the same fire area if the additional cabinet or group of not more than three cabinets is separated from other cabinets or groups of cabinets by at least 100 ft (30 m).

4-3.2* Storage cabinets shall be designed and constructed to limit the internal temperature at the center, 1 in. (2.5 cm) from the top, to not more than 325°F (162.8°C) when subjected to a 10-min fire test with burners simulating a room fire exposure using the standard time-temperature curve as given in NFPA 251, *Standard Methods of Fire Tests of Building Construction and Materials*. All joints and seams shall remain tight and the door shall remain securely closed during the fire test. Cabinets shall be marked in conspicuous lettering: "FLAMMABLE — KEEP FIRE AWAY."

The cabinet is not required to be vented for fire protection purposes; however, the following shall apply:

(a) If the cabinet is vented for whatever reasons, the cabinet shall be vented outdoors in such a manner that will not compromise the specified performance of the cabinet, as acceptable to the authority having jurisdiction.

(b) If the cabinet is not vented, the vent openings shall be sealed with the bungs supplied with the cabinet or with bungs specified by the manufacturer of the cabinet.

4-3.2.1 Metal cabinets constructed in the following manner are acceptable. The bottom, top, door, and sides of the cabinet shall be at least No. 18 gage sheet steel and double walled with 1½-in. (3.8-cm) air space. Joints shall be riveted, welded, or made tight by some equally effective means. The door shall be provided with a three-point latch arrangement and the door sill shall be raised at least 2 in. (5 cm) above the bottom of the cabinet to retain spilled liquid within the cabinet.

4-3.2.2 Wooden cabinets constructed in the following manner are acceptable. The bottom, sides, and top shall be constructed of exterior grade plywood at least 1 in. (2.5 cm) in thickness, which shall not break down or delaminate under fire conditions. All joints shall be rabbeted and shall be fastened in two directions with wood screws. Where more than one door is used, there shall be a rabbetted overlap of not less than 1 in. (2.5 cm). Doors shall be equipped with a means of latching, and hinges shall be constructed and mounted in such a manner as to not lose their holding capacity when subjected to fire

exposure. A raised sill or pan capable of containing a 2-in. (5-cm) depth of liquid shall be provided at the bottom of the cabinet to retain spilled liquid within the cabinet.

4-3.2.3 Listed cabinets that have been constructed and tested in accordance with 4-3.2 shall be acceptable.

4-4* Design, Construction, and Operation of Inside Liquid Storage Areas.

(See Section 1-2 for definitions. See A-4-4 for explanatory information on the types of inside liquid storage areas. See Appendix D for information on protection criteria.)

4-4.1 Scope. Section 4-4 applies to inside areas where the primary function is the storage of liquids. This shall include inside rooms, cut-off rooms, attached buildings, liquid warehouses, and hazardous material storage lockers that are used as inside storage areas. *(See Section 4-5 for storage of liquids in other types of occupancies.)*

4-4.2 Design and Construction Requirements.

4-4.2.1 All storage areas shall be constructed to meet the specified fire-resistance ratings in Table 4-4.2.1. Such construction shall comply with the test specifications given in NFPA 251, *Standard Methods of Fire Tests of Building Construction and Materials.*

Table 4-4.2.1 Fire Resistance Ratings for Inside Storage Areas for Liquids and for Liquid Warehouses

Type of Storage Area	Fire Resistance Rating, Hrs.		
	Interior Walls[1], Ceilings, Intermediate Floors	Exterior Roofs	Exterior Walls
Inside Storage Rooms:			
Floor area < 150 ft²	1	-	-
Floor area > 150 ft² and < 500 ft²	2	-	-
Cutoff Rooms and Attached Buildings:			
Floor area < 300 ft²	1	1[2]	-
Floor area > 300 ft²	2	2[2]	2[3]
Liquid Warehouses	4[4]	-	2[5] or 4[6]

SI Units: 1 sq ft = 0.09m².

[1]Between liquid storage areas and any adjacent areas not dedicated to liquid storage.
[2]Roofs of attached buildings, one story in height, shall be permitted to be of lightweight, noncombustible construction if the separating interior walls have minimum 3-ft (0.90-m) parapets.
[3]Where other portions of buildings or other properties are exposed.
[4]This shall be a standard fire wall.
[5]For exposing walls that are located more than 10 ft (3 m) but less than 50 ft (15 m) from an important building or line of adjoining property that can be built upon.
[6]For exposing walls that are located 10 ft (3 m) or less from an important building or line of adjoining property that can be built upon.

4-4.2.2 Openings in interior walls to adjacent rooms or buildings and openings in exterior walls with fire resistance ratings shall be provided with normally closed, listed fire doors with fire-resistance ratings corresponding to the fire resistance rating of the wall as specified in Table 4-4.2.2. Such doors shall be permitted to be arranged to stay open during material handling operations if the doors are designed to close automatically in a fire emergency by provision of listed closure devices. Fire doors shall be installed in accordance with NFPA 80, *Standard for Fire Doors and Fire Windows.*

Table 4-4.2.2 Fire Protection Ratings for Fire Doors

Fire Resistance Rating of Wall[1], Hrs.	Fire Protection Rating of Door, Hrs.
1	¾
2	1
4	3[2]

[1]As required by Table 4-2.2.1.
[2]One fire door required on each side of interior openings for attached liquid warehouses. See 4-4.2.3.

4-4.2.3 Communicating openings in fire walls separating liquid warehouses from adjacent building areas shall be protected by 3-hr fire doors on each side of the wall.

4-4.2.4 Construction design of exterior walls shall provide ready accessibility for fire fighting operations through provision of access openings, windows, or lightweight noncombustible wall panels.

Exception: This shall not apply to inside rooms.

4-4.2.5 Where Class IA or Class IB liquids or unstable liquids are dispensed, or where Class IA liquids or unstable liquids are stored in containers larger than 1 gal (4 L), the exterior wall or roof construction shall incorporate deflagration venting. (NFPA 68, *Guide for Venting of Deflagrations*, provides information on this subject.)

Exception: Inside storage rooms need not comply with this requirement.

4-4.2.6 Except for drains, floors shall be liquidtight, and the storage area shall be liquidtight where the walls join the floor.

4-4.2.7* Means shall be provided to prevent the flow of liquids under emergency conditions into adjoining building areas. This shall be accomplished by providing one or a combination of the following across the entire width of each opening:

(a) Noncombustible, liquidtight raised sills, curbs, or ramps of suitable height.

(b) Open-grated trenches.

(c) Other means acceptable to the authority having jurisdiction.

Exception: This requirement shall not apply to areas where only Class III liquids are stored.

4-4.2.8* Where automatic sprinkler protection is provided, in addition to the requirements of 4-4.2.7, means shall also be provided to prevent burning liquids from exposing other storage piles or racks and from exposing other important buildings, adjoining property, or critical natural resources.

Exception No. 1: This requirement shall not apply to areas where only the following are stored:

(a) *Class III liquids;*

(b) *Liquids that are heavier than water;*

(c) *Water-miscible liquids;*

(d) *Liquids having viscosities greater than 10,000 centipoise.*

Exception No. 2: This requirement shall not apply to areas where fire protection is provided by non-water extinguishing systems, such as total flooding CO_2, high expansion foam, or AFFF.

4-4.2.9 Electrical equipment and wiring in inside storage rooms used for the storage of Class I liquids shall be suitable for Class I, Division 2 hazardous (classified) locations. Electrical equipment and wiring in inside storage rooms used for the storage of only Class II and Class III liquids shall be suitable for general purpose use. (*See NFPA 70, National Electrical Code, for information on the design and installation of electrical wiring and equipment.*)

4-4.2.10 Where Class I liquids are dispensed or where Class II or Class III liquids at temperatures at or above their flash points are dispensed, electrical equipment and wiring shall be suitable for Class I, Division 2 hazardous (classified) locations. In addition, electrical equipment and wiring located within 3 ft (0.9 m) of dispensing nozzles shall be suitable for Class I, Division 1 hazardous (classified) locations. (*See NFPA 70, National Electrical Code, for further information.*)

4-4.2.11 Liquid storage areas where dispensing is conducted shall be provided with either a gravity or a continuous mechanical exhaust ventilation system. Mechanical ventilation shall be used if Class I liquids are dispensed within the room.

(a) Exhaust air shall be taken from a point near a wall on one side of the room and within 12 in. (30 cm) of the floor with one or more make-up inlets located on the opposite side of the room within 12 in. (30 cm) of the floor. The location of both the exhaust and inlet air openings shall be arranged to provide, as far as practicable, air movements across all portions of the floor to prevent accumulation of flammable vapors. Exhaust from the room shall be directly to the exterior of the building without recirculation.

Exception: Recirculation is permitted where it is monitored continuously using a fail-safe system that is designed to automatically sound an alarm, stop recirculation, and provide full exhaust to the outside in the event that vapor-air mixtures in concentration over one-fourth of the lower flammable limit are detected.

If ducts are used, they shall not be used for any other purpose and shall comply with NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*. If make-up air to a mechanical system is taken from within the building, the opening shall be equipped with a fire door or damper, as required in NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*. For gravity systems, the make-up air shall be supplied from outside the building.

(b) Mechanical ventilation systems shall provide at least 1 cu ft per min of exhaust per sq ft of floor area (1 m^3 per min per 3 m^2), but not less than 150 cfm (4 m^3 per min). The mechanical ventilation system for dispensing areas shall be equipped with an airflow switch or other equally reliable method that is interlocked to sound an audible alarm upon failure of the ventilation system.

4-4.3 General Storage Requirements.

4-4.3.1 The storage of any liquids shall not physically obstruct means of egress.

4-4.3.2 Wood at least 1-in. (2.5-cm) nominal thickness shall be permitted to be used for shelving, racks, dunnage, scuffboards, floor overlay, and similar installations.

4-4.3.3 Where storage on racks exists as permitted in this code, a minimum 4-ft (1.2-m) wide aisle shall be provided between adjacent rack sections and any adjacent storage of liquids. Main aisles shall be a minimum of 8 ft (2.4 m) wide.

4-4.3.4 Solid pile and palletized storage in liquid warehouses shall be arranged so that piles are separated from each other by at least 4 ft (1.2 m). Aisles shall be provided and so arranged that no container or portable tank is more than 20 ft (6 m) from an aisle. Main aisles shall be a minimum of 8 ft (2.4 m) wide.

4-4.3.5 Class I liquids shall not be permitted in basement areas. Class II and Class IIIA liquids shall be permitted to be stored in basements provided that automatic sprinkler protection and other fire protection facilities are provided in accordance with Section 4-8.

4-4.3.6 Limited quantities of combustible commodities, as defined in the scope of NFPA 231, *Standard for General Storage*, and NFPA 231C, *Standard for Rack Storage of Materials*, shall be permitted to be stored in liquid storage areas if the ordinary combustibles, other than those used for packaging the liquids, are separated from the liquids in storage by a minimum of 8 ft (2.4 m) horizontally, either by aisles or by open racks, and if protection is provided in accordance with Section 4-8.

4-4.3.7 Storage of empty or idle combustible pallets inside an unprotected liquid storage area shall be limited to a maximum pile size of 2500 sq ft (232 m^2) and to a maximum storage height of 6 ft (1.8 m). Storage of empty or idle combustible pallets inside a protected liquid storage area shall comply with NFPA 231, *Standard for General Storage*. Pallet storage shall be separated from liquid storage by aisles that are at least 8 ft (2.4 m) wide.

4-4.3.8 Containers in piles shall be stacked in such manner as to provide stability and to prevent excessive stress on container walls. Portable tanks stored over one tier high shall be designed to nest securely, without dunnage. (*See NFPA 386, Standard for Portable Shipping Tanks for Flammable and Combustible Liquids, for information on portable tank design.*) Materials handling equipment shall be suitable to handle containers and tanks safely at the upper tier level.

4-4.3.9 Containers or portable tanks in unprotected liquid storage areas shall not be stored closer than 36 in. (0.9 m) to the nearest beam, chord, girder, or other roof member.

4-4.4 Allowable Quantities and Storage Heights.

4-4.4.1 Except as provided for in 4-4.4.2 through 4-4.4.4, storage of liquids shall comply with Table 4-4.4(a) for unprotected storage or with Tables 4-4.4(b) and 4-4.4(c) for protected storage. Where storage of liquids is protected, the protection shall meet the requirements of Section 4-8.

Exception: Other quantities and arrangements of storage shall be permitted to be used where the storage is suitably protected and approved by the authority having jurisdiction.

Table 4-4.4(a) Indoor Unprotected Storage of Liquids in Containers and Portable Tanks

Class	Container Storage			Portable Tank Storage		
	Max. Pile Height (ft)	Max. Quant. per Pile (gal)	Max. Total Quant. (gal)*	Max. Pile Height (ft)	Max. Quant. per Pile (gal)	Max. Total Quant. (gal)*
IA	5	660	660	—	Not Permitted	—
IB	5	1,375	1,375	7	2,000	2,000
IC	5	2,750	2,750	7	4,000	4,000
II	10	4,125	8,250	7	5,500	11,000
IIIA	15	13,750	27,500	7	22,000	44,000
IIIB	15	13,750	55,000	7	22,000	88,000

SI Units: 1 ft = 0.3 m; 1 gal = 3.8 L.
*Applies only to cutoff rooms and attached buildings.

Table 4-4.4(b) Storage Arrangements for Protected Palletized or Solid Pile Storage of Liquids in Containers and Portable Tanks

Class	Storage Level	Max. Storage Height (ft)		Max. Quantity per Pile (gal)		Max. Quantity (gal)**	
		Containers	Port. Tanks	Containers	Port. Tanks	Containers	Port. Tanks
IA	Ground Floor	5	—	3,000	—	12,000	—
	Upper Floors	5	—	2,000	—	8,000	—
	Basement	Not Permitted		—	—	—	—
IB	Ground Floor	6½	7	5,000	20,000	15,000	40,000
	Upper Floors	6½	7	3,000	10,000	12,000	20,000
	Basement	Not Permitted		—	—	—	—
IC	Ground Floor	6½*	7	5,000	20,000	15,000	40,000
	Upper Floors	6½*	7	3,000	10,000	12,000	20,000
	Basement	Not Permitted		—	—	—	—
II	Ground Floor	10	14	10,000	40,000	25,000	80,000
	Upper Floors	10	14	10,000	40,000	25,000	80,000
	Basement	5	7	7,500	20,000	7,500	20,000
III	Ground Floor	20	14	15,000	60,000	55,000	100,000
	Upper Floors	20	14	15,000	60,000	55,000	100,000
	Basement	10	7	10,000	20,000	25,000	40,000

SI Units: 1 ft = 0.3 m; 1 gal = 3.8 L.
*These height limitations shall be increased to 10 ft for containers of 5 gal capacity or less. See Table D-4-6.2.2.
**Applies only to cutoff rooms and attached buildings.
NOTE: See Section 4-6 for protection requirements as applicable to this type of storage.

Table 4-4.4(c) Storage Arrangements for Protected Rack Storage of Liquids in Containers

Class	Type Rack	Storage Level	Max. Storage Height (ft)	Max. Quantity (gal)[2,3]
			Containers	Containers
IA	Double Row or Single Row	Ground Floor	25	7,500
		Upper Floors	15	4,500
		Basement	Not Permitted	—
IB	Double Row or Single Row	Ground Floor	25	15,000
		Upper Floors	15	9,000
IC		Basement	Not Permitted	—
II	Double Row or Single Row	Ground Floor	25	24,000
		Upper Floors	25	24,000
		Basement	15	9,000
III	Multi-Row Double Row or Single Row	Ground Floor	40	55,000
		Upper Floors	20	55,000
		Basement	20	25,000

SI Units: 1 ft = 0.3 m; 1 gal = 3.8 L.
NOTE 1: See Section 4-6 for protection requirements as applicable to this type of storage.
NOTE 2: Maximum quantity allowed on racks in cutoff rooms and attached buildings (*see 4-4.2*).
NOTE 3: Maximum quantity allowed per rack section in liquid warehouses (*see 4-5.7*).

4-4.4.2 Storage in inside rooms shall meet the requirements specified in Table 4-4.4.2. In addition, containers over 30 gal (113.5 L) capacity that contain Class I or Class II liquids shall not be stored more than one container high in inside rooms.

Table 4-4.4.2 Storage Limitations for Inside Rooms

Total Floor Area (sq ft)	Automatic Fire Protection Provided?[1]	Total Allowable Quantity (gal per sq ft of floor area)
≤150	No	2
	Yes	5
>150 and ≤500	No	4[2]
	Yes	10

SI Units: 1 sq ft = 0.09 m²; 1 gal = 3.8 L.
NOTE 1: The fire protection system shall be automatic sprinklers, water spray, carbon dioxide, dry chemical, or other approved system. (*See 4-3.*)
NOTE 2: Total allowable quantities of Class IA and IB liquids shall not exceed the quantities permitted in Table 4-4.4(a) or those permitted by 4-4.4.4.

4-4.4.3 Unprotected storage of liquids in racks shall not exceed the maximum total quantities allowed by Table 4-4.4(a). Storage of liquids that are protected in accordance with Section 4-8 shall not exceed the maximum total quantities allowed by Table 4-4.4(c).

Exception: Liquid warehouses need not comply with this requirement.

4-4.4.4 The total quantity of liquids stored in a liquid warehouse shall not be restricted. However, the storage heights and maximum quantity per pile shall comply with Tables 4-4.4(a), 4-4.4(b), and 4-4.4(c) whichever is applicable.

Exception: An unprotected liquid warehouse that is located a minimum of 100 ft (30 m) from exposed buildings or any property line that is or can be built upon need not comply with Table 4-4.4(a) if there is protection for exposures. Where protection for exposures is not provided, this minimum distance shall be increased to 200 ft (61 m).

4-4.4.5 Where two or more classes of liquids are stored in a single pile or rack section, the maximum total quantity and the maximum storage height permitted in that pile or rack section shall be the smallest of the individual maximum total quantities and maximum storage heights for the specific classes present, respectively. The maximum total quantity permitted shall be limited to a sum of the proportional amounts that each class of liquid present bears to the maximum total quantity permitted for its respective class. The sum of the proportional amounts shall not exceed 100 percent.

Exception: The maximum total quantities in liquid warehouses shall not be restricted. (See 4-4.4.3.)

4-4.5 Operations.

4-4.5.1 Dispensing of Class I liquids or Class II or Class III liquids at temperatures at or above their flash points shall not be permitted in cut-off rooms or attached buildings that exceed 1000 sq ft (93 m²) in floor area or in liquid warehouses unless the dispensing area is suitably cut off from the storage areas in accordance with Table 4-4.2.1 and meets all other requirements of 4-4.2.

4-4.5.2 Dispensing operations shall comply with the applicable requirements of Chapter 5.

4-5 Requirements for Liquid Storage Areas in Other Occupancies.

4-5.1 Basic Conditions.

4-5.1.1 Scope. Section 4-5 applies to areas where the storage of liquids is incidental and not the primary purpose of the area.

4-5.1.2 Where inside liquid storage areas are required in other occupancies, they shall meet all applicable requirements of Section 4-4 and all applicable requirements of this section. Where other factors substantially increase or decrease the hazard, the authority having jurisdiction shall be permitted to modify the quantities specified.

4-5.1.3 Storage of liquids shall not physically obstruct a means of egress. Class I liquids shall be so placed that a fire in the liquid storage would not prevent egress from the area.

4-5.1.4 Liquids used for building maintenance, painting, or other similar infrequent maintenance purposes shall be permitted to be stored temporarily in closed containers outside of storage cabinets or inside liquid storage areas, if limited to an amount that does not exceed a 10-day supply at anticipated rates of use.

4-5.1.5 Class I liquids shall not be stored in basements.

Exception: As provided for in 4-5.6.

4-5.2 General-Purpose Warehouses. (*See Section 1-2, Definitions.*)

4-5.2.1 General-purpose warehouses storing liquids (as defined in this code) shall be separate, detached buildings or shall be separated from other occupancies by a standard 1-hr fire wall or, if approved, by a fire partition having a fire resistance rating of not less than 2 hr. Each opening shall be protected as provided for in 4-4.2.2.

4-5.2.2 Warehousing operations that involve storage of liquids shall be restricted to inside liquid storage areas in accordance with Section 4-4.

Exception: As provided for in 4-5.2.3.

4-5.2.3 Class IB and IC liquids in containers of 1 gal (3.8 L) or less capacity, Class II liquids in containers of 5 gal (18.9 L) or less capacity, and Class III liquids in containers of 60 gal (227 L) or less capacity shall be permitted to be stored in warehouses that handle combustible commodities, as defined in NFPA 231, *Standard for General Storage*, provided that the storage area is protected with automatic sprinklers in accordance with the provisions of NFPA 231 for 20-ft (6-m) high storage of Class IV commodities and the quantities and height of liquid storage are limited to:

(a) Class IA liquids: not permitted;

(b) Classes IB & IC: 660 gal (2498 L), maximum 5 ft (1.5 m) high;

(c) Class II: 1375 gal (5204 L), maximum 5 ft (1.5 m) high;

(d) Class IIIA: 2750 gal (10 409 L), maximum 10 ft (3.0 m) high;

(e) Class IIIB: 13,750 gal (52 044 L), maximum 15 ft (4.6 m) high.

The liquid storage shall also comply with 4-5.2.4 through 4-5.2.9.

4-5.2.4 Liquids in Plastic Containers. Class I and Class I liquids in plastic containers shall not be stored in general-purpose warehouses, but shall be stored in inside liquid storage areas that meet the requirements of Section 4-4.

Exception No. 1: The following liquids, packaged in plastic containers, shall be permitted to be stored in general-purpose warehouses in accordance with the protection and storage limitations specified in 4-5.2.3 as follows:

(a) Products containing not more than 50 percent by volume of water-miscible liquids, with the remainder of the solution not being a Class I liquid, where packaged in individual containers;

(b) Products containing more than 50 percent water-miscible liquids in individual containers not exceeding 16 oz. (0.5 L) capacity.

Exception No. 2: Class I and Class II liquids in plastic containers shall be permitted to be stored in a general purpose warehouse if the packaging systems are listed and labeled for use with these materials. All other provisions of 4-5.2 shall also apply.*

4-5.2.5 Palletized, Solid Pile, or Rack Storage. Liquids in containers shall be permitted to be stored on pallets, in solid piles, or on racks, subject to the maximum total quantity and maximum storage height provisions of 4-5.2.3, provided the storage is protected in accordance with Section 4-8, as applicable.

4-5.2.6 Basement Storage Areas. Storage of liquids in basement areas of general purpose warehouses shall only be permitted as provided for in 4-4.3.6.

4-5.2.7 Mixed Liquid Storage. Where two or more classes of liquids are stored in a single pile or single rack section, the maximum total quantity and maximum storage height permitted shall be as provided for in 4-4.4.5.

4-5.2.8 Separation and Aisles. Storage of liquids in general purpose warehouses shall be arranged as provided for in 4-4.3.3 and 4-4.3.4.

4-5.2.9 Liquids and Ordinary Combustible Storage. The following applies to the storage of liquids and ordinary combustible commodities:

(a) Liquids shall not be stored in the same pile or in the same rack sections as ordinary combustible commodities [*see 4-5.2.9(b)*]. Where liquids are packaged together with ordinary combustibles, as in kits, the storage shall be considered on the basis of whichever commodity predominates.

(b) Except as provided for in 4-5.2.9(a), ordinary combustible commodities shall be separated from liquids in containers by a minimum distance of 8 ft (2.4 m).

4-5.2.10 Operations. Dispensing of Class I and Class II liquids in general purpose warehouses shall not be permitted unless the dispensing area is suitably cut off from other ordinary combustible or liquid storage areas, as specified in 4-4.2, and otherwise complies with the applicable provisions of 4-4.2.

4-5.3 Dwellings and Residential Buildings Containing Not More than Three Dwelling Units and Accompanying Attached and Detached Garages. Storage in excess of 25 gal (94.6 L) of Class I and Class II liquids combined shall be prohibited. In addition, storage in excess of 60 gal (227 L) of Class IIIA liquid shall be prohibited.

4-5.4 Assembly Occupancies, Buildings Containing More than Three Dwelling Units, and Hotels. Storage in excess of 10 gal (37.8 L) of Class I and Class II liquids combined or 60 gal (227 L) of Class IIIA liquids shall be in containers stored in storage cabinets, in safety cans, or in an inside storage area that does not have openings that communicate with that portion of the building used by the public.

4-5.5 Office, Educational, and Institutional Occupancies. The following requirements shall apply to office, educational, and institutional occupancies.

4-5.5.1 Storage shall be limited to that required for operation of office equipment, maintenance, demonstration, and laboratory work. This storage shall comply with the provisions of 4-5.5.2 through 4-5.5.5, except that the storage for industrial and educational laboratory work shall comply with NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*.

4-5.5.2 Containers of Class I liquids that are stored outside of an inside liquid storage area shall not exceed a capacity of 1 gal (3.8 L).

Exception: Safety cans shall be permitted up to a 2-gal (7.6-L) capacity.

4-5.5.3 Not more than 10 gal (37.8 L) of Class I and Class II liquids combined shall be stored in a single fire area outside of a storage cabinet or an inside liquid storage area unless in safety cans.

4-5.5.4 Not more than 25 gal (94.6 L) of Class I and Class II liquids combined shall be stored in a single fire area in safety cans outside of an inside liquid storage area or storage cabinet.

4-5.5.5 Not more than 60 gal (227 L) of Class IIIA liquids shall be stored outside of an inside liquid storage area or storage cabinet.

4-5.6 Mercantile Occupancies.

4-5.6.1* In storage and display areas that are accessible to the public, the storage of Class I, Class II, and Class IIIA liquids shall be limited to the quantities needed for display, storage, and normal merchandising purposes, but in no case shall exceed the quantities stated in the following:

(a) In protected storage and display areas, the total aggregate quantity of Classes IB, IC, II, and IIIA liquids in any combination shall not exceed 4 gal per sq ft (162 L per m^2) of gross floor area, up to a maximum total quantity of 7500 gal (28,388 L). The total quantity of Class IA liquids shall not exceed 120 gal (454 L).

(b) In unprotected ground floor storage and display areas, the total aggregate quantity of Classes IB, IC, II, and IIIA liquids in any combination shall not exceed 2 gal per sq ft (81 L per m^2) of gross floor area, up to a maximum total quantity of 7500 gal (28,388 L). The total quantity of Class IA liquids shall not exceed 120 gal (454 L).

(c) In unprotected storage and display areas on floors other than the ground floor, the total aggregate quantity of Classes IB, IC, II, and IIIA liquids in any combination shall not exceed 1 gal per sq ft (40 L per m^2) of gross floor area. The storage of Class IA liquids in such areas shall be prohibited.

(d) For the purpose of 4-5.6.1(a), "protected" shall mean protected with automatic sprinklers that are, as a minimum, installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, for Ordinary Hazard Group 2 Occupancies.

(e) For the purposes of 4-5.6.1(a), (b), and (c), "gross floor area," used for computing the maximum quantity of liquid that can be stored, shall mean that portion of the floor actually being used for merchandising of these liquids and the immediately adjacent aisle spaces.

(f) Where the storage arrangements, the sprinkler system design criteria, or other means of protection are based on fire test data, the maximum total quantities given in (a), (b), and (c) above shall be permitted to be doubled. (*For additional guidance on recommended protection, see Appendix D.*)

4-5.6.2 In storage areas that are not accessible to the public, the storage of Class I, Class II, and Class IIIA liquids shall not exceed the amounts stated in the following:

(a) In storage areas that are protected in accordance with 4-5.6.1(d) the total aggregate quantity of Classes IB, IC, II, and IIIA liquids in any combination shall not exceed 7500 gal (28,388 L). The total quantity of Class IA liquids shall not exceed 120 gal (454 L). Class IA liquids shall not be stored in basements.

(b) In unprotected storage areas, the total aggregate quantity of Classes IB, IC, II, and IIIA liquids in any combination shall not exceed the amounts given in 4-5.6.1(b) or 4-5.6.1(c), whichever is applicable.

(c) Where the storage arrangements, the sprinkler system design criteria, or other means of protection are based on fire test data, the maximum total quantities given in (a) and (b) above shall be permitted to be doubled. (*For additional guidance on recommended protection, see Appendix D.*)

4-5.6.3 Quantities in excess of those permitted in 4-5.6.2 shall be stored in accordance with other appropriate sections of this code.

4-5.6.4 Containers shall not be stacked more than 3 ft (0.9 m) or 2 containers high, whichever is the greater, unless placed on fixed shelving or otherwise satisfactorily secured.

4-5.6.5 Shelving shall be of stable construction and of sufficient depth and arrangement such that containers displayed thereon shall not easily be displaced.

4-5.6.6 Leaking containers shall be removed immediately to an adequately ventilated area, and the contents transferred to an undamaged container.

4-6* Hazardous Materials Storage Lockers.

4-6.1 Hazardous materials storage lockers that are used as inside rooms shall be considered inside liquid storage rooms and shall meet the requirements for inside rooms as set forth in Section 4-4, as applicable.

4-6.2 Subsections 4-6.3 and 4-6.4 shall apply to storage of flammable and combustible liquids in containers, in hazardous material storage lockers (hereinafter referred to as lockers) which are located outside.

4-6.3 The design and construction of a locker shall meet all applicable local, state, and federal regulations and requirements and shall be subject to the approval of the authority having jurisdiction. Movable prefabricated structures that have been examined, listed, or labeled by an organization acceptable to the authority having jurisdiction for use as a hazardous materials storage facility shall be acceptable.

4-6.3.1 Lockers governed by this standard shall not exceed 1500 sq ft (139 m^2) gross floor area. Vertical stacking of lockers shall not be permitted.

4-6.3.2 Where electrical wiring and equipment is required, it shall comply with 4-4.2.9.

4-6.3.3 Where dispensing or filling is permitted inside a locker, operations shall comply with the provisions of Chapter 5.

4-6.3.4 Ventilation shall be provided in accordance with 4-4.2.11.

4-6.3.5 **Spill or Leakage Control.** Lockers shall include a spill containment system to prevent the flow of liquids from the structure under emergency conditions. The containment system shall have sufficient capacity to contain 10 percent of the volume of containers allowed or the volume of the largest container, whichever is greater.

4-6.4 Designated sites shall be provided for the location and use of lockers and shall be subject to the approval of the authority having jurisdiction. The designated sites shall be arranged to provide at least the minimum separation distance between individual lockers, distance from locker to property line that is or can be built upon, and distance from locker to nearest side of public ways or to important buildings on the same property, as given in Table 4-6.4 and explanatory notes 1, 2, 3, and 4, as applicable.

4-6.4.1 Once the designated site is approved, it shall not be changed without the approval of the authority having jurisdiction.

4-6.4.2 More than one locker shall be permitted on a designated site, provided that separation distance between individual lockers is maintained in accordance with Table 4-6.4.

4-6.4.3 The approved designated storage site shall be protected from tampering or trespassing where the area is accessible to the general public.

4-6.4.4 Storage Practices.

4-6.4.4.1 Containers of liquid in their original shipping packages shall be permitted to be stored either palletized or solid piled. Unpackaged containers shall be permitted to be stored on shelves or directly on the floor of the locker. Containers over 30 gal (113.5 L) capacity storing Class I or Class II liquids shall not be stored more than two containers high. In all cases, the storage arrangement shall provide unrestricted access to and egress from the locker.

4-6.4.4.2 No other flammable or combustible material storage shall be permitted within the designated site approved for lockers.

4-6.4.4.3 Placarding or warning signs for lockers shall be in accordance with applicable local, state, and federal regulations or with NFPA 704, *Standard System for the Identification of the Fire Hazards of Materials*.

Table 4-6.4 Designated Sites

Area of Designated Site[1] (sq ft)	Distance between Individual Lockers (ft)	Distance from Locker to Property Line that Is or Can Be Built Upon[2] (ft)	Distance from Locker to Nearest Side of Public Ways or to Important Buildings on Same Property[2,5] (ft)
≤100	5	10	5
>100 ≤500	5	20	10
>500 ≤1500[4]	5	30	20

[1] Site area limits are intended to differentiate the relative size and thus the number of lockers that are permitted in one designated site.
[2] Distances apply to properties that have protection for exposures, as defined. If there are exposures and such protection for exposures does not exist, the distances shall be doubled.
[3] When the exposed building has an exterior wall, facing the designated site, that has a fire resistance rating of at least 2 hr and has no openings to abovegrade areas within 10 ft (3 m) horizontally and no openings to belowgrade areas within 50 ft (15 m) horizontally of the designated area, the distances can be reduced to half of those shown in the table, except they shall never be less than 5 ft (1.5 m).
[4] When a single locker has a gross single story floor area that will require a site area limit of greater than 1500 sq ft (139 m²) or when multiple units exceed the area limit of 1500 sq ft (139 m²), the authority having jurisdiction shall be consulted for approval of distances.

4-7 Outdoor Storage.

4-7.1 Outdoor storage of liquids in containers and portable tanks shall be in accordance with Table 4-7 and 4-7.1.1 through 4-7.1.4 and 4-7.2 through 4-7.4.

4-7.1.1 Where two or more classes of materials are stored in a single pile, the maximum gallonage in that pile shall be the smallest of the two or more separate gallonages.

4-7.1.2 No container or portable tank in a pile shall be more than 200 ft (60 m) from a 12-ft (3.6-m) wide access way to permit approach of fire control apparatus under all weather conditions.

4-7.1.3 The distances listed in Table 4-7 apply to properties that have protection for exposures as defined. If there are exposures, and such protection for exposures does not exist, the distances in column 4 shall be doubled.

4-7.1.4 Where total quantity stored does not exceed 50 percent of maximum per pile, the distances in columns 4 and 5 shall be permitted to be reduced 50 percent, but not to less than 3 ft (0.9 m)

4-7.2 A maximum of 1100 gal (4163 L) of liquids in closed containers and portable tanks shall be permitted to be stored adjacent to a building under the same management provided that:

(a) The adjacent building wall has an exterior fire resistance rating of 2 hr,

(b) There are no openings to areas at grade or above grade that are within 10 ft (3 m) horizontally of the storage,

(c) There are no openings directly above the storage, and

(d) There are no openings to areas below grade within 50 ft (15 m) horizontally of the storage.

Exception: The above provisions are not necessary if the building in question is limited to one story, is of fire-resistive or noncombustible construction, is devoted principally to the storage of liquids, and is acceptable to the authority having jurisdiction.

4-7.2.1 The quantity of liquids stored adjacent to a building protected in accordance with 4-7.2 shall be permitted to exceed that permitted in 4-7.2, provided the maximum

Table 4-7 Outdoor Liquid Storage in Containers and Portable Tanks

	1		2		3	4	5
Class	Container Storage—Max. per Pile		Portable Tank Storage Max. per Pile Gallons[1]		Distance between Piles or Racks (ft)	Distance to Property Line that Is or Can Be Built Upon (ft)[2,3]	Distance to Street, Alley, or a Public Way (ft)[3]
	Gallons[1,4]	Height (ft)	Gallons[1,4]	Height (ft)			
IA	1,100	10	2,200	7	5	50	10
IB	2,200	12	4,400	14	5	50	10
IC	4,400	12	8,800	14	5	50	10
II	8,800	12	17,600	14	5	25	5
III	22,000	18	44,000	14	5	10	5

SI Units: 1 ft = 0.3 m; 1 gal = 3.8 L.
[1] See 4-7.1.1 regarding mixed class storage.
[2] See 4-7.1.3 regarding protection for exposures.
[3] See 4-7.1.4 for smaller pile sizes.
[4] For storage in racks, the quantity limits per pile do not apply, but the rack arrangement shall be limited to a maximum of 50 ft (15 m) in length and 2 rows or 9 ft (2.7 m) in depth.

quantity per pile does not exceed 1100 gal (4163 L) and each pile is separated by a 10-ft (3-m) minimum clear space along the common wall.

4-7.2.2 Where the quantity stored exceeds the 1100 gal (4163 L) permitted adjacent to the building given in 4-7.2, or the provisions of 4-7.2 cannot otherwise be met, a minimum distance in accordance with column 4 of Table 4-7 shall be maintained between buildings and the nearest container or portable tank.

4-7.3 The storage area shall be graded in a manner to divert possible spills away from buildings or other exposures or shall be surrounded by a curb at least 6 in. (15 cm) high. Where curbs are used, provisions shall be made for draining of accumulations of ground or rain water or spills of liquids. Drains shall terminate at a safe location and shall be accessible to operation under fire conditions.

4-7.4 The storage area shall be protected against tampering or trespassers where necessary and shall be kept free of weeds, debris, and other combustible materials not necessary to the storage.

4-8 Fire Protection and Control.

4-8.1 Scope. Section 4-8 shall apply to all storage of liquids in containers and portable tanks as specified in Sections 4-2 through 4-7.

4-8.2 Where automatic sprinklers are used, they shall be installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*, and approved by the authority having jurisdiction. (*For additional information, see Appendix D.*)

4-8.2.1 Other systems such as automatic foam-water systems, automatic water-spray systems, or other combinations of systems shall be permitted if approved by the authority having jurisdiction. Such systems shall be designed and installed in accordance with the appropriate NFPA standard for the system selected. (*For additional information, see Appendix D.*)

4-8.2.2 In-rack sprinklers shall be installed in accordance with the provisions of NFPA 231C, *Standard for Rack Storage of Materials*, except as modified by 4-8.2. Alternate lines of in-rack sprinklers shall be staggered. Multiple levels of in-rack sprinkler heads shall be provided with water shields unless otherwise separated by horizontal barriers or unless the sprinkler heads are listed for such installations.

4-8.3 Where storage on racks exist as permitted in this code, racks storing Class I or Class II liquids shall be either single-row or double-row as described in NFPA 231C, *Standard for Rack Storage of Materials.*

4-8.4 Suitable fire extinguishers or preconnected hose lines, either 1½-in. (3.8-cm) lined or 1-in. (2.5-cm) hard rubber, shall be provided where liquids are stored. Where 1½-in. (3.8-cm) fire hose is used, it shall be installed in accordance with NFPA 14, *Standard for the Installation of Standpipe and Hose Systems.*

4-8.4.1 At least one portable fire extinguisher having a rating of not less than 20-B shall be located outside of, but not more than 10 ft (3 m) from, the door opening into any inside storage area.

4-8.4.2 At least one portable fire extinguisher having a rating of not less than 20-B shall be located not less than 10 ft (3 m), nor more than 50 ft (15 m), from any Class I or Class II liquid storage area located outside of an inside storage area or liquid warehouse.

4-8.5 In protected general purpose warehouses and in protected liquid storage areas, hand hose lines shall be provided in sufficient number to reach all liquid storage areas.

4-8.6 The water supply shall be sufficient to meet the fixed fire protection demand, plus a total of at least 500 gal (1892 L) per minute for inside and outside hose lines. [*See Tables D-4-6.2(a), (b), and (c).*]

4-8.7 Control of Ignition Sources. Precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include but are not limited to: open flames; lightning; smoking; cutting and welding; hot surfaces; frictional heat; static, electrical, and mechanical sparks; spontaneous ignition, including heat-producing chemical reactions; and radiant heat.

4-8.8* Materials with a water reactivity as outlined in NFPA 704, *Standard System for the Identification of the Fire Hazards of Materials*, shall not be stored in the same area with other liquids.

4-8.9 Power-operated industrial trucks used to move containers of Class I liquids shall be selected, maintained, and operated in accordance with NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Maintenance, and Operation.*

4-8.10 Water-based fire protection systems shall be inspected, tested, and maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.*

Chapter 5 Operations

5-1 Scope.

5-1.1 This chapter applies to operations involving the use or handling of liquids either as a principal or incidental activity, except as covered elsewhere in this code or in other NFPA standards.

5-1.2 The provisions of this chapter relate to the control of hazards of fire involving liquids. These provisions may not provide adequate protection for operations involving hazardous materials or chemical reactions nor do they consider health hazards resulting from exposure to such materials.

5-1.3 Provisions of this chapter shall not prohibit the use of movable tanks in conjunction with the dispensing of flammable or combustible liquids into fuel tanks of motorized equipment outside on premises not accessible to the public. Such uses shall only be made with the approval of the authority having jurisdiction.

5-2 General. Liquid processing operations shall be located and operated so that they do not constitute a significant fire or explosion hazard to life, to property of others, or to important buildings or facilities within the same plant. Specific requirements are dependent on the inherent risk in the operations themselves, including the liquids

being processed, operating temperatures and pressures, and the capability to control any liquid or vapor releases or fire incidents that might occur. The interrelationship of the many factors involved must be based on good engineering and management practices to establish suitable physical and operating requirements. (*See 5-5.1.3.*)

5-3 Facility Design.

5-3.1 Location.

5-3.1.1 The minimum distance of a processing vessel to adjoining property or to the nearest important building on the same property shall be based on the stability of the liquid and vessel capacity and shall be in accordance with Table 5-3.1.1, except as modified in 5-3.1.2.

5-3.1.2 Where process vessels are located in a building and the exterior wall facing the exposure (line of adjoining property that can be built upon or nearest important building on the same property) is greater than 25 ft (7.6 m) from the exposure and is a blank wall having a fire resistance rating of not less than 2 hr, any greater distances required in Table 5-3.1.1 may be waived. Where a blank wall having a fire resistance rating of not less than 4 hr is provided, distance requirements may be waived. In addition, when Class IA or unstable liquids are handled, the wall shall have explosion resistance in accordance with good engineering practice. (*See 5-3.2.7 relative to explosion relief of other walls of this building.*)

5-3.1.3 Other liquid processing equipment, such as pumps, heaters, filters, exchangers, etc., shall not be located closer than 25 ft (7.6 m) to property lines where the adjoining property is or can be built upon or to the nearest important building on the same property that is not an integral part of the process. This spacing requirement may be waived where exposures are protected as outlined in 5-3.1.2.

NOTE: Equipment operated at pressures over 1000 psig (7000 kPa) may require greater spacing.

5-3.1.4 Processing equipment in which unstable liquids are handled shall be separated from unrelated plant facilities that use or handle liquids by either 25-ft (7.6-m) clear spacing or a wall having a fire resistance rating of not less than 2 hr. The wall shall also have explosion resistance in accordance with good engineering practice.

5-3.1.5 Each process unit or building containing liquid-processing equipment shall be accessible from at least one side for fire fighting and fire control.

5-3.2 Construction.

5-3.2.1 Processing buildings or structures shall be of fire resistive or noncombustible construction, except that combustible construction may be used where automatic sprinklers or equivalent protection is provided, subject to approval of the authority having jurisdiction. (*See NFPA 220, Standard on Types of Building Construction.*)

5-3.2.2 Where walls are required for separation of processing operations from other occupancies or property lines, they shall have a fire resistance rating of at least 2 hr. In addition, where Class IA or unstable liquids are being stored or processed, the separating wall shall have explosion resistance in accordance with good engineering practice. (*See 5-3.2.7 relative to explosion relief of other walls of this building or area.*)

5-3.2.3 Class I liquids shall not be handled or used in basements. Where Class I liquids are handled or used above grade within buildings with basements or closed pits into which flammable vapors may travel, such below grade areas shall be provided with mechanical ventilation designed to prevent the accumulation of flammable vapors. Means shall be provided to prevent liquid spills from running into basements.

5-3.2.4 Provision for smoke and heat venting may be desirable to assist access for fire fighting. (NFPA 204M, *Guide for Smoke and Heat Venting*, provides information on this subject.)

Table 5-3.1.1 Location of Processing Vessels from Property Lines and Nearest Important Building on the Same Property Where Protection for Exposures Is Provided

Vessel Maximum Operating Liquid Capacity (gal)	Minimum Distance from Property Line that Is or Can Be Built Upon, Including Opposite Side of Public Way (ft)				Minimum Distance from Nearest Side of Any Public Way or from Nearest Important Building on Same Property that Is Not an Integral Part of the Process (ft)			
	Stable Liquid Emergency Relief		Unstable Liquid Emergency Relief		Stable Liquid Emergency Relief		Unstable Liquid Emergency Relief	
	Not Over 2.5 psig	Over 2.5 psig	Not Over 2.5 psig	Over 2.5 psig	Not Over 2.5 psig	Over 2.5 psig	Not Over 2.5 psig	Over 2.5 psig
275 or less	5	10	15	20	5	10	15	20
276 to 750	10	15	25	40	5	10	15	20
751 to 12,000	15	25	40	60	5	10	15	20
12,001 to 30,000	20	30	50	80	5	10	15	20
30,001 to 50,000	30	45	75	120	10	15	25	40
50,001 to 100,000	50	75	125	200	15	25	40	60
Over 100,000	80	120	200	300	25	40	65	100

NOTE: Double all of above distances where protection for exposures is not provided.

5-3.2.5 Areas shall have exit facilities arranged to prevent occupants from being trapped in the event of fire. NFPA *101, Life Safety Code*, provides information on the design of exit facilities. Exits shall not be exposed by the drainage facilities described in 5-3.4.

5-3.2.6 Adequate aisles shall be maintained for unobstructed movement of personnel and fire protection equipment.

5-3.2.7 Areas where Class IA or unstable liquids are processed shall have explosion venting through one or more of the following methods: (a) open air construction; (b) lightweight walls and/or roof; (c) lightweight wall panels and roof hatches; (d) windows of explosion-venting type. (NFPA 68, *Guide for Venting of Deflagrations*, provides information on this subject.)

5-3.3 Ventilation.

5-3.3.1 Enclosed processing areas handling or using Class I liquids or Class II or Class III liquids at temperatures above their flash points shall be ventilated at a rate sufficient to maintain the concentration of vapors within the area at or below 25 percent of the lower flammable limit. This shall be confirmed by one of the following:

(a) Calculations based on the anticipated fugitive emissions (*see Appendix F for calculation method*), or

(b) Sampling of the actual vapor concentration under normal operating conditions.

The sampling shall be conducted at a 5-ft (1.5-m) radius from each potential vapor source extending to or toward the bottom and the top of the enclosed processing area. The vapor concentration used to determine the required ventilation rate shall be the highest measured concentration during the sampling procedure.

NOTE: Equipment in enclosed processing areas may deteriorate over time, and periodic sampling should be conducted to ensure that leakage rates have not increased or that the ventilation rate is adequate for any increase in leakage rates.

An acceptable alternate is to provide ventilation at a rate of not less than 1 cu ft per min per sq ft of solid floor area (0.3 m^3 per min per m^2). Ventilation shall be accomplished by natural or mechanical ventilation, with discharge or exhaust to a safe location outside the building, without recirculation of the exhaust air.

Exception: Recirculation is permitted where it is monitored continuously using a fail-safe system that is designed to automatically sound an alarm, stop recirculation, and provide full exhaust to the outside in the event that vapor-air mixtures in concentration over one-fourth of the lower flammable limit are detected.

Provision shall be made for introduction of make-up air in such a manner as to avoid short-circuiting the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors may collect. Where natural ventilation is inadequate, mechanical ventilation shall be provided and shall be kept in operation while flammable liquids are being handled. Local or spot ventilation may be needed for the control of special fire or health hazards. Such ventilation, if provided, can be utilized for up to 75 percent of the required ventilation. (NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*, and NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, provide information on this subject.)

5-3.3.2 Equipment used in a building and the ventilation of the building shall be designed to limit flammable vapor-air mixtures under normal operating conditions to the interior of equipment and to not more than 5 ft (1.5 m) from equipment that exposes Class I liquids to the air. Examples of such equipment are dispensing stations, open centrifuges, plate and frame filters, open vacuum filters, and surfaces of open equipment.

5-3.4 Drainage.

5-3.4.1 Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location. This may require curbs, scuppers, or special drainage systems to control the spread of fire (*see 2-3.4*). (Appendix A of NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, provides information on this subject.)

5-3.4.2 Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators.

5-3.4.3 A facility shall be designed and operated to prevent the normal discharge of flammable or combustible liquids to public waterways, public sewers, or adjoining property.

5-3.5 Electrical Equipment.

5-3.5.1 This section shall apply to areas where Class I liquids are stored or handled and to areas where Class II or Class III liquids are stored or handled at a temperature above their flash points (*see 1-1.3*).

5-3.5.2 All electrical equipment and wiring shall be of a type specified by, and installed in accordance with, NFPA 70, *National Electrical Code*.

5-3.5.3 So far as it applies, Table 5-3.5.3 shall be used to delineate and classify areas for the purpose of installation of electrical equipment under normal conditions. In the application of classified areas, a classified area shall not extend beyond a floor, wall, roof, or other solid partition that has no communicating openings. The designation of classes and divisions is defined in Chapter 5, Article 500, of NFPA 70, *National Electrical Code*. [*See NFPA 497A, Recommended Practice for Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas, and NFPA 497M, Manual for Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations, for guidance.*]

5-3.5.4 The area classifications listed in Table 5-3.5.3 are based on the premise that the installation meets the applicable requirements of this code in all respects. Should this not be the case, the authority having jurisdiction shall have the authority to classify the extent of the area.

5-3.5.5 Where the provisions of 5-3.5.1, 5-3.5.2, 5-3.5.3, and 5-3.5.4 require the installation of electrical equipment suitable for Class I, Division 1 or Division 2 locations, ordinary electrical equipment including switchgear shall be permitted to be used if installed in a room or enclosure that is maintained under positive pressure with respect to the classified area. Ventilation make-up air shall not be contaminated. (NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, provides details for these types of installations.)

Table 5-3.5.3 Electrical Area Classifications

Location	NEC Class I Division	Extent of Classified Area
Indoor equipment installed in accordance with 5-3.3.2 where flammable vapor-air mixtures may exist under normal operation	1	Area within 5 ft of any edge of such equipment, extending in all directions.
	2	Area between 5 ft and 8 ft of any edge of such equipment, extending in all directions. Also, area up to 3 ft above floor or grade level within 5 ft to 25 ft horizontally from any edge of such equipment.*
Outdoor equipment of the type covered in 5-3.3.2 where flammable vapor-air mixtures may exist under normal operation	1	Area within 3 ft of any edge of such equipment, extending in all directions.
	2	Area between 3 ft and 8 ft of any edge of such equipment, extending in all directions. Also, area up to 3 ft above floor or grade level within 3 ft to 10 ft horizontally from any edge of such equipment.
Tank—aboveground	1	Area inside dike where dike height is greater than the distance from the tank to the dike for more than 50 percent of the tank circumference.
Shell, ends, or roof and dike area	2	Within 10 ft from shell, ends, or roof of tank. Area inside dikes to level of top of dike.
Vent	1	Within 5 ft of open end of vent, extending in all directions.
	2	Area between 5 ft and 10 ft from open end of vent, extending in all directions.
Floating roof	1	Area above the roof and within the shell.
Underground tank fill opening	1	Any pit, box, or space below grade level, if any part is within a Division 1 or 2 classified area.
	2	Up to 18 in. above grade level, within a horizontal radius of 10 ft from a loose fill connection and within a horizontal radius of 5 ft from a tight fill connection.
Vent—discharging upward	1	Within 3 ft of open end of vent, extending in all directions.
	2	Area between 3 ft and 5 ft of open end of vent, extending in all directions.
Drum and container filling outdoors, or indoors with adequate ventilation	1	Within 3 ft of vent and fill openings, extending in all directions.
	2	Area between 3 ft and 5 ft from vent or fill opening, extending in all directions. Also, up to 18 in. above floor or grade level within a horizontal radius of 10 ft from vent or fill openings.
Pumps, bleeders, withdrawal fittings, meters and similar devices		
Indoors	2	Within 5 ft of any edge of such devices, extending in all directions. Also up to 3 ft above floor or grade level within 25 ft horizontally from any edge of such devices.
Outdoors	2	Within 3 ft of any edge of such devices, extending in all directions. Also up to 18 in. above grade level within 10 ft horizontally from any edge of such devices.
Pits		
Without mechanical ventilation	1	Entire area within pit if any part is within a Division 1 or 2 classified area.
With adequate mechanical ventilation	2	Entire area within pit if any part is within a Division 1 or 2 classified area.
Containing valves, fittings, or piping, and not within a Division 1 or 2 classified area	2	Entire pit.
Drainage ditches, separators, impounding basins		
Outdoor	2	Area up to 18 inches above ditch, separator, or basin. Also up to 18 inches above grade within 15 ft horizontally from any edge.
Indoor		Same as pits.

*The release of Class I liquids may generate vapors to the extent that the entire building, and possibly a zone surrounding it, should be considered a Class I, Division 2 location.

(continued)

Table 5-3.5.3, cont.

Location	NEC Class I Division	Extent of Classified Area
Tank vehicle and tank car* loading through open dome	1	Within 3 ft of edge of dome, extending in all directions.
	2	Area between 3 ft and 15 ft from edge of dome, extending in all directions.
Loading through bottom connections with atmospheric venting	1	Within 3 ft of point of venting to atmosphere, extending in all directions.
	2	Area between 3 ft and 15 ft from point of venting to atmosphere, extending in all directions. Also up to 18 in. above grade within a horizontal radius of 10 ft from point of loading connection.
Office and rest rooms	Ordinary	If there is any opening to these rooms within the extent of an indoor classified area, the room shall be classified the same as if the wall, curb, or partition did not exist.
Loading through closed dome with atmospheric venting	1	Within 3 ft of open end of vent, extending in all directions.
	2	Area between 3 ft and 15 ft of open end of vent, extending in all directions. Also within 3 ft of edge of dome, extending in all directions.
Loading through closed dome with vapor control	2	Within 3 ft of point of connection of both fill and vapor lines, extending in all directions.
Bottom loading with vapor control any bottom unloading	2	Within 3 ft of point of connections, extending in all directions. Also up to 18 in. above grade within a horizontal radius of 10 ft from point of connections.
Storage and repair garage for tank vehicles	1	All pits or spaces below floor level.
	2	Area up to 18 in. above floor or grade level for entire storage or repair garage.
Garages for other than tank vehicles	Ordinary	If there is any opening to these rooms within the extent of an outdoor classified area, the entire room shall be classified the same as the area classification at the point of the opening.
Outdoor drum storage	Ordinary	
Indoor warehousing where there is no flammable liquid transfer	Ordinary	If there is any opening to these rooms within the extent of an indoor classified area, the room shall be classified the same as if the wall, curb, or partition did not exist.
Piers and wharves		See Figure 5-3.5.6.

*When classifying extent of area, consideration shall be given to the fact that tank cars or tank vehicles can be spotted at varying points. Therefore, the extremities of the loading or unloading positions shall be used.

5-3.5.6 For marine terminals handling flammable liquids, Figure 5-3.5.6 shall be used as a minimum basis to delineate and classify areas for the purpose of installation of electrical equipment.

5-4 Liquid Handling, Transfer, and Use.

5-4.1 General.

5-4.1.1 Class I liquids shall be kept in closed tanks or containers when not actually in use. Class II and Class III liquids shall be kept in closed tanks or containers when ambient or process temperature is at or above their flash point.

5-4.1.2 Where liquids are used or handled, provisions shall be made to promptly and safely dispose of leakage or spills.

5-4.1.3 Class I liquids shall not be used outside closed systems where there are open flames or other ignition sources within the classified areas as set forth in Table 5-3.5.3

5-4.1.4 Transfer of liquids among vessels, containers, tanks, and piping systems by means of air or inert gas pressure shall be permitted only under all of the following conditions:

(a) The vessels, containers, tanks, and piping systems shall be designed for such pressurized transfer and shall be capable of withstanding the anticipated operating pressure.

(b) Safety and operating controls, including pressure relief devices, shall be provided to prevent overpressure of any part of the system.

(c) Only inert gas shall be used to transfer Class I liquids. Inert gas shall be used to transfer Class II and Class III liquids that are heated above their flash points.

5-4.1.5 Positive displacement pumps shall be provided with pressure relief discharging back to the tank, pump suction, or other suitable location or shall be provided with interlocks to prevent overpressure.

5-4.1.6 Piping, valves, and fittings shall be in accordance with Chapter 3, "Piping Systems."

5-4.1.7 Listed flexible connectors shall be permitted to be used where vibration exists. Approved hose shall be permitted to be used at transfer stations.

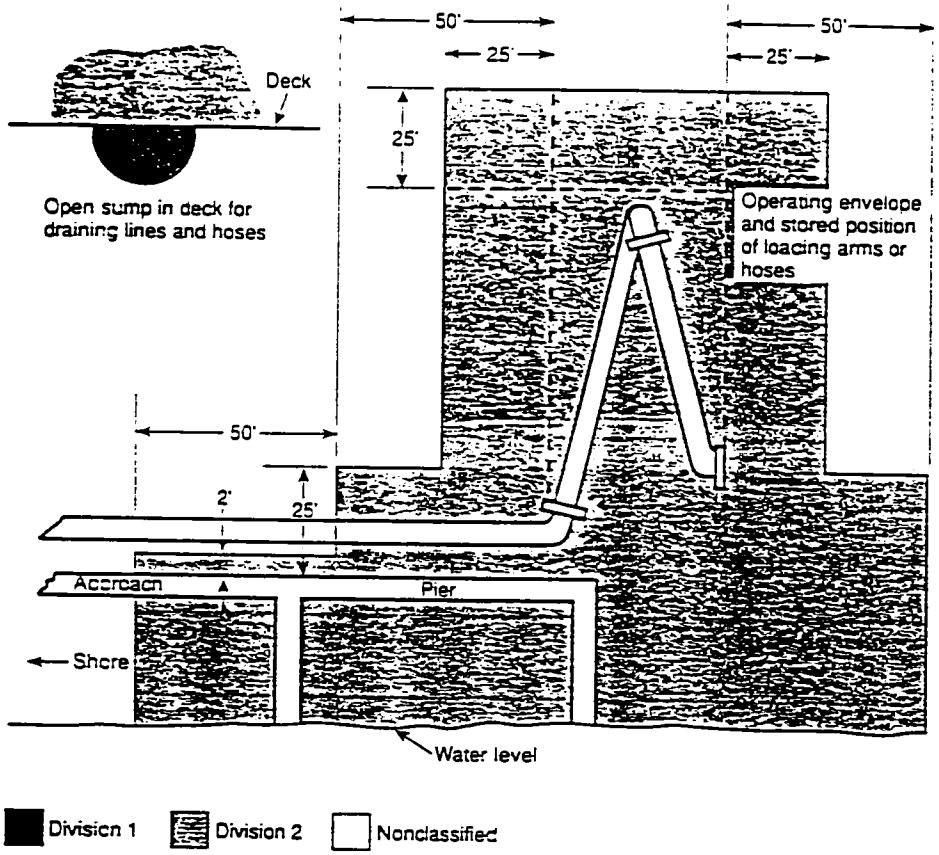

Figure 5-3.5.6 Marine terminal handling flammable liquids.

SI Units: 1 ft = 0.3 m.

Note 1: The "source of vapor" shall be the operating envelope and stored position of the outboard flange connection of the loading arm (or hose).

Note 2: The berth area adjacent to tanker and barge cargo tanks is to be Division 2 to the following extent:

(a) Twenty-five ft (7.6 m) horizontally in all directions on the pier side from that portion of the hull containing cargo tanks.

(b) From the water level to 25 ft (7.6 m) above the cargo tanks at their highest position.

Note 3: Additional locations may have to be classified as required by the presence of other sources of flammable liquids on the berth, or by Coast Guard or other regulations.

5-4.2* Equipment. Equipment shall be designed and arranged to prevent the unintentional escape of liquids and vapors and to minimize the quantity escaping in the event of accidental release.

5-4.3 Incidental Use of Liquids.

5-4.3.1 This section shall be applicable where the use and handling of liquids is only incidental to the principal business, such as automobile assembly, construction of electronic equipment, furniture manufacturing, or other similar activities.

5-4.3.2 Class I and Class II liquids shall be drawn from or transferred into vessels, containers, or portable tanks in the following manner only.

(a) From original shipping containers with a capacity of 5 gal (19 L) or less,

(b) From safety cans.

(c) Through a closed piping system.

(d) From portable tanks or containers by means of a device drawing through an opening in the top of the tank or container,

(e) By gravity through a listed self-closing valve or self-closing faucet, or

(f) If hose is used in the transfer operation, it shall be equipped with a self-closing valve without a hold-open latch in addition to the outlet valve. Only listed or approved hose shall be used.

5-4.3.3 Except as provided in 5-4.3.4 and 5-4.3.5, all storage shall comply with Chapter 4, "Container and Portable Tank Storage."

5-4.3.4 The quantity of liquid that may be located outside of storage cabinets, inside storage rooms, cut-off rooms and attached buildings, general purpose warehouses, liquid warehouses, or other specific processing areas that are cut off by at least a 2-hr fire-rated separation from the general plant area shall not exceed the greater of the quantity in either (a) or the sum of (b), (c), (d), and (e) below:

(a) A supply for one day, or

(b) 25 gal (95 L) of Class IA liquids in containers,

(c) 120 gal (454 L) of Class IB, IC, II, or III liquids in containers,

(d) Two portable tanks each not exceeding 660 gal (2498 L) of Class IB, IC, Class II, or Class IIIA liquids, and

(e) 20 portable tanks each not exceeding 660 gal (2498 L) of Class IIIB liquids.

5–4.3.5 Where quantities of liquids in excess of the limits in 5–4.3.4 are necessary, storage shall be in tanks, which shall comply with the applicable requirements of Chapter 2, "Tank Storage," Section 5-3, and 5–4.1 and 5–4.2.

5–4.3.6 Areas in which liquids are transferred from one tank or container to another container shall be separated from other operations that might represent an ignition source by distance or by fire resistant construction. Drainage or other means shall be provided to control spills. Natural or mechanical ventilation shall be provided in accordance with 5-3.3, "Ventilation." (NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*, provides information on the design and installation of mechanical ventilation.)

5–4.4 Loading and Unloading Operations.

5–4.4.1 Tank Vehicles and Tank Cars.

5–4.4.1.1 Tank vehicle and tank car loading or unloading facilities shall be separated from aboveground tanks, warehouses, other plant buildings, or the nearest line of adjoining property that can be built upon by a distance of at least 25 ft (7.6 m) for Class I liquids and at least 15 ft (4.6 m) for Class II and Class III liquids, measured from the nearest fill spout or (liquid or vapor) transfer connection. These distances may be reduced by utilizing fixed fire protection systems, dikes, fire-rated barriers, or combinations of any of these. Buildings for pumps or shelters for personnel may be a part of the facility.

5–4.4.1.2 Static Protection. Bonding facilities for protection against static sparks during the loading of tank vehicles through open domes shall be provided (a) where Class I liquids are loaded, or (b) where Class II or Class III liquids are loaded into vehicles that may contain vapors from previous cargoes of Class I liquids.

5–4.4.1.3 Protection as required in 5–4.4.1.2 shall consist of a metallic bond wire permanently electrically connected to the fill stem or to some part of the rack structure in electrical contact with the fill stem. The free end of such wire shall be provided with a clamp or equivalent device for convenient attachment to some metallic part in electrical contact with the cargo tank of the tank vehicle.

5–4.4.1.4 Such bonding connection shall be made to the vehicle or tank before dome covers are raised and shall remain in place until filling is completed and all dome covers have been closed and secured.

5–4.4.1.5 Bonding, as specified in 5–4.4.1.2, 5–4.4.1.3, and 5–4.4.1.4, is not required:

(a) Where vehicles are loaded exclusively with products not having a static accumulating tendency, such as asphalts (including cutback asphalts), most crude oils, residual oils, and water-soluble liquids

(b) Where no Class I liquids are handled at the loading facility and the tank vehicles loaded are used exclusively for Class II and Class III liquids

(c) Where vehicles are loaded or unloaded through closed-bottom or -top connections whether the hose or pipe is conductive or nonconductive.

5–4.4.1.6 Filling through open domes into the tanks of tank vehicles or tank cars that contain vapor-air mixtures within the flammable range, or where the liquid being filled can form such a mixture, shall be by means of a downspout that extends near the bottom of the tank. This precaution is not required when loading liquids that are nonaccumulators of static charges. (NFPA 77, *Recommended Practice on Static Electricity*, provides additional information on static electricity protection.)

5–4.4.1.7 Stray Currents. To protect against stray currents, tank car facilities where flammable and combustible liquids are loaded or unloaded through open domes shall be protected by permanently bonding the fill pipe to at least one rail and to the rack structure, if of metal. Multiple pipes entering the rack area shall be permanently bonded together. In addition, in areas where excessive stray currents are known to exist, all pipes entering the rack area shall be provided with insulating sections to electrically isolate the rack piping from the pipelines. These precautions are not necessary where Class II or Class III liquids are handled exclusively and there is no probability that tank cars will contain vapors from previous cargoes of Class I liquids.

5–4.4.1.8 Equipment such as piping, pumps, and meters used for the transfer of Class I liquids between storage tanks and the fill stem of the loading rack shall not be used for the transfer of Class II or Class III liquids.

Exception No. 1: This provision shall not apply to water-miscible liquids where the class is determined by the concentration of liquid in water.

Exception No. 2: This provision shall not apply where the equipment is cleaned between transfers.

5–4.4.1.9 Remote pumps located in underground tanks shall have a listed leak-detection device installed on the pump discharge side that will indicate if the piping system is not essentially liquidtight. This device shall be checked and tested at least annually according to the manufacturer's specifications to ensure proper installation and operation.

5–4.4.1.10 When top loading a tank vehicle with Class I or Class II liquids without a vapor control system, valves used for the final control of flow shall be of the self-closing type and shall be manually held open except where automatic means are provided for shutting off the flow when the vehicle is full. Automatic shutoff systems shall be provided with a manual shutoff valve located at a safe distance from the loading nozzle to stop the flow if the automatic system fails. When top loading a tank vehicle with vapor control, flow control shall be in accordance with 5–4.4.1.11 and 5–4.4.1.12.

5–4.4.1.11 When bottom loading a tank vehicle with or without vapor control, a positive means shall be provided for loading a predetermined quantity of liquid, together with a secondary automatic shutoff control to prevent overfill. The connecting components between the loading rack

and the tank vehicle required to operate the secondary control shall be functionally compatible. The connection between the liquid loading hose or pipe and the truck piping shall be by means of a dry disconnect coupling.

5-4.4.1.12 When bottom loading a tank vehicle that is equipped for vapor control, but when vapor control is not used, the tank shall be vented to the atmosphere, at a height not lower than the top of the cargo tank of the vehicle, to prevent pressurization of the tank. Connections to the plant vapor control system shall be designed to prevent the escape of vapor to the atmosphere when not connected to a tank vehicle.

5-4.4.2 Wharves.

5-4.4.2.1 This section shall apply to all wharves, except marine service stations as covered in NFPA 30A, *Automotive and Marine Service Station Code*. If liquids are handled in bulk quantities across general purpose piers or wharves, NFPA 307, *Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves*, shall be followed.

5-4.4.2.2 Handling packaged cargo of liquids, including full and empty drums, bulk fuel, and stores, over a wharf during cargo transfer shall be subject to the approval of the wharf supervisor and the senior deck officer on duty.

5-4.4.2.3 Wharves at which liquid cargoes are to be transferred in bulk quantities to or from tank vessels shall be at least 100 ft (30 m) from any bridge over a navigable waterway or from an entrance to or superstructure of any vehicular or railroad tunnel under a waterway. The termination of the wharf loading or unloading fixed piping shall be at least 200 ft (60 m) from a bridge or from an entrance to or superstructure of a tunnel.

5-4.4.2.4 Substructure and deck shall be substantially designed for the use intended. Deck may employ any material that will afford the desired combination of flexibility, resistance to shock, durability, strength, and fire resistance. Heavy timber construction is acceptable.

5-4.4.2.5 Tanks used exclusively for ballast water or Class II or Class III liquids may be installed on suitably designed wharves.

5-4.4.2.6 Loading pumps capable of building up pressures in excess of the safe working pressure of cargo hose or loading arms shall be provided with bypasses, relief valves, or other arrangements to protect the loading facilities against excessive pressure. Relief devices shall be tested at least annually to determine that they function satisfactorily at their set pressure.

5-4.4.2.7 All pressure hoses and couplings shall be inspected at intervals appropriate to the service. With the hose extended, the hose and couplings shall be tested using the in-service maximum operating pressure. Any hose showing material deterioration, signs of leakage, or weakness in its carcass or at the couplings shall be withdrawn from service and repaired or discarded.

5-4.4.2.8 Piping, valves, and fittings shall be in accordance with Chapter 3, with the following exceptions and additions.

(a) Flexibility of piping shall be assured by appropriate layout and arrangement of piping supports so that motion of the wharf structure resulting from wave action, currents, tides, or the mooring of vessels will not subject the pipe to excessive strain.

(b) Pipe joints that depend on the friction characteristics of combustible materials or on the grooving of pipe ends for mechanical continuity of piping shall not be permitted.

(c) Swivel joints may be used in piping to which hoses are connected, and for articulated swivel-joint transfer systems, provided the design is such that the mechanical strength of the joint will not be impaired if the packing materials should fail, as by exposure to fire.

(d) Each line conveying Class I or Class II liquids leading to a wharf shall be provided with a readily accessible block valve located on shore near the approach to the wharf and outside of any diked area. Where more than one line is involved, the valves shall be grouped in one location.

(e) Means shall be provided for easy access to cargo line valves located below the wharf deck.

5-4.4.2.9 Pipelines on wharves shall be adequately bonded and grounded if Class I or Class II liquids are handled. If excessive stray currents are encountered, insulating joints shall be installed. Bonding and grounding connections on all pipelines shall be located on the wharf side of hose riser insulating flanges, if used, and shall be accessible for inspection.

5-4.4.2.10 Hose or articulated swivel-joint pipe connections used for cargo transfer shall be capable of accommodating the combined effects of change in draft and maximum tidal range, and mooring lines shall be kept adjusted to prevent surge of the vessel from placing stress on the cargo transfer system. Hose shall be supported to avoid kinking and damage from chafing.

5-4.4.2.11 Material shall not be placed on wharves in such a manner as to obstruct access to fire fighting equipment or important pipeline control valves. Where the wharf is accessible to vehicle traffic, an unobstructed roadway to the shore end of the wharf shall be maintained for access of fire fighting apparatus.

5-4.4.2.12 Loading or unloading shall not commence until the wharf supervisor and the person in charge of the tank vessel agree that the tank vessel is properly moored and all connections are properly made.

5-4.4.2.13 Mechanical work shall not be performed on the wharf during cargo transfer, except under special authorization based on a review of the area involved, methods to be employed, and precautions necessary.

5-5 Vapor Recovery and Vapor Processing Systems.

5-5.1 Scope.

5-5.1.1 This section shall apply to vapor recovery and vapor processing systems where:

(a) The vapor source operates at pressures from vacuum up to and including 1 psig (6.9 kPa).

(b) There is a potential for vapor mixtures in the flammable range.

5-5.1.2 This section does not apply to:

(a) Marine systems complying with U.S. DOT Regulations 33CFR Parts 154, 155, 156, and U.S. Coast Guard Regulations 46CFR Parts 30, 32, 35, 39.

(b) Service station systems complying with NFPA 30A.

5-5.2 Overpressure/Vacuum Protection. Tanks and equipment shall have independent venting for overpressure or vacuum conditions that might occur from malfunction of the vapor recovery or vapor processing system.

Exception: For tanks, venting complying with 2-3.5 or 2-3.6.

5-5.3 Vent Location.

5-5.3.1 Vents on vapor processing systems shall be not less than 12 ft (3.6 m) from adjacent ground level, with outlets located and directed so that flammable vapors will disperse to below LFL before reaching locations containing potential ignition sources.

5-5.3.2 Vapor processing equipment and vents shall be located in accordance with 5-3.1.

5-5.4 Vapor Collection Systems.

5-5.4.1 Piping. Vapor collection piping shall be designed to prevent trapped liquid.

5-5.4.2 Liquid Carryover Protection. Vapor recovery and vapor processing systems that are not designed to handle liquid shall be provided with a means to eliminate any liquid that carries over to or condenses in the vapor collection system.

5-5.4.3* Liquid Level Monitoring.

(a) A liquid knock-out vessel used in the vapor collection system shall have means to verify the liquid level and a high liquid level sensor that activates an alarm.

(b) For unmanned facilities, the high liquid level sensor shall initiate the shut down of liquid transfer into the vessel and shutdown of vapor recovery or vapor processing systems.

5-5.5 Overfill Protection.

5-5.5.1 Storage tanks served by vapor processing or vapor recovery systems shall be equipped with overfill protection in accordance with Section 2-10.

5-5.5.2 Overfill protection of tank vehicles shall be in accordance with 5-4.4.1.10, 5-4.4.1.11, and 5-4.4.1.12.

5-5.6 Sources of Ignition.

5-5.6.1 Vapor Release. Tank or equipment openings provided for purposes of vapor recovery shall be protected against possible vapor release in accordance with 2-4.6.6, 2-5.4.9, 5-4.4.1.11, and 5-4.4.1.12.

5-5.6.2* Electric. Electrical area classification shall be in accordance with 5-3.5.

5-5.6.3* Static Electricity. Vapor collection and vapor processing equipment shall be protected against static electricity in accordance with 5-6.2.4.

5-5.6.4* Spontaneous Ignition. Where there is the potential for spontaneous ignition, precautions shall be taken either by design or written procedures to prevent ignition.

5-5.6.5* Friction Heat or Sparks from Mechanical Equipment. Mechanical equipment used to move vapors that are in the flammable range shall be designed to prevent sparks or other ignition sources under both normal and equipment malfunction conditions.

5-5.6.6* Flame Propagation. Where there is reasonable potential for ignition of a vapor mix in the flammable range, means shall be provided to stop the propagation of flame through the vapor collection system. The means chosen shall be appropriate for the conditions under which they will be used.

5-5.6.7 Explosion Protection. Where used, explosion protection systems shall comply with NFPA 69, *Standard on Explosion Prevention Systems*.

5-5.7 Emergency System Shutdown. Emergency shutdown systems shall be designed to fail to a safe position in the event of loss of normal system power (i.e., air or electric) or equipment malfunction.

5-6 Fire Prevention and Control.

5-6.1 General.

5-6.1.1 This section covers the commonly recognized management control systems and methods used to prevent or minimize the loss from fire or explosion in liquid processing facilities.

NOTE: Other recognized factors of fire prevention and control, involving construction, location, separation, etc., are covered elsewhere in this chapter.

5-6.1.2 The wide range in size, design, and location of liquid processing facilities precludes the inclusion of detailed fire prevention and control systems and methods applicable to all such facilities. The authority having jurisdiction shall be consulted on specific cases, where applicable; otherwise, qualified engineering judgment shall be exercised per 5-6.1.3.

5-6.1.3 The extent of fire prevention and control provided for the liquid processing facility shall be determined by an engineering evaluation of the operation, followed by the application of sound fire protection and process engineering principles. The evaluation shall include, but not be limited to:

(a) Analysis of fire and explosion hazards of the liquid operations

(b) Analysis of hazardous materials, hazardous chemicals or hazardous reactions in the operations and the safeguards taken to control such materials, chemicals, or reactions

(c) Analysis of facility design requirements in Section 5-3

(d) Analysis of the liquid handling, transfer, and use requirements in Section 5-4

(e) Analysis of local conditions, such as exposure to and from adjacent properties, flood potential, or earthquake potential

(f) Consideration of fire department or mutual aid response.

5-6.2 Control of Ignition Sources.

5-6.2.1 Precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include, but are not limited to:

(a) Open flames

(b) Lightning

(c) Hot surfaces

(d) Radiant heat

(e) Smoking

(f) Cutting and welding

(g) Spontaneous ignition

(h) Frictional heat or sparks

(i) Static electricity

(j) Electrical sparks

(k) Stray currents

(l) Ovens, furnaces, and heating equipment.

5-6.2.2 Smoking shall be permitted only in designated and properly identified areas.

5-6.2.3 Welding, cutting, and similar spark-producing operations shall not be permitted in areas containing flammable liquids until a written permit authorizing such work has been issued. The permit shall be issued by a person in authority following his/her inspection of the area to assure that proper precautions have been taken and will be followed until the job is completed. (*See NFPA 51B, Standard for Fire Prevention in Use of Cutting and Welding Processes.*)

5-6.2.4 Static Electricity. All equipment, such as tanks, machinery, and piping, where an ignitable mixture may be present shall be bonded or connected to a ground. The bond or ground or both shall be physically applied or shall be inherently present by the nature of the installation. Electrically isolated sections of metallic piping or equipment shall be bonded to the other portions of the system or individually grounded to prevent hazardous accumulations of static electricity. (NFPA 77, *Recommended Practice on Static Electricity*, provides information on this subject.)

5-6.3 Inspection and Maintenance.

5-6.3.1 All fire protection equipment shall be properly maintained, and periodic inspections and tests shall be done in accordance with both standard practice and equipment manufacturer's recommendations.

5-6.3.2 Maintenance and operating practices shall control leakage and prevent spillage of flammable liquids.

5-6.3.3 Combustible waste material and residues in operating areas shall be kept to a minimum, stored in covered metal containers, and disposed of daily.

5-6.3.4 Ground areas around facilities where liquids are stored, handled, or used shall be kept free of weeds, trash, or other unnecessary combustible materials.

5-6.3.5 Aisles established for movement of personnel shall be maintained clear of obstructions to permit orderly evacuation and ready access for manual firefighting activities.

5-6.4 Emergency Planning and Training.

5-6.4.1 An emergency action plan, consistent with the available equipment and personnel, shall be established to respond to fire or other emergencies. This plan shall include the following.

(a) Procedures to be used in case of fire, such as sounding the alarm, notifying the fire department, evacuating personnel, and controlling and extinguishing the fire

(b) Appointment and training of persons to carry out firesafety duties

(c) Maintenance of fire protection equipment

(d) Holding fire drills

(e) Shutdown or isolation of equipment to reduce the escape of liquid

(f) Alternate measures for the safety of occupants while any fire protection equipment is shut down.

5-6.4.2 Personnel responsible for the use and operation of fire protection equipment shall be trained in the use of that equipment. Refresher training shall be conducted at least annually.

5-6.4.3 Planning of effective fire control measures shall be coordinated with local emergency response agencies.

5-6.4.4 Procedures shall be established to provide for safe shutdown of operations under emergency conditions. Provisions shall be made for periodic training, inspection, and testing of associated alarms, interlocks, and controls.

5-6.4.5 The emergency procedure shall be kept readily available in an operating area and updated regularly.

5-6.4.6 Where premises are likely to be unattended for considerable periods of time, a summary of the emergency plan shall be posted or located in a strategic and accessible location.

5-6.5 Detection and Alarm.

5-6.5.1 An approved means for prompt notification of fire or emergency to those within the plant and to the available public or mutual aid fire department shall be provided.

5-6.5.2 Those areas, including buildings, where a potential exists for a flammable liquid spill shall be monitored as appropriate. Some methods may include:

(a) Personnel observation or patrol

(b) Process monitoring equipment that would indicate a spill or leak may have occurred

(c) Provision of gas detectors to continuously monitor the area where facilities are unattended.

5-6.6 Portable Fire-Control Equipment.

5-6.6.1 Listed portable fire extinguishers shall be provided for facilities in such quantities, sizes, and types as may be needed for the special hazards of operation and storage as determined per 5-6.1.3. (NFPA 10, *Standard for Portable Fire Extinguishers*, provides information on the suitability of various types of extinguishers.)

5-6.6.2 When the need is indicated per 5-6.1.3, water may be utilized through standpipe and hose systems (*see NFPA 14, Standard for the Installation of Standpipe and Hose Systems*) or through hose connections from sprinkler systems using combination spray and straight stream nozzles to permit effective fire control (*see NFPA 13, Standard for the Installation of Sprinkler Systems*).

5-6.6.3 When the need is indicated per 5-6.1.3, mobile foam apparatus shall be provided. NFPA 11C, *Standard for Mobile Foam Apparatus*, provides information on the subject.

5-6.6.4 Automotive and trailer-mounted fire apparatus, where determined necessary, shall not be used for any purpose other than fire fighting.

5-6.7 Fixed Fire Control Equipment.

5-6.7.1 A reliable water supply or other suitable fire control agent shall be available in pressure and quantity to meet the fire demands indicated by the special hazards of operation, storage, or exposure as may be determined by 5-6.1.3.

5-6.7.2 Hydrants, with or without fixed monitor nozzles, shall be provided in accordance with accepted practice. The number and placement will depend on the hazard of the liquid-processing facility, storage, or exposure as may be determined by 5-6.1.3. (*See NFPA 24, Standard for the Installation of Private Fire Service Mains and Their Appurtenances, for information on this subject.*)

5-6.7.3 Where the need is indicated by the hazards of liquid processing, storage, or exposure as determined by 5-6.1.3, fixed protection may be required utilizing approved sprinkler systems, water spray systems, deluge systems, fire resistive materials, or a combination of these. (*See NFPA 13, Standard for the Installation of Sprinkler Systems, and NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection, for information on these subjects.*)

5-6.7.4 The following fire control systems may be appropriate for the protection of specific hazards as determined per 5-6.1.3. If provided, such systems shall be designed, installed, and maintained in accordance with the following NFPA standards:

(a) NFPA 11, *Standard for Low Expansion Foam and Combined Agent Systems*,

(b) NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*,

(c) NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*,

(d) NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*,

(e) NFPA 12B, *Standard on Halon 1211 Fire Extinguishing Systems*,

(f) NFPA 16, *Standard on the Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems*,

(g) NFPA 17, *Standard for Dry Chemical Extinguishing Systems*.

Chapter 6 Referenced Publications

6-1 The following documents or portions thereof are referenced within this code and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

6-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 11, *Standard for Low Expansion Foam and Combined Agent Systems*, 1988 edition.

NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*, 1988 edition.

NFPA 11C, *Standard for Mobile Foam Apparatus*, 1990 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 1993 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 1992 edition.

NFPA 12B, *Standard on Halon 1211 Fire Extinguishing Systems*, 1990 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1991 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 1993 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 1990 edition.

NFPA 16, *Standard on the Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems*, 1991 edition.

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, 1990 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 1992 edition.

NFPA 30A, *Automotive and Marine Service Station Code*, 1993 edition.

NFPA 31, *Standard for the Installation of Oil-Burning Equipment*, 1992 edition.

NFPA 32, *Standard for Drycleaning Plants*, 1990 edition.

NFPA 33, *Standard for Spray Application Using Flammable and Combustible Materials*, 1989 edition.

NFPA 34, *Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids*, 1989 edition.

NFPA 35, *Standard for the Manufacture of Organic Coatings*, 1987 edition.

NFPA 36, *Standard for Solvent Extraction Plants*, 1993 edition.

NFPA 37, *Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines*, 1990 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 1991 edition.

NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*, 1989 edition.

NFPA 69, *Standard on Explosion Prevention Systems*, 1992 edition.

NFPA 70, *National Electrical Code*, 1993 edition.

NFPA 80, *Standard for Fire Doors and Fire Windows*, 1992 edition.

NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*, 1993 edition.

NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*, 1992 edition.

NFPA 99, *Standard for Health Care Facilities*, 1993 edition.

NFPA *101*, *Life Safety Code*, 1991 edition.

NFPA 220, *Standard on Types of Building Construction*, 1992 edition.

NFPA 231, *Standard for General Storage*, 1990 edition.

NFPA 231C, *Standard for Rack Storage of Materials*, 1991 edition.

NFPA 251, *Standard Methods of Fire Tests of Building Construction and Materials*, 1990 edition.

NFPA 307, *Standard for the Construction and Fire Protection of Marine Terminals, Piers, and Wharves*, 1990 edition.

NFPA 385, *Standard for Tank Vehicles for Flammable and Combustible Liquids*, 1990 edition.

NFPA 386, *Standard for Portable Shipping Tanks for Flammable and Combustible Liquids*, 1990 edition.

NFPA 395, *Standard for the Storage of Flammable and Combustible Liquids at Farms and Isolated Sites*, 1993 edition.

NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Maintenance, and Operation*, 1992 edition.

NFPA 704, *Standard System for the Identification of the Fire Hazards of Materials*, 1990 edition.

6-1.2 Other Publications.

6-1.2.1 ANSI Publications. American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

ANSI B31, *American National Standard Code for Pressure Piping*.

ANSI B31.3-80, *Petroleum Refinery Piping*.

ANSI B31.4-79, *Liquid Petroleum Transportation Piping Systems*.

ANSI/UL 1313-83, *Nonmetallic Safety Cans for Petroleum Products*.

6-1.2.2 API Publications. American Petroleum Institute, 1220 L Street, N.W., Washington, DC 20005.

API 12B, *Bolted Tanks for Storage of Production Liquids*, Twelfth Edition, January, 1977.

API 12D, *Field Welded Tanks for Storage of Production Liquids*, Eighth Edition, January, 1982.

API 12F, *Shop Welded Tanks for Storage of Production Liquids*, Seventh Edition, January, 1988.

API 650, *Welded Steel Tanks for Oil Storage*, Eighth Edition, 1988.

API 2000, *Venting Atmospheric and Low-Pressure Storage Tanks*, 1982.

6-1.2.3 ASME Publication. American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017.

ASME, *Boiler and Pressure Vessel Code*.

6-1.2.4 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM A 395-88, *Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures*.

ASTM D 56-87, *Standard Method of Test for Flash Point by the Tag Closed Cup Tester*.

ASTM D 93-85, *Standard Method of Test for Flash Point by the Pensky-Martens Closed Tester*.

ASTM D 3278-82, *Standard Method of Tests for Flash Point of Liquids by Setaflash Closed Tester*.

ASTM D 3828-87, *Standard Test Methods for Flash Point by Setaflash Closed Tester*.

ASTM D 5-86, *Test for Penetration for Bituminous Materials*.

ASTM D 92-85, *Cleveland Open Cup Test Method*.

ASTM D 323-89, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)*.

ASTM/ANSI D 3435-80, *Plastic Containers (Jerry Cans) for Petroleum Products*.

ASTM D 4021-86, *Standard Specification for Glass-Fiber Reinforced Polyester Underground Petroleum Storage Tanks*.

ASTM F 852-86, *Standard for Portable Gasoline Containers for Consumer Use*.

ASTM F 976-86, *Standard for Portable Kerosine Containers for Consumer Use*.

6-1.2.5 ATA Publication. American Trucking Association-Traffic Department, 2200 Mill Road, Alexandria, VA 22314.

National Motor Freight Classification.

6-1.2.6 NRFC Publication. National Railroad Freight Committee, 222 South Riverside Plaza, Chicago, IL 60606-5945.

Uniform Freight Classification.

6-1.2.7 STI Publication. Steel Tank Institute, 728 Anthony Trail, Northbrook, IL 60062.

sti-P_3-1987, *sti-P_3 Specification and Manual for External Corrosion Protection of Underground Steel Storage Tanks*.

6-1.2.8 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062.

UL 58-1986, *Standard for Steel Underground Tanks for Flammable and Combustible Liquids*.

UL 80-1980, *Standard for Steel Inside Tanks for Oil Burner Fuel*.

UL 142-1987, *Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids*.

UL 842-1980, *Standard for Valves for Flammable Fluids*.

UL 1316-1983, *Standard for Glass-Fiber Reinforced Plastic Underground Storage Tanks for Petroleum Products*.

6-1.2.9 U.S. Government Publication. U.S. Government Printing Office, Washington, DC 20402.

Code of Federal Regulations, Title 49, Transportation.

Appendix A Explanatory Material

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

A-2-3.6.7 Exception. Ethyl alcohol (ethanol) has a heat of combustion of 11,548 Btu/lb (26.8 millJoules per kg) and a rate of burning of 0.000626 lbs/sq ft per sec (0.015 Kg m^2 sec). The burning rate was calculated based on pan pool fires of diameters between 0.7 and 16.5 ft (0.2 to 5.0 m). The pool fires were burning at steady state in a wind-free environment. The ratio of the lip height of the pan (freeboard) to the diameter of the pan was approximately 0.06. Details of these tests may be found in "Fire Tests of Distilled Spirit Storage Tanks." Client Report CR-5727.1, for the Association of Canadian Distillers.

A-2-5 Section 2-5 provides an approach that allows considerable flexibility for compliance without compromising fire safety, while fostering ingenuity in application of fire safety principles to achieve the intended objectives, outlined in the performance criteria set out at the beginning of each subsection. Each subsection has been written with the first sentence outlining the performance criteria which, if implemented, would achieve compliance with that subsection. In order to clarify the intent of each performance criterion, the subsequent paragraphs constitute one method of achieving compliance with the intent envisioned in the performance requirements. It is recognized that other combinations of requirements may also be used to meet the intent of the performance criteria, provided such requirements are acceptable to the authority having jurisdiction.

A-3-6 Buried steel piping should be coated with a suitable material and should be cathodically protected. Galvanized steel pipe, by itself and without other corrosion protection methods, is not acceptable for underground piping. Steel swing joints and stainless steel flexible connectors should also be made corrosion resistant when in contact with the soil. Thus, such fittings should also be coated and cathodically protected when installed between nonmetallic, compatible tanks and piping, such as fiberglass reinforced plastic.

A-3-9 Where loading and unloading risers for Class II or Class IIIA liquids are located in the same immediate area as loading and unloading risers for Class I liquids, consideration should be given to providing positive means, such as different pipe sizes, connection devices, special locks, or other methods designed to prevent the erroneous transfer of Class I liquids into or from any container or tank used for Class II or Class IIIA liquids.

Exception No. 1: This provision need not apply to water-miscible liquids where the class is determined by the concentration of liquid in water.

Exception No. 2: This provision need not apply where the equipment is cleaned between transfers.

A-4-3.2 Venting of storage cabinets has not been demonstrated to be necessary for fire protection purposes. Additionally, venting a cabinet could compromise the ability of the cabinet to adequately protect its contents from involvement in a fire since cabinets are not generally tested with any venting. Therefore, venting of storage cabinets is not recommended.

However, it is recognized that some jurisdictions may require storage cabinets to be vented and that venting may also be desirable for other reasons, such as health and safety. In such cases, the venting system should be installed so as to not affect substantially the desired performance of the cabinet during a fire. Means of accomplishing this may include thermally actuated dampers on the vent openings or sufficiently insulating the vent piping system to prevent the internal temperature of the cabinet from rising above that specified. Any make-up air to the cabinet should also be arranged in a similar manner.

If vented, the cabinet should be vented from the bottom with make-up air supplied to the top. Also, mechanical exhaust ventilation is preferred and should comply with NFPA 91, *Standard for Exhaust Systems for Air Conveying of Materials*. Manifolding the vents of multiple storage cabinets should be avoided.

A-4-4.2.7 The appropriate height for sills, curbs, or ramps will depend on a number of factors, including the maximum expected spill volume, the floor area, and the existence of any drainage systems. Historically, curbs and sills have been 4 in. (10 cm) high. A variety of ramp, curb, or sill heights can be used to obtain the desired containment volume in each containment area. As a guide, 1 sq ft area of water at a 1 in. height equals 0.62 gal (2.35 L). Once the total quantity of necessary liquid containment has been established, the necessary ramp, curb, or sill heights can then be calculated. Where open-grated trenches are used, the volume of the trench should be able to contain the maximum expected spill volume or otherwise be connected to a properly designed drainage system.

A-4-4.2.8 Sprinkler water can transport burning liquids to unaffected areas, including underneath other storage piles or racks, further spreading the fire. It is therefore important to control the flow of liquids, including sprinkler water, and safely remove it from the affected area.

This may be accomplished by using one or more of the following:

(a) Noncombustible, liquidtight raised sills, curbs, or ramps of suitable height at exterior openings.

(b) Interior, noncombustible and liquidtight raised sills, curbs, or other flow diverting structures.

(c) Sloped floors.

(d) Open-grated trenches or floor drains connected to a properly designed drainage system.

(e) Wall scuppers discharging to a safe location or a properly designed drainage system.

(f) Other means acceptable to the authority having jurisdiction.

Drainage systems, including trenches, drains, and wall scuppers themselves, should be designed to handle the expected flow rate of water from sprinklers and hose streams. Otherwise, burning liquids may spread throughout the storage area and potentially into other unaffected

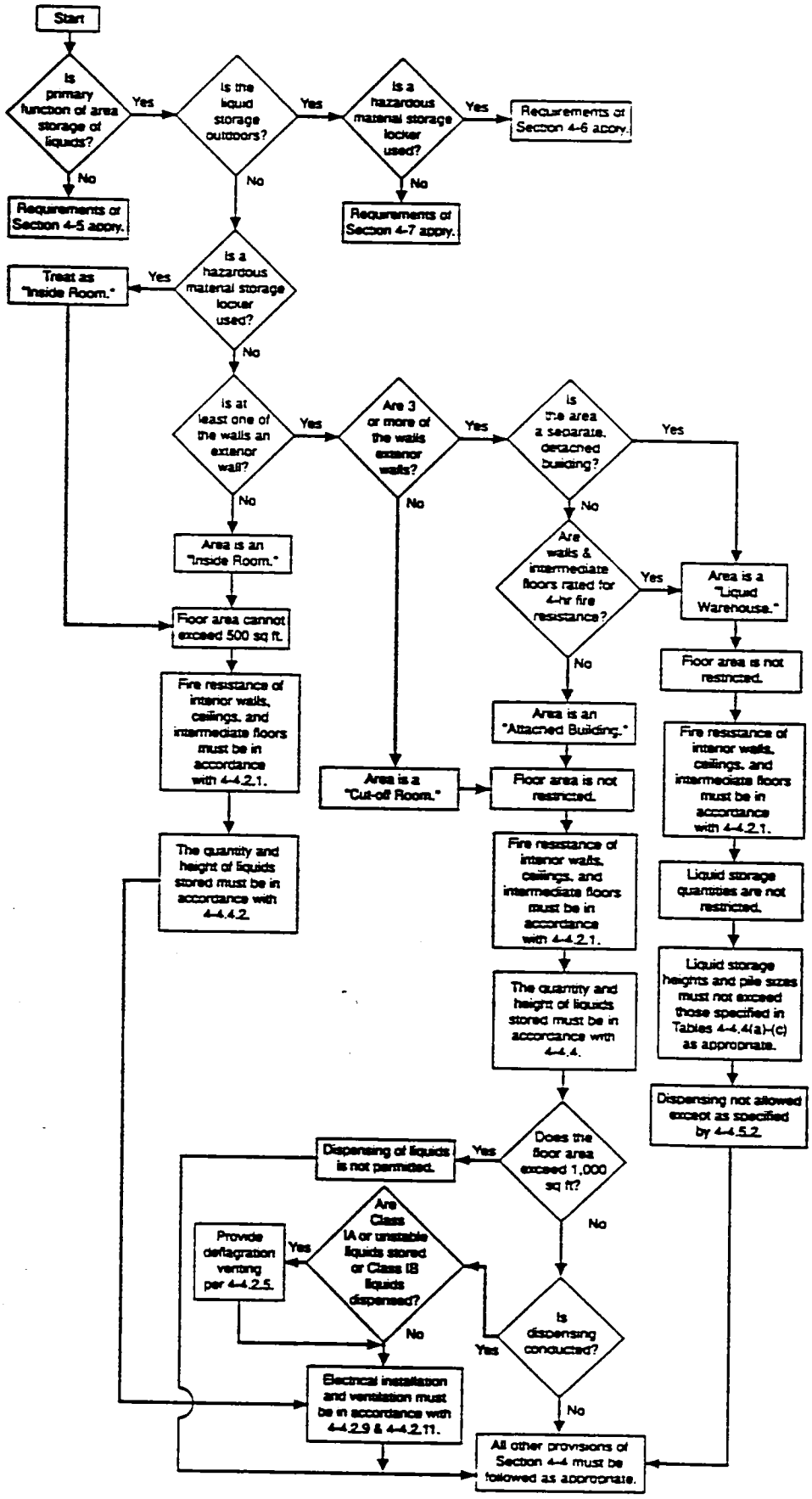

Figure A-4-4(a) Guide to application of Chapter 4, "Container and Portable Tank Storage."

areas. The drainage systems should also terminate in a safe location so as to not subsequently expose other important facilities, adjoining property, or important natural resources. Such "safe locations" may be specially designed containment basins, sumps, pits, collection tanks, waste treatment facilities, or other locations able to safely contain the discharge liquids. Since in nearly all cases it is impractical to size such locations based on the maximum possible operating time of sprinklers and hose streams, it is common practice to base the size on sprinklers and hose streams operating for a specified period of time. The appropriate period of time depends on the particular situation and the potential consequences of exceeding the determined volume. Evaluation of the potential consequences should include consideration of the following:

(a) Properties and hazards of materials in liquid storage area

(b) Type and design of fire protection system(s), including expected flow rates

(c) Surrounding topography and surface (soil type)

(d) Proximity to other important buildings, adjoining property, and critical natural resources

(e) Contingency plans (or backup systems) and the availability of resources to implement

(f) Capabilities and response time of emergency responders

(g) Other applicable codes and regulations.

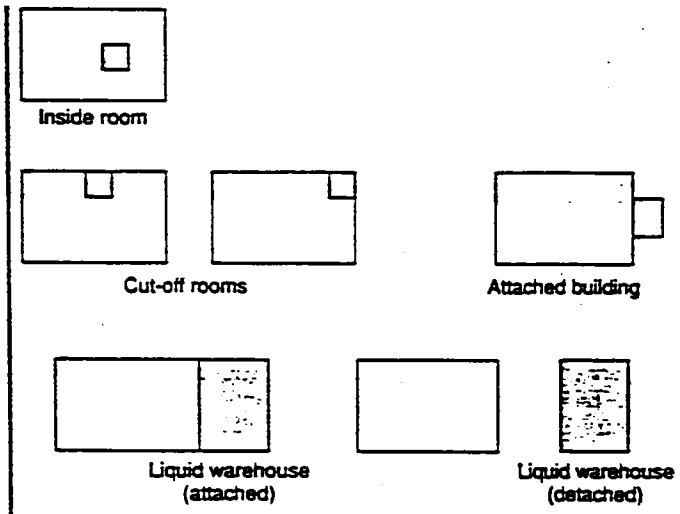

Figure A-4-4(b) Examples of the various inside liquid storage areas. Shaded areas are the liquid storage areas.

A-4-4.4.1 Exception. Other arrangements include, but are not limited to, increases in pile height, pile size, or maximum total quantity stored, or use of multiple-row racks or high-rise warehouses.

A-4-5.2.4 Exception No. 2 Based on work done by the Factory Mutual Research Corp., it was determined that flammable liquids in plastic containers could cause uncontrollable fires under certain conditions of storage in general purpose warehouses. A research project on flammable liquids container storage carried out by Underwriters Laboratories Inc., under the auspices of the National Fire Protection Research Foundation, has suggested a test protocol that can judge the capability of packaging systems to withstand a small ignition source or to minimize the rate at which the lading is released from the containers, so that the fire can be controlled by automatic sprinklers.

There is currently no nationally recognized consensus standard for conducting such tests.

A-4-5.6.1 Table A-4-5.6.1 can be consulted for guidance in determining amounts of storage permitted in mercantile establishments.

Maximum total quantities permitted should be limited to the sum of proportional amounts that each class of liquid present bears to the maximum total permitted for its respective class. The sum of proportional amounts should not exceed 100 percent.

A-4-6 Environmental concerns have dictated special handling of hazardous materials, chemicals, and wastes. Some of these have flammable and combustible liquid characteristics, in addition to their environmental and health problems, thus causing some questions as to how they should be stored and handled.

Several manufacturers have met this problem by designing and manufacturing movable, modular prefabricated storage lockers — working diligently with various building officials and authorities having jurisdiction. This results in a product that is intended to meet government standards and regulations for hazardous materials storage. Several municipalities have passed model ordinances covering the design, construction, and location of hazardous materials storage lockers. Design features can include but are not limited to the following:

(a) Secondary spill containment sumps

(b) Deflagration venting

(c) Ventilation requirements, including mechanical ventilation where dispensing operations are expected

(d) Electrical equipment for hazardous locations in accordance with NFPA 70, *National Electrical Code*

(e) Static electricity control

(f) Fire suppression systems (dry chemical or sprinklers)

(g) Heavy structural design for:

1. Security provisions
2. Doors that lock and permit pallet loading
3. Wind load, snow load, and storage load conditions
4. Anchorage provisions
5. Skid design, permitting relocation using lift trucks

(h) Fire rated exterior walls, if required

(i) Interior partitions to segregate incompatible materials

Table A-4-5.6 Allowable Storage Amounts, Mercantile Occupancies for Areas Accessible and Not Accessible to the Public

Level of Protection	Class IA[1]		Classes IB, IC, II, and IIIA Any Combination[1]	
	Gal/Ft²	Max. Qty. (Gal)	Gal/Ft²	Max. Qty. (Gal)
Protected per 4-5.6.1(a)				
Ground floor	N/A	120	4	
Basement, other floor	0	0	4	7,500
Protected per 4-5.6.1(f) or 4-5.6.2(c)				
Ground floor	N/A	240	4	
Basement, other floor	0	0	4	15,000
Unprotected				
Ground floor	N/A	120	2	
Basement, other floors	0	0	1	7,500

[1]Areas accessible to the public or not accessible to the public.
N/A = Not Applicable.

(j) Size limits to limit quantities that may be stored within preassembled or ready-to-assemble designs

(k) Nonsparking floors

(l) Shelving, if required

(m) Heating or cooling units, if needed

(n) Corrosion protection as required

(o) Employee safety provisions (eye/face wash)

(p) NFPA 704 hazard symbols.

Features provided are determined by specific storage requirements and needs of the owner, keeping in mind applicable regulations and ordinances that apply and the approval requirements of the authority having jurisdiction.

Several testing laboratories have developed internal procedures for the examination, testing, and listing or labeling of hazardous material storage lockers submitted by manufacturers.

A-4-8.8 The indiscriminate mixed storage of materials that have a high toxicity or high reactivity hazard that are also flammable liquids is a practice that might result in either a catastrophic release of toxic materials or an explosion. (See also 1-1.4.)

A-5-4.2 Where the vapor space of equipment is usually within the flammable range, the probability of explosion damage to the equipment can be limited by inerting, by providing an explosion suppression system, or by designing the equipment to contain the peak explosion pressure that can be modified by explosion relief. Where the special hazards of operation, sources of ignition, or exposures indicate a need, consideration should be given to providing protection by one or more of the above means.

See NFPA 68, *Guide for Venting of Deflagrations*, and NFPA 69, *Standard on Explosion Prevention Systems*, for additional information on various methods of mitigating losses from explosions.

A-5-5.4.3 If the liquid knock-out vessel utilizes a pump for automatic liquid removal, consideration should be given to a low-level alarm and shutdown to avoid running the pump dry, resulting in a potential source of ignition.

A-5-5.6.2 Electrical enclosures that need to be opened frequently for maintenance (i.e., enclosures housing vapor processing system controls) have a higher potential for mechanical damage that could render the enclosures unable to contain an explosion. Additional inspection might be needed to ensure the integrity of the enclosure.

A-5-5.6.3 The most recent edition of American Petroleum Institute Recommended Practice 2003, *Protection Against Ignition Arising Out of Static, Lightning, and Stray Currents*, can be used as a reference for protections against static ignition.

A-5-5.6.4 Spontaneous ignition may be a problem in:

(a) Facilities where pyrophoric deposits can accumulate from the handling of oxygen-deficient vapors containing sulfur compounds or asphaltic materials. When air is introduced into the system, the pyrophoric materials can react, resulting in potential ignition and fire.

(b) Facilities that handle fluids in such a way that mixing of hypergolic or otherwise incompatible materials may occur. Such mixing could occur with fluids remaining in the vapor recovery system from prior loading activities.

(c) Facilities handling oxygenated hydrocarbons in carbon absorption units. Higher heats of absorption for these types of vapors can potentially lead to overheated carbon beds and increase the chance that an oxidation reaction can be initiated. (For further information, refer to American Petroleum Institute Report, "An Engineering Analysis of the Effects of Oxygenated Fuels on Marketing Vapor Recovery Equipment," September, 1990.)

A-5-5.6.5 Department of Transportation Coast Guard Regulation 33 CFR Part 154, Section 154.826(b), (c), and (d) can be used as a reference for vapor mover designs that minimize the potential for ignition.

A-5-5.6.6 The potential for ignition in the vapor collection system needs to be evaluated on a case-by-case basis.

If ignition occurs, flame propagation in piping systems containing vapor mixtures in the flammable range normally starts with low speed burning (deflagration). As the flame moves through the piping, it accelerates and, within

a short distance, can reach supersonic speeds (detonation). Initial low speed flame propagation can be stopped by flame arresters, liquid seals, or automatic fast-acting valve systems where designed, operated, and tested within the requirements of NFPA 69. Flame propagation can also be stopped for both deflagrations and detonations by use of detonation arresters tested in accordance with U.S. Department of Transportation Coast Guard Regulations 33 CFR Part 154, Appendix A or other procedures acceptable to the authority having jurisdiction, or automatic fast-acting valve systems tested under the appropriate conditions.

Appendix B Emergency Relief Venting for Fire Exposure for Aboveground Tanks

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

The requirements for emergency venting given in Table 2-8 and the modification factors in 2-2.6.7 are derived from a consideration of:

1. Probable maximum rate of heat transfer per unit area
2. Size of tank and the percentage of total area likely to be exposed
3. Time required to bring tank contents to boil
4. Time required to heat unwet portions of the tank shell or roof to a temperature where the metal will lose strength
5. Effect of drainage, insulation, and the application of water in reducing fire exposure and heat transfer.

Table 2-8 is based on a composite curve that is composed of three straight lines when plotted on log-log paper. The curve may be defined in the following manner:

(a) The first straight line is drawn on log-log paper between the point 400,000 Btu/hr, at 20 sq ft (1.858 m^2) exposed surface area and the point 4,000,000 Btu/hr, at 200 sq ft (18.58 m^2) exposed surface area. The equation for this portion of the curve is $Q = 20{,}000A$.

(b) The second straight line is drawn on log-log graph paper between the points 4,000,000 Btu/hr, at 200 sq ft (18.58 m^2) exposed surface area and 9,950,000 Btu/hr, at 1000 sq ft (92.9 m^2) exposed surface area. The equation for this portion of the curve is $Q = 199{,}300A^{0.566}$.

(c) The third straight line is plotted on log-log graph paper between the points 9,950,000 Btu/hr, at 1000 sq ft (92.9 m^2) exposed surface area and 14,090,000 Btu/hr, at 2800 sq ft (260.12 m^2) exposed surface area. The equation for this portion of the curve is $Q = 963{,}400A^{0.338}$.

For areas exceeding 2800 sq ft (260.12 m^2) it has been concluded that complete fire involvement is unlikely, and loss of metal strength from overheating will cause failure in the vapor space before development of maximum possible vapor evolution rate. Therefore, additional venting capacity beyond the vapor equivalent of 14,090,000 Btu/hr (4130 kw) will not be effective or required.

$Q = 20{,}000A$		$Q = 199.300A^{0.566}$		$Q = 963{,}400A^{0.338}$	
A	Q	A	Q	A	Q
20	400,000	200	4,000,000	1,000	10,000,000
30	600,000	250	4,539,000	1,200	10,593,000
40	800,000	300	5,032,000	1,400	11,122,000
50	1,000,000	350	5,491,000	1,600	11,601,000
60	1,200,000	400	5,922,000	1,800	12,040,000
70	1,400,000	500	6,719,000	2,000	12,449,000
80	1,600,000	600	7,450,000	2,400	13,188,000
90	1,800,000	700	8,129,000	2,800	14,000,000
100	2,000,000	800	8,768,000	and over	
120	2,400,000	900	9,372,000		
140	2,800,000	1,000	10,000,000		
160	3,200,000				
180	3,600,000				
200	4,000,000				

For tanks and storage vessels designed for pressures over 1 psig (6.89 kPa), additional venting for exposed surfaces beyond 2800 sq ft (260.12 m^2) is believed to be desirable because, under these storage conditions, liquids are stored close to their boiling points. Therefore, the time to bring the container contents to boiling conditions might not be significant. For these situations a heat input value should be determined on the basis of

$$Q = 21{,}000A^{0.82}$$

The flow capacities are based on the assumption that the stored liquid will have the characteristics of hexane, and the vapor liberated has been transposed to equivalent free air at 60°F (15.6°C) and 14.7 psia (101.3 kPa) by using appropriate factors in:

$$CFH = \frac{70.5Q}{L\sqrt{M}}$$

Where:

70.5 = the factor for converting pounds of gas to cubic feet of air
Q = the total heat input per hour expressed in Btu
L = latent heat of vaporization
M = molecular weight

No consideration has been given to possible expansion from the heating of the vapor above the boiling point of the liquid, its specific heat, or the difference in density between the discharge temperature and 60°F (15.6°C), since some of these changes are compensating.

Since tank vent valves are ordinarily rated in CFH standard air, the figures derived from Table 2-8 may be used with the appropriate tank pressure as a basis for valve selection.

Table B-2 gives for a variety of chemicals the constants that can be used to compute the vapor generated and equivalent free air for liquids other than hexane, where greater exactness is desired. Inspections of the table will show that the use of hexane in deriving Table 2-8 provides results that are within an acceptable degree of accuracy for the listed liquids.

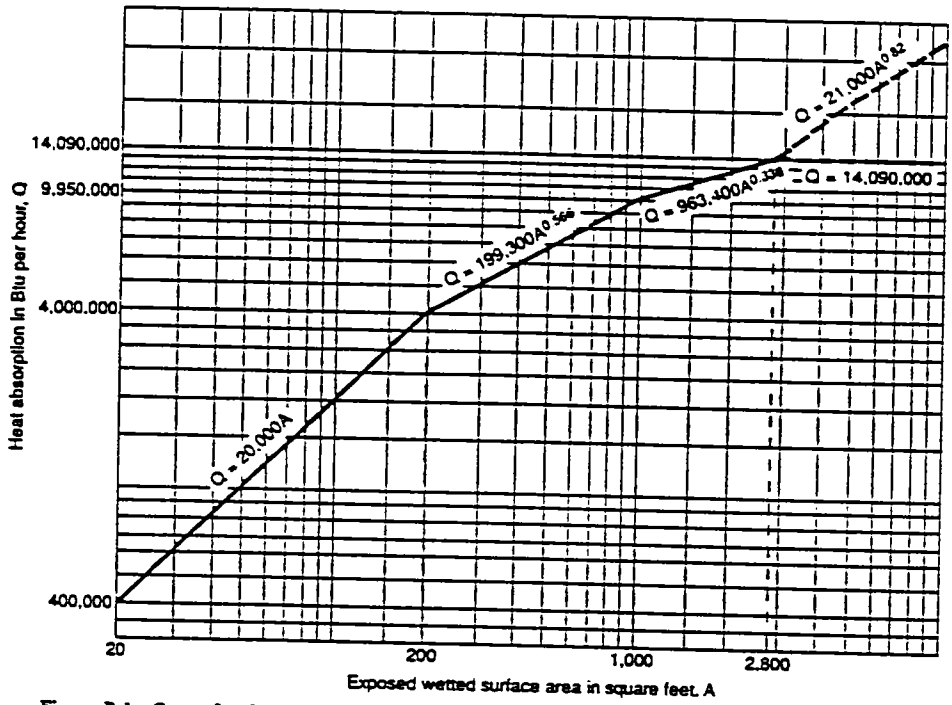

Figure B-1 Curve for determining requirements for emergency venting during fire exposure.

Note: See Table B-1 for approximate wetted area for horizontal tanks.

Table B-1 Appropriate Wetted Areas for Horizontal Tanks
(Wetted Area Equals 75 Percent Total Area)

Tank Diam. (ft)	3	4	5	6	7	8	9	10	11	12
Tank Length (ft)	Approximate Wetted Area of Tanks with Flat Heads									
3	32									
4	39	55								
5	46	65	88							
6	53	74	100	128						
7	60	84	112	142	173					
8	67	93	124	156	190	226				
9	74	102	136	170	206	245	286			
10	81	112	147	184	223	264	308	353		
11	88	121	159	198	239	283	329	377	428	
12	95	131	171	213	256	301	350	400	454	509
13	102	140	183	227	272	320	371	424	480	537
14	109	150	194	241	289	339	393	447	506	565
15	116	159	206	255	305	358	414	471	532	594
16	123	169	218	269	322	377	435	495	558	622
17	130	178	230	283	338	395	456	518	584	650
18	137	188	242	298	355	414	477	542	610	678
19		197	253	312	371	433	499	565	636	707
20		206	265	326	388	452	520	589	662	735
21		216	277	340	404	471	541	612	688	763
22		225	289	354	421	490	562	636	714	792
23		235	300	368	437	508	584	659	740	820
24		244	312	383	454	527	605	683	765	848
25			324	397	470	546	626	706	791	876
26			336	411	487	565	647	730	817	905
27			347	425	503	584	668	754	843	933
28			359	440	520	603	690	777	869	961
29			371	454	536	621	711	801	895	989
30			383	468	553	640	732	824	921	1018
31			395	482	569	659	753	848	947	1046
32				496	586	678	775	871	973	1074
33				510	602	697	796	895	999	1103
34				524	619	715	817	918	1025	1131
35				539	635	734	838	942	1051	1159
36				553	652	753	860	966	1077	1187
37				567	668	772	881	989	1103	1216

Tank Diam. (ft)	3	4	5	6	7	8	9	10	11	12
Tank Length (ft)	Approximate Wetted Area of Tanks with Flat Heads									
38					685	791	902	1013	1129	1244
39					701	810	923	1036	1155	1272
40					718	828	944	1060	1181	1301
41					734	847	966	1083	1207	1329
42					751	866	987	1107	1233	1357
43					767	885	1008	1130	1259	1385
44						904	1029	1154	1284	1414
45						923	1051	1178	1310	1442
46						941	1072	1201	1336	1470
47						960	1093	1225	1362	1498
48						979	1114	1248	1388	1527
49						998	1135	1272	1414	1555
50							1157	1295	1440	1583
51							1178	1319	1466	1612
52							1199	1342	1492	1640
53							1220	1366	1518	1668
54							1246	1389	1544	1696
55							1263	1413	1570	1725
56								1437	1593	1753
57								1460	1622	1781
58								1484	1648	1809
59								1507	1674	1839
60								1531	1700	1866
61									1726	1894
62									1752	1923
63									1778	1951
64									1803	1979
65									1829	2007
66									1855	2036
67										2064
68										2092
69										2120
70										2149
71										2177
72										2205

SI Units: 1 ft = 0.3 m; 1 sq ft = 0.09 m².

Table B-2 Values of $L\sqrt{M}$ for Various Flammable Liquids

Chemical	$L\sqrt{M}$	Molecular Weight	Heat of Vaporization Btu per lb at Boiling Point
Acetaldehyde	1673	44.05	252
Acetic acid	1350	60.05	174
Acetic anhydride	1792	102.09	177
Acetone	1708	58.08	224
Acetonitrile	2000	41.05	312
Acrylonitrile	1930	53.06	265
n-Amyl alcohol	2025	88.15	216
iso-Amyl alcohol	1990	88.15	212
Aniline	1795	93.12	186
Benzene	1493	78.11	169
n-Butyl acetate	1432	116.16	133
n-Butyl alcohol	2185	74.12	254
iso-Butyl alcohol	2135	74.12	248
Carbon disulfide	1310	76.14	150
Chlorobenzene	1422	112.56	134
Cyclohexane	1414	84.16	154
Cyclohexanol	1953	100.16	195
Cyclohexanone	1625	98.14	164
o-Dichlorobenzene	1455	147.01	120
cis-Dichloroethylene	1350	96.95	137
Diethylamine	1403	73.14	164
Dimethylacetamide	1997	87.12	214
Dimethylamine	1676	45.08	250
Dimethylformamide	2120	73.09	248
Dioxane (diethylene ether)	1665	88.10	177
Ethyl acetate	1477	88.10	157
Ethyl alcohol	2500	46.07	368
Ethyl chloride	1340	64.52	167
Ethylene dichloride	1363	98.96	137
Ethyl ether	1310	74.12	152
Furan	1362	68.07	165
Furfural	1962	96.08	200
Gasoline	1370-1470	96.0	140-150
n-Heptane	1383	100.20	138
n-Hexane	1337	86.17	144
Hydrogen cyanide	2290	27.03	430
Methyl alcohol	2680	32.04	474
Methyl ethyl ketone	1623	72.10	191
Methyl methacrylate	1432	100.14	143
n-Octane	1412	114.22	132
n-Pentane	1300	72.15	153
n-Propyl acetate	1468	102.13	145
n-Propyl alcohol	2295	60.09	296
iso-Propyl alcohol	2225	60.09	287
Tetrahydrofuran	1428	72.10	168
Toluene	1500	92.13	156
Vinyl acetate	1532	86.09	165
o-Xylene	1538	106.16	149

SI Units: 1 Btu per lb = 2.3 KiloJoule/Kilogram.

NOTE: For data on other chemicals refer to available handbooks on properties of chemicals.

Appendix C Abandonment or Removal of Underground Tanks

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

C-1 Introduction.

C-1-1 Care is required not only in the handling and use of flammable or combustible liquids, but also in abandoning tanks that have held flammable or combustible liquids. This is particularly true of underground service station tanks that are most frequently used for the storage of motor fuel and occasionally for the storage of other flammable or combustible liquids, such as crankcase drainings (which may contain some gasoline). Through carelessness, explosions have occurred because flammable or combustible liquid tanks had not been properly conditioned before being abandoned.

C-1-2 In order to prevent accidents caused by improper conditioning, it is recommended that the procedures outlined below be followed when underground tanks are removed, abandoned, or temporarily taken out of service.

C-1-3 Underground tanks taken out of service can be safeguarded or disposed of by any one of the three following means:

(a) Placed in a temporarily out of service condition. Tanks should be rendered temporarily out of service only when it is planned that they will be returned to active service within a reasonable period or pending removal or abandonment within 90 days.

(b) Abandoned in place, with proper safeguarding.

(c) Removed.

C-1-4 In cases where tanks are either rendered temporarily out of service or permanently abandoned, records should be kept of tank size, location, date of abandonment, and method used for placing the abandoned tank in a safe condition.

C-1-5 Procedures for carrying out each of the above methods of disposing of underground tanks are described in the following sections. No cutting torch or other flame- or spark-producing equipment should be used until the tank has been completely purged or otherwise rendered safe. In each case, the numbered steps given should be carried out successively.

C-2 Rendering Tanks "Temporarily Out of Service."

C-2-1 Cap or plug all lines such as fill line, gage opening, pump suction, and vapor return. Secure against tampering.

C-2-2 Disconnect piping at all tank openings.

C-3 Abandoning Underground Tanks in Place.

C-3-1 Remove all flammable or combustible liquid from the tank and from all connecting lines.

C-3-2 Disconnect the suction, inlet, gage, and vent lines.

C-3-3 Fill the tank completely with an inert solid material. Cap remaining underground piping.

C-4 Removal of Underground Tanks.

C-4-1 Remove all flammable or combustible liquids from tank and from connecting lines.

C-4-2 Disconnect piping at all tank openings. Remove sections of connecting lines that are not to be used further and cap or plug all tank openings. After removal, the tank can be gas freed on the premises if it can be done safely at that location or can be transported to an area not accessible to the public and the gas freeing completed at that location.

C-5 Disposal of Tanks.

C-5-1 If a tank is to be disposed of as junk, it should be retested for flammable vapors and, if necessary, rendered gas-free. After junking and before releasing to junk dealer, a sufficient number of holes or openings should be made in it to render it unfit for further use. NFPA 327, *Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers Without Entry*, provides information on safe procedures for such operations.

Appendix D Suggested Fire Protection for Containers of Flammable and Combustible Liquids

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

The following contains additional information and recommendations relating to the requirements in Section 4-4.

CAUTION: The following tables suggest sprinkler design densities that have been developed from limited fire testing and the application of engineering judgment. There are many variables that should be considered in the application of these tables.

Examples of these variables include:

(a) Ignition scenario

(b) Properties of the liquids

(c) Container type and size

(d) Packaging methods

(e) Distance from the top of the storage to the sprinklers

(f) Storage configuration

1. Pile size
2. Storage height
3. Storage method
4. Flue spaces

(g) Type of sprinklers

1. Temperature rating
2. Response time index (RTI)
3. Orifice size

These examples are not all-inclusive, and each installation should be designed using sound fire protection engineering judgment. The parameters of the protection arrangements contained in the tables may be modified accordingly.

D-1 The preferred method of storage of liquids in buildings is in cutoff rooms or in attached buildings rather than in inside rooms because of fire department accessibility and the advantages of providing explosion venting where needed.

D-2 Recommendations for Specific Storage Arrangements.

D-2.1 Design criteria in this appendix do not apply to storage in plastic drums. (*See Appendix E for additional information on this subject.*)

D-2.2 Palletized and Solid Pile Storage. For protected storage of liquids, as specified in Table 4-4.4(b), automatic sprinkler protection should be provided in accordance with Table D-2.2.

D-2.3 Rack Storage. In protected storage of liquids arranged, as specified in Table 4-4.4(c), automatic sprinkler protection should be provided in accordance with Tables D-2.3(a) and D-2.3(b), as applicable, except that racks with solid shelves should be provided with in-rack sprinklers at every tier or level.

D-2.4 Automatic aqueous film-forming foam- (AFFF-) water sprinkler systems for container storage of liquids has been shown to be an acceptable method for providing fixed protection. Such protection should be provided in accordance with Tables D-2.4(a) and D-2.4(b). (*See Appendix E for additional information on this subject.*)

D-2.5 For protected storage of liquids in mercantile occupancies, as specified in 4-5.6, automatic sprinkler protection should be provided in accordance with Tables D-2.5(a) and D-2.5(b).

D-2.6 Rack storage of liquids in containers [drums of 55 gal (208 L) capacity] stored on-end on wood pallets on conventional double-row racks to a maximum height of storage of 25 ft (7.6 m) should be provided protection in accordance with Table D-2.4(b).

D-2.7 For design criteria for specific installations, insurance engineers, fire protection consultants, and other knowledgeable persons should be consulted.

Table D-2.2 Automatic Sprinkler Protection for Solid Pile and Palletized Storage of Liquids in Containers and Portable Tanks[1]

IMPORTANT: See the caution statement at the beginning of this appendix.

Storage Conditions		Ceiling Sprinkler Design and Demand					
			Area (sq ft)[3]				
Class Liquid	Container Size and Arrangement	Density gpm/ sq ft	High Temp.	Ord. Temp.	Maximum Spacing	Minimum Hose Stream Demand (gpm)	Minimum Duration Sprinklers & Hose Streams[2]
IA	5 gal or less, with/without cartons, palletized or solid pile	0.30	3000	5000	100 sq ft	750	2 hr
	Containers greater than 5 gal on end or side, palletized or solid pile	0.60	5000	8000	80 sq ft	750	
IB,* IC,* & II*	5 gal or less, with/without cartons, palletized or solid pile[4]	0.30	3000	5000	100 sq ft	500	2 hr
	Containers greater than 5 gal on pallets or solid pile, one high	0.25	5000	8000	100 sq ft		
IB,* IC,* & II	Metal containers, 5 gal or less, with/without cartons, palletized or solid pile[5]	0.21[6,7]	1500	N/T[8]	100 sq ft	250	2 hr
II	Containers greater than 5 gal on pallets or solid pile, more than one high on end or side	0.60	5000	8000	80 sq ft	750	2 hr
IB,* IC,* II*	Portable tanks, one high	0.30	3000	5000	100 sq ft	500	2 hr
II	Portable tanks, two high	0.60	5000	8000	80 sq ft	750	2 hr
III	5 gal or less, with/without cartons, palletized or solid pile	0.25	3000	5000	120 sq ft	500	1 hr
	Containers greater than 5 gal on pallets or solid pile, on end or sides, up to three high	0.25	3000	5000	120 sq ft	500	1 hr
	Containers greater than 5 gal on pallets or solid pile, on end or sides, up to 18 ft high	0.35	3000	5000	100 sq ft	750	2 hr
	Portable tanks, one high	0.25	3000	5000	120 sq ft	500	1 hr
	Portable tanks, two high	0.50	3000	5000	80 sq ft	750	2 hr

SI Units: 1 gal = 3.8 L; 1 sq ft = 0.3 m.

* See Appendix E, introductory paragraphs.

[1] See 4-4.4 and Table 4-4.4(b) for additional information pertaining to protected palletized or solid piling of liquids.

[2] Minimum hose stream demand includes small hand hose (1½ in.) required in 4-8.3.

[3] The design area contemplates the use of wet pipe systems. Where dry pipe systems are required, it introduces a possible delay that needs to be compensated for by increased area of application (plus 30 percent).

[4] One test indicated that a sprinkler density of 0.3 gpm per sq ft might not be sufficient for the protection of storage of cartons more than 1 pallet high.

[5] Using 5 gal cylindrical metal containers with plastic spouts or solid plastic caps and 1 gal F-style (oblong) metal containers.

[6] Maximum Storage Height: 4 ft, under an 18-ft ceiling.

[7] See Test 3, Table 4A, Appendix E-4.

[8] N/T = Not Tested.

Table D-2.3(a) Automatic Sprinkler Protection Requirements for Rack Storage of Liquids in Containers of Five Gallon Capacity or Less, in Cartons on Conventional Wood Pallets or without Cartons, on Pallets[1]

IMPORTANT: See the caution statement at the beginning of this appendix.

	Ceiling Sprinkler Design & Demand				In-Rack Sprinkler Arrangement and Demand[2,3,4]					
		Area (sq ft)[6]								
Class Liquid	Density gpm/ sq ft	High Temp.	Ord. Temp.	Max. Spacing	Racks up to 9 ft (2.7 m) deep	Racks over to 9 ft (2.7 m) to 12 ft (3.7 m) deep	Min. Nozzle Pressure	Number of Sprinklers Operating	Minimum Hose Stream Demand (gpm)	Minimum Duration Sprinkler & Hose Stream[5]
I (max. 25 ft height)	0.40	3000	5000	80 sq ft/hd	(a) ord. temp. sprinklers 8 ft apart horizontally (b) one line sprinklers above each level of storage (c) locate in longitudinal flue space, staggered vertically (d) shields required where multilevel	(a) ord. temp. sprinklers 8 ft apart horizontally (b) two lines sprinklers above each level of storage (c) locate in transverse flue spaces, staggered vertically and within 20 in. of aisle (d) shields required where multilevel	30 psi	(a) 8 sprinklers if only one level (b) 6 sprinklers ea. on two levels, if only two levels (c) 6 sprinklers ea. on top 3 levels, if three or more levels (d) hydraulically most remote	750	2 hr
II (max. 25 ft height)	0.30	3000	5000	100 sq ft/hd	(a) ord. temp. sprinklers 8 ft apart horizontally (b) one line sprinklers between levels at nearest 10 ft vertical intervals (c) locate in longitudinal flue space, staggered vertically (d) shields required where multilevel	(a) ord. temp. sprinklers 8 ft apart horizontally (b) two lines between levels at nearest 10 ft vertical intervals (c) locate in transverse flue spaces, staggered vertically and within 20 in. of aisle (d) shields required where multilevel	30 psi	(a) hydraulically most remote — 6 sprinklers at each level, up to max. of three levels	750	2 hr
III (max. 40 ft height)	0.25	3000	3000	120 sq ft/hd	Same as Class II	Same as Class II	30 psi	Same as Class II	500	2 hr
I, II & III[7]	0.55[8]	2000[9]	NT	100 sq ft/hd	NT[10]	NT	NT	NT	500	2 hr

SI Units: 1 gal = 3.8 L; 1 sq ft = 0.09 m²; 1 ft = 0.3 m; 1 in. = 2.5 cm.

[1] See Table 4-6.1(b) and Section 4-6 for additional information pertaining to protected rack storage.

[2] Additional in-rack protection required for solid shelves, as indicated in D-2.3.

[3] See 4-6.3 for types of racks permitted.

[4] See 4-6.5 for additional information pertaining to in-rack sprinklers.

[5] Minimum hose streams demand includes small hand hose (1½ in.) required in 4-7.1.3.

[6] The design area contemplates the use of wet pipe systems. Where dry pipe systems are required, it introduces a possible delay that needs to be compensated for by increased areas of application (plus 30 percent).

[7] Using F-style metal containers and 5-gal tighthead metal containers equipped with plastic pour spout.

[8] Max. 14-ft storage height (3 tiers: floor, 5 ft and 10 ft); max. 18-ft ceiling; min. 7½-ft aisles.

[9] Using listed or approved 0.64-in. extra-large orifice, pendent style, 286°F, quick response or standard element sprinklers.

[10] Maximum 6-ft deep rack.

NT = Not Tested

Table D-2.3(b) Automatic Sprinkler Protection for Rack Storage of Liquids in Containers Greater than Five Gallon Capacity[1]

IMPORTANT: See the caution statement at the beginning of this appendix.

	Ceiling Sprinkler Design & Demand				In-Rack Sprinkler Arrangement and Demand[2,3,4]					
Class Liquid	Density gpm/ sq ft	Area (sq ft)[6] High Temp.	Area (sq ft)[6] Ord. Temp.	Max. Spacing	On-Side Storage Racks up to 9 ft	On-End Storage (on pallets) up to 9 ft deep racks	Min. Nozzle Pressure	Number of Sprinklers Operating	Minimum Hose Stream Demand (gpm)	Minimum Duration Sprinkler & Hose Stream[5]
LA (max. 25 ft height)	0.60	3000	5000	80 sq ft/hd	(a) ord. temp. sprinklers 8 ft apart horizontally (b) one line sprinklers above each tier of storage (c) locate in longitudinal flue space, staggered vertically (d) shields required where multilevel	(a) ord. temp. sprinklers 8 ft apart horizontally (b) one line sprinklers above each tier of storage (c) locate in longitudinal flue space, staggered vertically (d) shields required where multilevel	30 psi	(a) hydraulically most remote—6 sprinklers at each level	1000	2 hr
IB, IC & II (max. 25 ft height)	0.60[7]	3000	5000	100 sq ft/hd	(a) see (a) above (b) one line sprinklers every three tiers of storage (c) see (c) above (d) see (d) above	(a) see (a) above (b) see (b) above (c) see (c) above (d) see (d) above	30 psi	(a) see (a) above	750	2 hr
III (max. 40 ft height)	0.25	3000	5000	120 sq ft/hd	(a) see (a) above (b) one line sprinklers every sixth level (maximum) (c) see (c) above (d) see (d) above	(a) see (a) above (b) one line sprinklers every third level (maximum) (c) see (c) above (d) see (d) above	15 psi	(a) see (a) above	500	1 hr

SI Units: 1 gal = 3.8 L; 1 sq ft = 0.09 m^2; 1 ft = 0.3 m; 1 in. = 2.5 cm.

[1] See Table 4-6.1(b) and D-2.3 for additional information pertaining to protected rack storage.

[2] Additional in-rack protection required for solid shelves, as indicated in D-2.3.

[3] See 4-6.3 for types of racks permitted.

[4] See 4-6.3 for additional information pertaining to in-rack sprinklers.

[5] Minimum hose stream demand includes small hand hose (1½ in.) required in 4-7.1.3.

[6] The design area contemplates the use of wet pipe systems. Where dry pipe systems are required, it introduces a possible delay that needs to be compensated for by increased areas of application (plus 30 percent).

[7] Where there is only one tier of drums above the highest line of in-rack sprinklers, the ceiling water demand density may be reduced to 0.25 gpm/sq ft over 5000 sq ft.

Table D-2.4(a) Automatic AFFF-Water Protection[1] Requirements for Rack Storage of Liquids in Containers

IMPORTANT: See the caution statement at the beginning of this appendix.

	Ceiling Sprinkler Design & Demand			In-Rack Sprinkler Arrangement and Demand[2]					
		Area (sq ft)							
Class Liquid[4]	Density gpm/sq ft	High Temp.	Ord. Temp.	On-End Storage, of drums (on pallets) up to 25 ft	Minimum Nozzle Pressure	Number of Sprinklers Operating	Hose Stream Demand[3]	Duration AFFF Supply	Duration Water Supply
I.A. I.B. I.C. II	0.30	1500	2550	(a) ord. temp. sprinklers up to 10 ft apart horizontally (b) one line sprinklers above each level of storage (c) locate in longitudinal flue space, staggered vertically (d) shields required for multilevel	30 psi	3 sprinklers per level	500	15 min	2 hr

SI Units: 1 gal = 3.8 L; 1 sq ft = 0.09 m²; 1 ft = 0.3 m; 1 in. = 2.5 cm.
[1] System shall be a closed head wet system with approved devices for proportioning AFFF.
[2] Except as modified herein, in-rack sprinklers should be installed in accordance with NFPA 231C, *Standard for Rack Storage of Materials*.
[3] Hose stream demand includes inside hand hose (1½ in.) required in 4-7.1.3.
[4] Maximum height of storage should be limited to 25 ft.

Table D-2.4(b) Closed Head Foam-Water (AFFF) Sprinkler Protection Requirements for Solid Pile and Palletized Storage of Flammable and Combustible Liquids in Metal Containers of Five Gallon Capacity or Less

IMPORTANT: See the caution statement at the beginning of this appendix.

Package Type	Class Liquid	Density gpm/ft²	Area ft²	Temp. Rating	Max. Spacing	Orifice Size, in.	Maximum Height (ft)	Hose gpm	Water Supply Duration (min)	Foam Supply Duration (min)
Cartoned	IB, IC, II	.40	2000	286°F	100 sq ft/hd	17/32	11	500	120	15
Uncartoned	IB, IC, II	.30	2000	286°F	100 sq ft/hd	½ or 17/32	12	500	120	15

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Table D-2.5(a) Automatic Sprinkler Protection Requirements for Class I Liquid Storage in Metal Containers of One Gallon Capacity or Less with Uncartoned or Case-Cut Shelf Display up to 6½ ft. and Palletized Storage Above in a Double Row Rack Array

IMPORTANT: See the caution statement at the beginning of this appendix.

	Ceiling Sprinkler Design and Demand				In-Rack Sprinkler Arrangement and Demand					
		Area (sq ft)								
Class Liquid	Density gpm/sq ft	High Temp.	Ord. Temp.	Maximum Spacing	Racks up to 9 ft deep	Racks 9 ft to 12 ft deep	Minimum Nozzle Pressure	Number of Sprinklers Operating	Minimum Hose Stream Demand gpm	Minimum Duration Sprinklers and Hose Stream (hrs.)
Maximum 20 ft storage height	0.6	2,000[1]	N/T	100 sq ft/hd	(a) ord. temp. quick response sprinklers, max. 8 ft 3 in. horizontal spacing (b) one line of sprinklers at the 6 ft level and the 11½ ft level of storage (c) locate in longitudinal flue space, staggered vertical (d) shields required where multilevel	N/T	30 psi (½ in. orifice) or 14 psi (17/32 in. orifice)	(a) 6 sprinklers ea. on two levels (b) hydraulically most remote 12 sprinklers	500	2

SI Units: 1 gal = 3.8 L; 1 sq ft = 0.09m²; 1 ft = 0.3 m; 1 in. = 2.5 cm.
[1] Using listed or approved extra-large orifice, pendent style, 286°F quick response or standard link sprinklers under a 30-ft ceiling and using minimum 7½-ft aisle.
N/T = Not Tested.

Table D-2.5(b) Automatic Sprinkler Protection Requirements for Class I and II Liquid Storage in Metal Containers on Shelving[1] Ceiling Sprinkler Design and Demand

IMPORTANT: See the caution statement at the beginning of this appendix.

Container Size	Density (gpm/sq ft)	Area (sq ft)	Maximum Spacing (sq ft)	Minimum Hose Stream Demand (gpm)	Minimum Duration Sprinklers and Hose Stream (hrs)
5 gal or less without carton	0.19	1500	100	250	2 hr

SI Units: 1 gal = 3.8 L; 1 sq ft = 0.09 m²; 1 ft = 0.3 m.
[1] Shelving should be solid or open-grate metal, and storage height should not exceed 6 ft under an 18-ft ceiling. Shelf width should be 2 ft or less.

Appendix E Fire Test Data

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

SI Units: 1 gal = 3.8 L; 1 ft = 0.3 m; 1 sq ft = 0.09 m².

E-1 This appendix explains fire test data and loss experience that were used to help promulgate protection tables that are presented in Appendix D. While these data are limited, they do illustrate the seriousness of a potential drum rupture in a fire and the primary failure mode of built-up internal pressure in combination with the weakening of the rim joint due to localized overheating. The possibility of a BLEVE (Boiling Liquid Expanding Vapor Explosion) is also demonstrated. Due to the many unknowns, conservative practice would be to limit all Class I liquids stored in drums to not over one drum high, since protection tables were developed with this philosophy.

E-2 Very limited fire tests and fire experience, relative to flammable aerosols, indicate the serious problem they present to the fire protection engineer. Exploding pressurized aerosol cans are to be expected, together with the flaming fireball and rocketing action, spreading fire to a potentially larger area. The protection philosophy expressed is primarily to limit storage heights and to contemplate a larger area of application. Use of pressure-relieving can designs would be expected to affect favorably the design considerations for fixed protection.

E-3 Fire Tests — Drum Storage

(1) *1949 Fire Tests.* A series of fire tests were made in 1949 at the Factory Mutual test center in Norwood, Massachusetts. The tests were conducted in the 15-ft high section of the fire test building used at that time. The tests used ICC Specification 5 drums, which were 14 gage compared with the 16 gage Specification 17C drums and 18 gage Specification 17E drums used more commonly today.

The tests involved storage horizontally on metal racks up to 4 drums high, and palletized upright, 3 drums high. Test drums contained either water, gasoline, or benzene, located in the first or second tier and equipped with pressure- and temperature-sensing connections. The gasoline and benzene drums were piped to manual vents so that pressure could be relieved before the drums ruptured. Other drums in the array contained water or were empty.

Sprinkler protection consisted of open, old-type sprinklers, which could be manually turned on, either at the start of the fire (short preburn) or at a time simulating the first sprinkler operation (long preburn). Sprinklers were spaced either at 100 sq ft/head with a flow rate of 0.22 or 0.28 gpm/sq ft or spaced at 50 sq ft/head with a flow rate of 0.44 or 0.56 gpm/sq ft.

Gasoline was pumped through piping to designated discharge points in or near the pile at flow rates from 1 to 15 gpm. In some tests, 5 or 10 gal of fuel were poured on the floor below the drums and ignited. Duration of flows were the length of time required to empty a single drum at the rate of flow used.

When sprinkler discharge was turned on immediately, the pressure that developed in the test drums was due almost entirely to the vapor pressure as the body of liquid increased in temperature. When sprinkler discharge was started, simulating normal sprinkler operation, there was a rapid pressure increase due to heating of the vapor space. This usually dropped when cooling by sprinkler discharge started.

Early tests showed that 100-sq ft spacing of sprinklers and densities of 0.22 and 0.28 gpm/sq ft would not prevent excessive temperature and pressure increases in drums. Spacing of 50 sq ft per sprinkler was used in subsequent tests. Test measurement and visual observation indicated that 0.56 gpm/sq ft provided considerably better cooling and flushing away of fuel than the 0.44-gpm/sq ft sprinkler density.

When fuel was discharged on the floor, only the bottom tier of storage was severely exposed. When fuel was discharged at a higher level, simulating a leaking drum, those drums in the immediate vicinity in upper tiers were severely exposed.

The rate of fuel flow had very little effect on the heating of any particular drum. The lower rates, 1 to 2 gpm, had a much longer duration and resulting exposure was greater before the 55-gal duration supply was used up.

With on-side drum storage in racks, the rate of temperature rise in the test drum on the lowest tier was 3 to 5 times as high with storage more than one drum high than it was with one-high storage. Tests with on-end palletized storage were only conducted three-high.

When 5 or 10 gal of gasoline were spilled on the floor and then ignited, the 5-gal spill gave a more severe exposure to drums because of the longer time before sprinklers would have operated. The 10-gal spill exposed more drums, but the exposure to any one drum was no more severe.

A very small leak from a drum filled with gasoline gave a very severe exposure, because of the localized exposure to the leaking drum and insufficient heat at the ceiling to operate the sprinklers.

Drums containing benzene heated much more rapidly than drums containing water because of the lower specific heat of benzene. Early pressure build-up in the vapor space is more pronounced with water, possibly because of more film vaporization on the early stages of the fire.

(2) *1967 Fire Tests.* A series of fire tests were made to compare the effects of severe fire exposure to water- and heptane-filled drums. The tests were carried out in the Factory Mutual explosion tunnel, using new ICC-17E (18 gage) 55-gal drums.

A single drum was encircled with a ring of oil burners. Temperatures were measured at various points in the drum. The fuel rate to the oil burners was about 1 gpm. There was no cooling applied to the drum.

Using heptane, the drum ruptured at about 17 psig, at a drum rim temperature of 1190°F (643.4°C). The cover seam unrolled and a BLEVE resulted, after a fire exposure of 3 to 4 min.

On similar tests using water, failure occurred at 40 psig after 10 min.

The tests indicated that the heptane-filled drum will rupture much sooner and at a much lower internal pressure than a water-filled drum. This is attributed to the fact that drums were found to leak around the joint of the rim before the rupture. The small leakage of heptane vapor through the rim joint causes a localized flame at this

already weakened location on the rim, whereas steam issuing from a similar leak in a water-filled drum tends to cool the metal at this point.

(3) *1974 Fire Tests.* A series of fire tests were made to evaluate protection of on-end drum storage with AFFF foam discharging from a standard sprinkler system. The tests were conducted in the 30-ft high area of the Factory Mutual test center in Rhode Island.

Based on the 1967 tests, a standard for success was that no drum should exceed 15 psig pressure.

Tests were made with water-filled drums, palletized, 2, 3, and 4 pallets high, and on racks, 5 tiers high.

Fuel was heptane, piped to the base of the top tier of storage, with a 10-gal floor spill in each case. Sprinklers were automatic, 286°F (141.1°C) heads.

Test 1: In this test, storage was 4 pallet-loads high. Fuel discharge rate was 2 gpm. Sprinkler discharge density was 0.30 gpm/sq ft. The first sprinkler opened at 34 sec. Only 4 sprinklers operated, but the three-dimensional fire in the pile continued strong. Several drums bulged, 2 ruptured, and 6 exceeded 15 psig pressure.

Test 2: In this test, storage was 3 tiers high, sprinkler density was 0.60 gpm/sq ft. Other conditions were the same as Test 1.

Two sprinklers opened at about 1 min 20 sec. A considerable number of drums were deformed. Four of the 8 monitored drums exceeded 15 psig pressure.

Test 3: This test was rack storage with 160°F (71.1°C) automatic sprinklers in each tier except the bottom. Fuel rate was 2 gpm. Ceiling protection was 0.30 gpm/sq ft.

Five in-rack sprinklers and 1 ceiling sprinkler opened. One drum in the first tier, which had no in-rack sprinklers, reached a pressure of 16 psig. Two drums fell from the fifth tier, due to burning away of a pallet.

Test 4: Test 4 was a repeat of Test 3, except the fuel flow rate was 15 gpm.

Eight ceiling sprinklers and 5 in-rack sprinklers operated. Ceiling temperatures reached 1665°F (909.5°C). One monitored drum in the first tier reached 20 psig. Several drums were bulged.

Test 5: Test 5 was a repeat of Test 2, except storage was 2 tiers high.

The fuel was a greater distance from the ceiling so sprinklers did not operate until 3½ to 4 min after ignition. Damage to drums was severe, with many rupturing and all eight monitored drums going over 15 psig.

Generally, results were good in rack storage, where in-rack sprinklers were provided at each tier. For palletized storage, the AFFF protection controlled the floor fire, although pallets hindered spread of foam. Ceiling sprinklers only did not adequately protect palletized storage where an elevated spill resulted in a three-dimensional fire within the pile.

Most of the ruptured drums failed at the top chime, but one drum developed a slow leak at a bottom chime. In Test 5, several drums were heated by a localized fire that did not open sprinklers at the roof. This slow overpressurization can lead to superheated liquid release and a resulting severe BLEVE when the drum eventually ruptures.

E-4 Fire Tests — Small Containers.

(1) *1957 Fire Test (Nonpressurized Smaller Containers).* A fire test was made on 10½-ft high storage of paint in 1-gal cans in cartons. The storage was palletized, but the pallets were fire-stopped, so it was equivalent to solid piled storage. The paint varied in flash point from 105 to 170°F (40.5 to 76.7°C) (Class II and IIIA). Sprinkler protection was 160°F (71.1°C) heads, 10 × 10 ft, with a density of 0.23 gpm/sq ft. Ceiling height was 15 ft.

Six sprinklers operated and controlled the fire. Temperatures over the fire reached a maximum of 1100°F (593.3°C) and dropped below 500°F (260°C) after 10 min. Five hundred and three cans had their covers blown off and 20 cans had burst seams. The paint released from the cans was slight, but it would be much more significant if a pile had toppled over or if cans had not all been stored cover-side up.

(2) *1970 Fire Test (Pressurized Containers)* A fire test was made in the 30-ft high section of the Factory Mutual Rhode Island test facility. The storage was 13-oz and 16-oz cans of lacquer in shipping cartons stored 2 pallet by 2 pallet by 2 pallet high on racks. Storage height was 9 ft 9 in. Protection was by twelve 160°F (71.1°C) sprinklers spaced 10 × 10 ft providing a discharge density of 0.30 gpm/sq ft.

Fifty seconds after ignition, containers began to burst. At 62 sec, 3 sprinklers operated. The fire became more and more intense and, with all 12 sprinklers operating, there was no suppressing effect. The discharge was increased to 0.50 gpm/sq ft without effect. After about 5 min, the fuel was nearly exhausted. Containers were thrown to every corner of the test building.

Temperatures over the fire were over 1000°F (537.8°C) for 3½ min and over 1700°F (926.6°C) for 2 min.

(3) *1991 Foam-Water Fire Tests.* A series of fire tests involving the palletized storage of 1- and 5-gal metal containers, and 5-gal plastic containers, filled with heptane (a Class IB flammable liquid), were conducted at Underwriters Laboratories Inc. in Northbrook, IL. The testing was sponsored by the National Fire Protection Research Foundation as part of their international Foam-Water Sprinkler Research Project. The test storage arrays were intended to simulate palletized storage in a flammable liquid warehouse and were protected using a ceiling mounted closed-head foam-water sprinkler system. An in-line balanced pressure foam proportioning system was used with a 3 percent concentration of alcohol resistant aqueous film forming foam (AFFF) on the palletized storage arrays. A 10-gal (37.9-L) heptane spill was used as the ignition scenario for each of the fire tests.

A series of six fire tests were conducted with 1-gal metal F-style (oblong) containers of heptane packed 4 containers in a cardboard carton. A summary of these tests is contained in Table 3A. Five fire tests were conducted using uncartoned 5-gal metal tight-head containers of heptane fitted with plastic pour spouts. The results of these fire tests are contained in Table 3B. Also, two fire tests were conducted using uncartoned 5-gal plastic tight-head containers of heptane. The results of these fire tests are contained in Table 3C.

A complete and detailed report of these fire tests, which were conducted as part of the International Foam-Water Sprinkler Research Project, can be obtained from the National Fire Protection Research Foundation, Batterymarch Park, Quincy, MA 02269.

Table 3A Foam-Water Fire Tests
Palletized 1-Gallon Metal F-Style Containers of Heptane in Cardboard Cartons

1.	Test location:	Underwriters Laboratories Inc., Northbrook, IL				
2.	Ceiling height:	27 ft (8.2 m)				
3.	Storage arrangement:	2 by 2 (heptane) pallet array with 6 in. (15 cm) longitudinal and transfers flue spaces. (Test Nos. 12 and 13 included palletized Class II commodity exposed to the heptane array.)				
4.	Ignition:	10 gal (37.9 L) of heptane: Nine 1-gal (3.8-L) plastic bags positioned in the flue spaces between the pallets and 1 gal (3.8 L) spilled over the base for simultaneous ignition.				
5.	Sprinklers:	½-in. (12.7-mm) standard orifice in tests 3, 5, 9, and 12, and 17/32-in. (13.5-mm) large orifice in tests 11 and 13, 286°F (141°C) temperature rated. RTI = 400 (ft-sec)$^{0.5}$ [221 (m-sec)$^{0.5}$], 10 ft by 10 ft (2.5 m by 2.5 m) spacing.				
6.	Foam concentrate:	3% alcohol resistant AFFF type. Listed for use on hydrocarbon fuels at a 3% concentration and on polar solvent type fuels at a 6% concentration.				
7.	Foam proportioner:	In-line balanced pressure type installed in the base of the sprinkler riser.				
8.	Fire test number:	3	5	9	11	12	13
9.	Fuel quantity (gal):	160	480	960	1440	1920	1600
10.	Storage ht (in.):	16	38	76	114	156	128
11.	Design density:	0.3	0.3	0.3	0.4	0.4	0.4
12.	Foam concentrate (%):	3	3	3	3	3	3
13.	First sprinkler actuation (sec):	38	36	34	34	38	42
14.	Time of foam-water (sec):	70	68	48	62	57	61
15.	No. operating sprinklers:	4	4	10	5	5	4
16.	Duration of foam-water water application (min):	2.5	2.5	2.5	6.4	9.4	9.3
17.	Foam-water solution discharged (gal):	300	300	750	1283	1873	1488
18.	Fire suppressed:	Yes	Yes	Yes	Yes	*	Yes
19.	Measurable fuel loss (gal):	None	None	None	None	15	None

*Test discontinued at 10 minutes due to shielding of fire in flue space.

(4) *1991 Fire Tests.* A series of four fire tests involving the storage of cartoned and uncartoned 1-gal (3.8-L) and 5-gal (18.9-L) metal containers, filled with heptane (a Class IB flammable liquid), and latex paint in uncartoned 1-gal (3.8-L) metal, 5-gal (18.9-L) plastic, and 5-gal (18.9-L) metal containers were conducted at Underwriters Laboratories Inc. in Northbrook, IL. The tests were arranged in a palletized array, and a simulated retail display area was protected using a ceiling mounted wet pipe sprinkler system. A 10-gal (37.9-L) or a 5-gal (18.9-L) heptane spill was used as the ignition scenario in these tests.

Three palletized fire tests were conducted with 1-gal (3.8-L) metal F-Style (oblong) containers of heptane packed 4 containers in a cardboard carton and 5-gal (18.9-L) metal tightened containers of heptane. A summary of these tests is contained in Table 4A. A fourth fire test was conducted with uncartoned 1-gal (3.8-L) metal F-Style containers of heptane, 5-gal (18.9-L) metal tightened containers of heptane with plastic pour spouts, uncartoned 1-gal (3.8-L) metal friction lid containers of latex paint, 5-gal (18.9-L) plastic friction lid containers of latex paint, and 5-gal (18.9-L) metal tightened containers of latex paint. A summary of this test is contained in Table 4B.

E-5 Fire experience examples involving flammable and combustible liquids in containers stored in buildings.

(1) *1951 Fire.* Drums of petroleum naphtha were stored temporarily in a general purpose warehouse used mainly for storing can ends in wood boxes. Storage was 1 drum high on pallets.

Two drums had small punctures and leaks near the bottom, caused either maliciously or by moving equipment. The leak was ignited, and one drum ruptured at the

Table 3B Foam-Water Fire Tests
Palletized 5-Gallon Metal Tighthead Containers of Heptane with Plastic Pour Spouts

1.	Test location:	Underwriters Laboratories Inc., Northbrook, IL				
2.	Ceiling height:	27 ft (8.2 m)				
3.	Storage arrangement:	2 by 2 (heptane) pallet array with 6 in. (15 cm) longitudinal and transverse flue spaces.				
4.	Ignition:	10 gal (37.9 L) of heptane, nine 1-gal (3.8-L) plastic bags positioned in the flue spaces between the pallets and 1 gallon (3.8 L) spilled over the bags for simultaneous ignition.				
5.	Sprinklers:	½-in. (12.7 mm) standard orifice, 286°F (141°C) temperature rated, RTI = 400 $(ft\text{-}sec)^{0.5}$ [221 $(m\text{-}sec)^{0.5}$], 10 ft by 10 ft (2.5 m by 2.5 m) spacing.				
6.	Foam concentrate:	3% alcohol resistant AFFF type. Listed for use on hydrocarbon fuels at a 3% concentration and on polar solvent type fuels at a 6% concentration.				
7.	Foam proportioner:	In-line balanced pressure type installed in the base of the sprinkler riser.				
8.	Fire test number:	1	4	6	8	10
9.	Fuel quantity (gal):	160	320	480	960	1440
10.	Storage ht (in.):	19	33	47	94	141
11.	Design density:	0.3	0.3	0.3	0.3	0.3
12.	Foam concentrate (%):	3	3	3	3	3
13.	First sprinkler actuation (sec):	48	49	49	50	50
14.	Time of foam-water (sec):	80	81	81	390	82
15.	No. operating sprinklers:	4	5	5	4	4
16.	Duration of foam-water water application (min):	2.5	2.5	4.2	2.5	7
17.	Foam-water solution discharged (gal):	300	375	625	300	840
18.	Fire suppressed:	Yes	Yes	Yes	Yes	Yes
19.	No. vented containers:	32	32	32	51	72
20.	Measurable fuel loss (gal):	None	None	10*	5**	None

*Two containers fell off the array and spilled their contents.
**Once container was empty following the test.

bottom seam. A drum rupture resulted that opened 272 sprinklers. The fire department was called promptly and they and sprinklers were able to contain the fire, helped by the low combustible concentration in the warehouse and by failure of any other drums to rupture.

Forty-two million can ends were wet down, but fire damage was limited. No explosion damage was reported. (The intensity of the BLEVE may have been limited by much of the liquid leaking from the drum before it ruptured.) Total damage was about $200,000.

(2) *1965 Fire.* Pressurized containers of paint were stored 15 ft high on racks. A fire started in the top tier from a gas-fired radiant heater. Bursting containers spread burning paint over a large area, opening 188 165°F (73.9°C) sprinklers. The fire spread 25 ft along a rack but was slowed by aisles and inert material. A portion of the roof over the fire area collapsed.

(3) *1966 Fire.* Pressurized containers of alcohol-base hair spray and deodorant were stored palletized, 17 ft high. The fire was contained within a 1200 sq ft pile by 107 operating sprinklers. Damage exceeded $400,000.

(4) *1971 Distribution Warehouse Fire.* A sprinklered 67,000 sq ft, one-story, noncombustible warehouse for automotive equipment and supplies was destroyed by fire from undetermined cause. Storage consisted of various metal, plastic and rubber parts in cardboard cartons, plus flammable and combustible liquids in containers ranging from 1-pt aerosol cans up to, and including, 55-gal metal drums. Method of storage was mostly on wooden pallets on open metal racks, double row, with 3 and 4 tiers to a total storage height of 15 to 17 ft. A considerable portion of the racks was used for storage of flammable and combustible liquids in 5-gal and 55-gal metal containers on wooden pallets, 4 tiers high. Both flammable and nonflammable

Table 3C Foam-Water Fire Tests
Palletized 5-Gallon Plastic Tighthead Containers of Heptane

1.	Test location:	Underwriters Laboratories Inc., Northbrook, IL	
2.	Ceiling height:	27 ft (8.2 m)	
3.	Storage:	2 by 2 (heptane) pallet array with 6 in. (15 cm) longitudinal and transverse flue spaces.	
4.	Ignition:	10 gal (37.9 L) of heptane, nine 1-gallon (3.8-L) plastic bags positioned in the flue spaces between the pallets and 1 gal (3.8 L) spilled over the bags for simultaneous ignition.	
5.	Sprinklers:	½-in. (12.7-mm) standard orifice, 286°F (141°C) for Test 2A and 165°F (74°C) for Test 7, RTI = 400 (ft-sec)$^{0.5}$ [221 (m-sec)$^{0.5}$], 10 ft by 10 ft (2.5 m by 2.5 m) spacing.	
6.	Foam concentrate:	3% alcohol resistant AFFF type. Listed for use on hydrocarbon fuels at a 3% concentration and on polar solvent type fuels at a 6% concentration.	
7.	Foam proportioner:	In-line balanced pressure type installed in the base of the sprinkler riser.	
8.	Fire test number:	2A	7
9.	Fuel quantity (gal):	160	160
10.	Storage height (in.):	19	19
11.	Design density:	0.3	0.3
12.	Foam concentration (%):	3	3
13.	First sprinkler actuation (sec):	44	35
14.	Time of foam-water application (sec):	58	35*
15.	Number of operating sprinklers	14	10
16.	Duration of foam-water application (min):	3.4	9.1
17.	Quantity of foam-water water discharged (gal):	1470	2735
18.	Fire suppressed:	No	No
19.	No. breached containers:	25	24
20.	Measurable fuel loss (gal):	85	115

*Sprinkler system piping was filled with foam-water solution to reduce the delay in discharging foam into the fire.
NOTE: Additional fire tests of the 5-gal tighthead polyethylene container were not conducted due to concerns over storage array integrity when stacked more than one container [19 in. (48.3 cm)] high.

aerosols in pint cans in cartons were palletized and stored in portions of the racks. Ceiling sprinkler design was wet pipe, extra-hazardous schedule, using 17/32 orifice, 165°F (73.9°C) heads, supplied from a fairly strong city water supply (52 psi static, 38 psi residual, with 1580 gpm flowing). A review of the hydraulics indicates system was capable of supplying a density of 0.2 gpm/sq ft for the most remote 2000 sq ft area.

Despite immediate fire department response to a central station water flow alarm and use of a fire department siamese connection, the fire spread beyond the capability of the sprinkler system and the system was soon overtaxed, resulting in early roof collapse and breaking of sprinkler piping, and thus requiring closing of the main control valve. Numerous "fireball" explosions of aerosol cans and ruptures of 55-gal drums were reported, several affecting manual fire fighting operations, requiring about 3 hr for control.

(5) *1975 Fire.* About one hundred 55-gal drums of Class IB and IC liquids were stored palletized, 3 drums high, in a corner of a general-purpose warehouse, together with ordinary combustible commodities up to 11 ft high in racks. The roof was Class II steel deck, 15 ft high.

Sprinklers were on an ordinary hazard system, 160°F (71.1°C) heads.

Employees discovered a large fire in progress in the drum storage area. Shortly after the public fire department arrived, drums started to rupture, creating large fireballs. One drum failed at the bottom and rocketed through the roof, landing 750 ft from the building. The roof partially collapsed and one system was then shut off. Most of the building and contents were severely damaged.

The fire probably started in an open waste pail near the drum storage. Total loss was about $3,300,000.

Table 4A Fire Tests Involving Mixed Storage
Palletized 5-Gallon (18.9-L) Metal Tighthead Containers of Heptane with Plastic Spouts and 1-Gallon (3.8-L) Metal F-Style Containers of Heptane in Cardboard Cartons

1.	Test location:	Underwriters Laboratories Inc., Northbrook IL		
2.	Ceiling height:	18 ft (5.5 m)		
3.	Storage arrangement:	Test 1 2 by 2 pallet array with 6 in. (15 cm) longitudinal and transverse flue spaces.	Test 2 & 3 10 pallet array with 6 in. (15 cm) longitudinal and transverse flue spaces.	
4.	Ignition:	Test 1 10 gal (37.9 L) of heptane. Nine 1-gal (3.8-L) plastic bags positioned in the flue spaces between the pallets and 1 gal (3.8 L) spilled over the bags for simultaneous ignition.	Test 2 & 3 5 gal (18.9 L) of heptane, four 1-gal (3.8-L) plastic bags positioned in the flue spaces between the pallets and 1 gal (3.8 L) spilled over the bags for simultaneous ignition.	
5.	Sprinklers:	½-in. (12.7-mm) standard orifice, 286°F (141°C), RTI = 400 (ft-sec)$^{0.5}$ [221 (m-sec)$^{0.5}$], 10 ft by 10 ft (2.5 m by 2.5 m) spacing.		
6.	Sprinkler system type:	Wet pipe—water only.		
7.	Fuel quantity [gal (l)]:	Test 1 880 (3,331)	Test 2 1,400 (5,300)	Test 3 1,400 (5,300)
8.	Storage height [in. (m)]:	80 (2)	48.5 (1.2)	48.5 (1.2)
9.	Sprinkler system discharge density [gpm/ft^2 (mm/min)]:	0.29 (12)	0.29 (12)	0.21 (8.6)
10.	First sprinkler actuation (sec):	35	68	54
11.	Number of operating sprinklers:	5	3	4
12.	Fire controlled:	No[1]	Yes	Yes
13.	Measurable fuel loss [gal (l)]:	1 (3.8)	No	No
14.	Significant observations:	Many plastic pour spouts melted on 5-gal (18.9-L) containers. Several 5-gal (18.9-L) containers bulged. One 1-gal (3.8-L) container ruptured or "bleved."	Six 5-gal (18.9-L) containers vented.	Twenty-four 5-gal (18.9-L) containers vented.

[1] A manually activated AFFF foam-water deluge system was activated at approximately 5 min. into test resulting in fire suppression.

Table 4B Fire Test Involving Shelf Storage of Uncartoned 1-Gallon (3.8-L) Metal F-Style Containers of Heptane, Shelf and Floor Storage of 5-Gallon (18.9-L) Metal Tighthead Containers of Heptane with Plastic Pour Spouts, Shelf and Floor Storage of Uncartoned 1-Gallon (3.8-L) Metal Friction Lid Containers of Latex Paint, Shelf Storage of 5-Gallon (18.9-L) Plastic Friction Lid Containers of Latex Paint and Floor Storage of 5-Gallon (18.9-L) Metal Tighthead Containers of Latex Paint

1.	Test location:	Underwriters Laboratories Inc., Northbrook, IL
2.	Ceiling height:	18 ft (5.5 m)
3.	Storage arrangement:	Retail store display involving an 8 ft (2.4 m) long by 4 ft (1.2 m) wide, 3 tier high double backed metal shelf arrangement and an 8 ft (2.5 m) long by 3 ft (0.9 m) wide pyramidal floor storage array. A 5-ft (1.5-m) aisle separated the shelf array from the floor array.
4.	Ignition:	5 gal (18.9 L) of heptane. Four 1-gal (3.8-L) plastic bags positioned in the center of aisle space and 1 gal (3.8 L) spilled over the bags for simultaneous ignition.
5.	Sprinklers:	½-in. (12.7-mm) standard orifice, 286°F (141°C), RTI = 400 (ft-sec)$^{0.5}$ [221 (m-sec)$^{0.5}$], 10 ft by 10 ft (2.5 m by 2.5 m) spacing.
6.	Sprinkler system type:	Wet pipe—water only.
7.	Fuel quantity [gal (l)]:	Heptane—326 (1,234), Latex paint—176 (666)
8.	Storage height [in. (m)]:	Shelf Array: 66 (1.7); Floor Array: 46 (1.2)
9.	Sprinkler system discharge density [gpm/ft^2 (mm/min)]:	0.19 (7.7)
10.	First sprinkler actuation (sec):	39
11.	Number of operating sprinklers:	4
12.	Fire controlled:	Yes
13.	Measurable fuel loss [gal (l)]:	No
14.	Significant observations:	Three 1-gal (3.8-L) latex paint container friction lids separated and popped off. Ten 5-gal (18.9-L) metal heptane containers vented. Four 5-gal (18.9-L) metal containers deformed.

Appendix F Fugitive Emissions Calculations

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

F-1 Introduction.

An alternative method of providing adequate ventilation for an enclosed area is by making a reasonable estimate of fugitive emissions from hydrocarbon-handling equipment within the enclosed area and providing sufficient diluent ventilation. Application of this method requires certain calculations, and one technique is described below.

In calculating the ventilation rate required, the anticipated hydrocarbon leakage rate (under normal conditions) must be determined. Then, sufficient dilution air must be added to the space in question to ensure that the concentration of flammable vapor/gas is maintained below 25 percent of the lower flammable limit (LFL) for all but periods of process upset, abnormal operation or equipment, rupture, or breakdown.

Fugitive emission factors for specific hydrocarbon handling equipment can be obtained from emission testing at specific facilities or from existing publications. A few existing publications are: API's *Fugitive Hydrocarbon Emissions from Petroleum Production Operations*, Volume I and II, 1980, and *EPA/Radian Study* conducted in 1979, and EPA's *Protocols for Generating Unit-Specific Emission Estimates for Equipment Leaks of VOC and HAP*, 1987 (Document No. 87-222-124-10-02). All emission data used should be reviewed to assure emission rates are representative of actual conditions during normal operations.

F-2 Calculation Technique.

In the example below, the required ventilation rate will be determined for an enclosed area (60 ft W × 120 ft L × 40 ft H) on a cold-weather, offshore platform containing production equipment.

1. List the total applicable hydrocarbon-handling components and their anticipated total hydrocarbon fugitive emissions. The fugitive emissions equipment component leak rates can be obtained from emission measurements at the facility in question, from one of the existing publications listed above, or from other studies that are representative of the equipment involved.

2. The total number of specific components handling hydrocarbons should be obtained by an actual field count for existing equipment or from the design drawings for proposed equipment. Note that components handling gas should be listed separately from those handling liquid hydrocarbons.

3. Determine the total anticipated gas emission (pounds day) for each component by multiplying the number of components by the applicable prediction factor. This product is the total gas emission anticipated for that specific type component.

4. Subtotal the total anticipated gas emissions (pounds day) for all components to obtain the total gas service emission rate.

5. Repeat Steps 2 through 4 to determine the hydrocarbon liquids total anticipated emissions.

6. Add the subtotals from Steps 4 and 5 to determine the total anticipated emissions.

7. Convert the total hydrocarbon emission from pounds/day to pounds/hour. For the example chosen, assume that the total anticipated hydrocarbon emissions is 297.26 lb/day. Dividing by 24, the conversion yields 12.39 lb/hour.

8. Calculate the average mole weight of the hydrocarbon emissions. An example follows:

83%	methane (Molecular Wt = 16)
13%	ethane (Molecular Wt = 30)
4%	butane (Molecular Wt = 58)
100%	

0.83 × 16 = 13.28
0.13 × 30 = 3.90
0.04 × 58 = 2.32
Total = 19.50

To simplify further calculations, the 19.5 is rounded to 20, and 20 is used as the average mole weight of the hydrocarbon emissions mixture.

9. Calculate the cubic feet/pound-mole at the estimated ambient temperature of the area. This calculation is made utilizing the fact that the volume of 1 pound-mole of an ideal gas is 359 cu ft at 32°F and 14.7 psia.

From the Gas Law ($PV = nRT$) and Charles' Gas Law ($V_1T_2 = V_2T_1$), and from the fact that volume at constant pressure varies proportionately to the ratio of temperatures when the temperature is expressed in degrees Rankine (°F + 460), calculate the actual volume. Assuming an ambient temperature of 88°F, an example follows:

At 88°F and 14.7 psia, 359 cu ft of ideal gas would occupy:

(359) (460 + 88)/(460 + 32), or 400 cu ft

10. Determine the total hydrocarbon leak rate in cubic feet per minute (cfm) using the equation:

$$G = \frac{(E)\ (V)}{60\ (mw)}$$

Where:
G = Leak rate, cfm
E = Emissions rate, lb/hr
V = Volume, ft³/lb-mole
mw = Average mole weight
60 = min/hour

In our example, E = 12.39 lb/hr and the average mole weight is 20,

G = (12.39 lb/hr) (400 ft³/lb-mole) / (60 min/hr) (20)
G = 4.13 cfm

11. As per NFPA 69, *Standard on Explosion Prevention Systems*, the hydrocarbon concentration may be expressed by the following equation:

$$C = (G/Q)\ (1 - e^{-kn}),$$

Where:
C = Concentration of hydrocarbon in air, % expressed as a decimal
G = Leak rate, cfm
Q = Fresh air introduction rate, cfm
n = Number of air changes
k = Mixing efficiency factor = 0.2 to 0.9

The factor $(1 - e^{-kn})$ can be considered equal to 1 because as the number of air changes (n) approaches steady state (i.e., approximately 3 air changes), this factor approaches unity.

As an example, if the leakage rate is assumed to be 4.13 cfm, 100 percent LFL methane is assumed (5 percent concentration), and it is desired to maintain a 25 percent LFL mixture, the required fresh air introduction rate may be determined as follows:

Q = 4.13 cfm/(0.25 × 0.05)
Q = 330 cfm

12. Due to the variations in emission factors for processing equipment, the calculated rate should be multiplied by a safety factor of 4. The required ventilation rate is determined as follows:

Q = 330 cfm × 4
Q = 1320 cfm, the minimum ventilation rate

Thus, minimum ventilation to achieve adequate ventilation for an enclosed area of the size given above that contains the fugitive emissions sources assumed is 1320 cfm.

13. Depending on the size of the enclosed area and the equipment configuration, supplemental internal recirculation may be advisable to avoid areas of stagnation. With higher local concentrations where recirculation is justified, it should be designed with adequate air movement and direction to minimize "dead" areas where vapor may collect. If other criteria is lacking, a recirculation rate of 1 cfm/ft² of floor area can be used.

14. If conditions exist where there is a substantial risk of a large flammable vapor release in a confined space and the calculated rate of diluent ventilation is not sufficient to dilute and disperse the released vapor to below the LFL within four hours, then supplemental emergency ventilation should be produced. This can be by natural ventilation through panels or louvers, or by switching recirculation fans to full fresh air make-up, or exhaust. Consideration should be given to the travel direction of ventilated vapor to avoid it reaching an ignition source outside the enclosed space being ventilated.

15. The above procedure is adapted from "Module Ventilation Rates Quantified," Oil and Gas Journal, W. E. Gale, December 23, 1985, p. 41.

Appendix G Referenced Publications

G-1 The following documents or portions thereof are referenced within this code for informational purposes only and thus are not considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

G-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 10, *Standard for Portable Fire Extinguishers*, 1990 edition.

NFPA 16A, *Recommended Practice for the Installation of Closed-Head Foam-Water Sprinkler Systems*, 1988 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 1992 edition.

NFPA 30B, *Code for the Manufacture and Storage of Aerosol Products*, 1990 edition.

NFPA 49, *Hazardous Chemicals Data*, 1991 edition.

NFPA 68, *Guide for Venting of Deflagrations*, 1988 edition.

NFPA 77, *Recommended Practice on Static Electricity*, 1993 edition.

NFPA 204M, *Guide for Smoke and Heat Venting*, 1991 edition.

NFPA 321, *Standard on Basic Classification of Flammable and Combustible Liquids*, 1991 edition.

NFPA 325M, *Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids*, 1991 edition.

NFPA 327, *Standard Procedures for Cleaning or Safeguarding Small Tanks and Containers Without Entry*, 1993 edition.

NFPA 329, *Recommended Practice for Handling Underground Releases of Flammable and Combustible Liquids*, 1992 edition.

NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, 1993 edition.

NFPA 497A, *Recommended Practice for Classification of Class I Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 1992 edition.

NFPA 497M, *Manual for Classification of Gases, Vapors, and Dusts for Electrical Equipment in Hazardous (Classified) Locations*, 1991 edition.

NFPA 780, *Lightning Protection Code*, 1992 edition.

G-1.2 Other Publications.

G-1.2.1 API Publications. American Petroleum Institute, 1220 L Street, N.W., Washington, DC 20005.

API 620-1982, *Recommended Rules for the Design and Construction of Large, Welded, Low-Pressure Storage Tanks.*

API 1615-1979, *Installation of Underground Petroleum Storage Systems.*

API 1632-1983, *Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems.*

API 2003, *Protection Against Ignition Arising Out of Static, Lightning, and Stray Currents.*

API 2015-1985, *Cleaning Petroleum Storage Tanks.*

API 2015A-1982, *A Guide for Controlling the Lead Hazard Associated with Tank Entry and Cleaning.*

API 2015B-1981, *Cleaning Open Top and Covered Floating Roof Tanks.*

"An Engineering Analysis of the Effects of Oxygenated Fuels on Marketing Vapor Recovery Equipment," September, 1990.

G-1.2.2 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D 86-82, *Standard Method of Test for Distillation of Petroleum Products.*

G-1.2.3 Association of Canadian Distillers Publication. Association of Canadian Distillers, Suite 1100, 90 Rue Sparks, Ottawa, Ontario, Canada K1P 5T8.

"Fire Tests of Distilled Spirits Storage Tanks," Client Report CR-5727.1.

G-1.2.4 NACE Publications. National Association of Corrosion Engineers, P.O. Box 218340, Houston, TX 77218.

NACE Standard RP-01-69 (1983 Rev.), Recommended Practice, *Control of External Corrosion of Underground or Submerged Metallic Piping Systems.*

NACE Standard RP-02-85, Recommended Practice, *Control of External Corrosion on Metallic Buried, Partially Buried, or Submerged Liquid Storage Systems.*

G-1.2.5 Oil and Gas Journal. PennWell Publishing Co., 3050 Post Oak Boulevard, Houston, TX 77056.

"Module Ventilation Rates Quantified," Gale, W. E., December 23, 1985, p. 41.

G-1.2.6 PEI Publication. Petroleum Equipment Institute, 6514 East 6th Street, Tulsa, OK 74133-1719.

PEIRP100-90, *Recommended Practices for Installation of Underground Liquid Storage Systems.*

G-1.2.7 ULC Publication. Underwriters Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario, Canada.

ULC-S603.1 M 1982, *Standard for Galvanic Corrosion Protection Systems for Steel Underground Tanks for Flammable and Combustible Liquids.*

G-1.2.8 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Code of Federal Regulations, Title 33, Navigation and Navigable Waterways, Parts 154-156.

Code of Federal Regulations, Title 46, Shipping, Parts 30, 32, 35, 39.

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APPENDIX D

Navy Environmental and Natural Resources Program Manual
"Storage Tanks"
(OPNAVINST 5090.1B)

CHAPTER 16

STORAGE TANKS

16-1 Scope

This chapter provides information and guidance applicable to the regulation of storage tanks (STs), both underground storage tanks (USTs) and aboveground storage tanks (ASTs) containing petroleum products and/or hazardous substances (HS) at Navy shore facilities within the United States, the Commonwealth of Puerto Rico, Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Marianas Islands. Responsibilities and requirements pertaining to Navy activities in foreign countries are described in Chapter 18. Petroleum storage tanks are also governed by the Spill Prevention Control and Countermeasure requirements described in Chapter 10.

16-1.1 References. Relevant references are:

a. 40 CFR 110, EPA Regulations on Discharge of Oil;

b. 40 CFR 112, EPA Regulations on Oil Pollution Prevention;

c. 40 CFR 280, EPA Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks;

d. OPNAVINST 5100.23D, Navy Underground Storage Tank Program Guidance Document, NAVFACENGCOM 1989; (NOTAL)

e. Tank Management System (TMS) Guidance Document, NAVFACENGCOM (NOTAL).

16-2 Legislation

16-2.1 Clean Water Act (CWA). The goal of the CWA is to protect the surface waters of the United States. Under the Clean Water Act, EPA published oil pollution prevention regulations in 1973. These regulations, contained in reference (b), were amended in 1974 and again in 1976. The CWA prohibits the discharge of oil into surface waters, if the discharge violates applicable State standards or causes a sheen on, or film upon, or discoloration of the surface of the water, or sludge beneath the water surface. The Federal Oil Pollution Prevention Regulations require preparation of Spill Prevention Control and Countermeasures Plans and also contain specific guidelines for the design and operation of petroleum storage tanks (see Chapter 9). The guidelines for oil storage tanks in reference (b) include requirements for secondary containment; control of stormwater drainage from containment areas; corrosion protection of buried metallic tanks and piping; inspection and testing of aboveground tanks; testing of underground tanks and pipelines; requirements for spill prevention devices such as high level alarms, security requirements for oil storage areas, and personnel training requirements. In 1991, the EPA proposed extensive revisions to reference (b), which are to be implemented in 2 phases. The Phase I revisions proposed to change many recommended practices into mandatory regulatory requirements and would also require the registration of aboveground storage tanks. Phase II revisions, which are expected to be more substantive in nature, would include requirements for facility-specific contingency plans and would mandate aboveground storage tank integrity testing. Neither Phase I or Phase II revisions have yet been issued.

16-2.2 Hazardous and Solid Waste Amendments (HSWA). HSWA extended and strengthened the provisions of the Solid Waste Disposal Act (SWDA) as amended by the Resource Conservation and Recovery Act (RCRA). One major

portion, Subtitle I, provides for the development and implementation of a comprehensive regulatory program for Underground Storage Tanks (USTs) containing "regulated substances" and releases of these substances to the environment. HSWA requires that Federal facilities comply with all Federal, State, and local requirements regarding USTs, including payment of registration fees or permit fees when such fees are not taxes.

Federal regulations outline procedures by which EPA may approve State programs to operate in place of the Federal UST requirements if those State programs have standards that are no less stringent than the Federal requirements and provide for adequate enforcement of compliance with those standards. States with approved UST programs or Memoranda of Understanding (MOUs) with EPA will have primary enforcement responsibility with respect to UST program requirements in their States. Currently most States have a UST regulatory program in place. After EPA approves the State program, facilities must comply with all applicable provisions of the State UST programs.

16-3 Terms and Definitions

16-3.1 **Above Ground Storage Tanks (ASTs).** All tanks and attached piping containing regulated substances in which greater than 90 percent of the tank volume (including piping) is above the surface of the ground.

16-3.2 **Petroleum.** Petroleum, including crude oil or any fraction thereof, that is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute.)

16-3.3 **Regulated Substance.** Any HS regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (excluding any substances regulated as hazardous waste (HW) under Subtitle C of RCRA), and petroleum substances including crude oil, motor fuels, jet fuels, distillate fuel oils, residual fuel oils, lubricants, petroleum solvents and used oils.

16-3.4 **Release.** Any spilling, leaking, emitting, discharging, escaping, leaching, or disposing of a HS or petroleum from a ST into ground water, surface water, or subsurface soils.

16-3.5 **Storage Tanks (STs).** All storage tanks (both above and underground), containing regulated substances.

16-3.6 **Tank Management Plan.** An operations and management document, for activity-level use, that stresses above and underground storage tank spill prevention, planning, regulatory compliance, and record keeping.

16-3.7 **Underground Storage Tanks (USTs).** All tanks and attached piping containing regulated substances in which 10 percent or more of the tank volume (including piping) is beneath the surface of the ground. The following systems are excluded from Federal regulation under RCRA Subtitle I (but may be regulated by States):

a. Any UST system holding HW listed or meeting the criteria of Subtitle C of RCRA, or a mixture of such HW and other regulated substances (such tanks are regulated under RCRA Subtitle C).

b. Any wastewater treatment tank system that is part of a wastewater treatment facility regulated under Section 402 or 307(b) of the CWA.

c. A farm or residential tank of 1,100 gallons or less capacity used for storing motor fuel for noncommercial purposes.

d. A tank of 1,100 gallons or less used for storing heating oil for consumptive use on the premises where stored.

e. A stationary tank of 1,100 gallons or less used for storing fuel to supply stationary fuel-fired equipment through a system of fixed valves or piping.

f. Any UST system that contains a de minimis concentration of regulated substances.

g. Any emergency spill or overflow containment UST system that is expeditiously emptied after use.

h. Any tank system on or above the floor of underground areas, such as basements or tunnels.

i. Any surface impoundment, pit, pond, or lagoon.

j. Any septic tank or stormwater/wastewater collection system.

k. Any flow-through process tank.

l. A liquid trap or associated gathering lines directly related to oil or gas production and gathering operations.

m. A pipe connected to a tank, system, trap, or line described in clauses 16-3.7a through l.

16-4 Requirements

16-4.1 General Operating Requirements

16-4.1.1 Transfer operations will be monitored to ensure that spilling or overflowing does not occur. Overfill protection equipment will be maintained to prevent releases.

16-4.1.2 Corrosion protection measures, including cathodic protection, will be maintained and inspected.

16-4.1.3 Installation of new ST systems and repairs to existing ST systems will be conducted according to Federal, State, and local requirements.

16-4.1.4 Written records demonstrating compliance with operational requirements will be maintained by the activity.

16-4.2 Aboveground Storage Tanks (ASTs)

16-4.2.1 General Operating Requirements. ASTs are not currently subject to Federal regulation beyond the petroleum pollution prevention and discharge reporting requirements of references (a) and (b). Some States have new AST regulations, but these are not applicable to the Navy by law since there has been no waiver of sovereign immunity except where an agreement to the contrary has been executed between the Navy and a State. Activities with ASTs will apply best management practices to the daily operation of those ASTs.

16-4.2.2 Release Detection, Testing, and Inspection. Whenever possible, release detection systems will be installed on AST systems.

16-4.2.3 Release Reporting, Investigation, and Confirmation. Releases of petroleum or HS from ASTs should be reported according to the guidance in Chapter 10. Suspected releases from the underground portions of ASTs will be immediately investigated by integrity testing and/or by performing a subsurface investigation. If regulated substances are found in adjacent properties, then the EPA or State agency can require an activity to conduct a release investigation of suspect STs.

16-4.2.4 Out-of-Service ASTs and Closure. Permanent closure of ASTs will be conducted per any applicable State or local regulations. At a minimum, ASTs and associated pipelines will be emptied and cleaned and pipelines will be either capped or blank flanged, and marked as to origin.

16-4.3 Underground Storage Tanks (USTs)

16-4.3.1 General Operating Requirements

16-4.3.1.1 All new UST systems must be protected from corrosion, must be equipped with spill/overfill prevention equipment and with an approved method of release detection, and must be installed per nationally recognized standards. New pressurized piping that conveys regulated substances must also be properly designed, constructed, protected from corrosion, and equipped with an automatic line leak detection system. Repairs will be tested for tightness; records of all repairs are required to be maintained for 5 years.

16-4.3.1.2 Existing USTs that are regulated by Federal, State, or local regulations will be either replaced or upgraded to meet corrosion protection and spill/overfill prevention standards by 22 December 1998 or per applicable Navy/State agreement. Existing USTs that are either exempt or deferred from the UST regulations will be replaced or upgraded if possible, particularly if those USTs are located in environmentally sensitive areas. Existing USTs will be upgraded by the addition of secondary containment, spill/overfill prevention equipment, and corrosion protection as dictated by the activity's SPCC plan. Existing piping associated with tank systems will also be either upgraded or replaced to meet corrosion protection requirements.

16-4.3.1.3 All new and existing HS USTs and associated underground piping will have secondary containment by 22 December 1998 or per applicable Navy/State agreement.

16-4.3.2 Release Detection, Testing, and Inspections. Any UST system that stores fuel solely for emergency power generators is exempt from release detection requirements.

16-4.3.2.1 Release detection systems will be installed on petroleum and HS UST systems as required by Federal, State, or local regulations. Whenever possible, release detection systems will also be installed on non-regulated USTs.

16-4.3.2.2 Records demonstrating compliance with release detection requirements and with testing and inspection requirements will be maintained by the activity.

16-4.3.3 Release Reporting, Investigation and Confirmation

16-4.3.3.1 Releases and suspected releases from USTs will be reported to the EPA or State agency within 24 hours of discovery. HS releases and releases of petroleum or HS into surface waters from USTs should be reported according to the guidance in Chapter 11.

16-4.3.3.2 Suspected releases from USTs will be immediately investigated by integrity testing and/or by performing a subsurface investigation. If regulated substances are found in adjacent properties, then the EPA or State agency can require an activity to conduct a release investigation of suspect STs.

16-4.3.4 Release Response and Corrective Action for UST Systems Containing Regulated Substances

16-4.3.4.1 After a confirmed release is reported to either the EPA or State agency, further release of regulated substance from the UST must be stopped, and fire, explosion, and vapor hazards will be mitigated. If necessary to prevent any further release, the UST system will be emptied. Steps to prevent further migration of any aboveground or exposed below ground releases will be taken. If the source of an underground release is not known, subsurface sampling will be conducted in order to determine the source. The possible presence of free product will be investigated and recovery of free product will be conducted as soon as practicable. UST releases into surface waters require the response actions described in Chapter 10 to be taken.

16-4.3.4.2 UST releases require an initial abatement report, initial site characterization report, and free product recovery report to be submitted to the EPA or State agency within the time frame specified by the agency. In addition, a release investigation report and/or corrective action plan will be submitted if requested or otherwise required by the EPA or State agency.

16-4.3.4.3 Soil and groundwater contamination resulting from UST releases will be cleaned up per an approved corrective action plan or as otherwise authorized or requested by the EPA or State agency. Prior to any cleanup, the EPA or State agency will be notified of the activity's intent to begin cleanup.

16-4.3.4.4 Free floating product will be removed to the maximum extent practicable.

16-4.3.4.5 Soil and ground-water contamination will be investigated to determine cleanup measures.

16-4.3.5 Out-of-Service UST Systems and Closure

16-4.3.5.1 Corrosion protection systems will be maintained during temporary closure of an UST system even if the system is empty. Release detection systems will continue to be operated unless the system is emptied.

16-4.3.5.2 When USTs are temporarily closed for 3 months or more, vent lines will be left open and functioning and all other lines, pumps, manways, and ancillary equipment will be capped and secured.

16-4.3.5.3 USTs that do not meet the standards for new or upgraded UST systems will be permanently closed within 12 months of temporary closure unless an extension is granted by the EPA or State agency.

16-4.3.5.4 The EPA or State agency will be notified at least 30 days in advance of an UST permanent closure. For permanent closure, USTs will be emptied, cleaned, and either filled with a solid inert material or removed from the ground. A site assessment will be conducted at the time of permanent closure unless an approved external release detection method was in use prior to closure. If contamination is encountered during closure, then corrective action will be initiated.

16-4.3.5.5 Continued use of a regulated UST system to store a non-regulated substance is considered a change-in-service. A change-in-service requires that the UST be emptied and cleaned and that a site assessment be performed. The EPA or State agency will be notified 30 days in advance of a change-in-service.

16-4.3.5.6 The EPA or State agency can require investigation and cleanup of USTs that were permanently closed prior to 22 December 1988 if the UST site may pose a threat to human health or the environment.

16-4.3.5.7 Permanent closure, site assessment, site characterization, and corrective action records will be maintained for at least 50 years to protect the Navy from potential future liability.

16-5 Navy Policy

16-5.1 The Navy's ST Program policy is to comply with all applicable Federal, State, and local regulations pertaining to the management of STs.

16-5.2 Whenever possible, the Navy shall replace older, unprotected steel tanks with state-of-the-art ASTs or state-of-the-art double-walled USTs with continuous interstitial monitoring.

The Navy's preferred method of UST system closure is by removal. Leaving an UST system in the ground and filling it with an inert material

shall be done only when extenuating circumstances preclude the removal of an UST system.

16-5.3 Navy activities with STs shall have a tank management plan containing the following information:

a. Listing of all STs at the Activity.

b. For USTs, the regulatory requirements for each.

c. A plan of action for achieving and maintaining compliance through monitoring, removal, repair, retrofit, replacement, and remediation of regulated ST systems.

It is recommended that the ST management plan include all STs that have the potential to cause environmental damages and/or health hazards regardless of whether the ST is included in existing regulations. For example, a currently exempt UST, such as an UST that stores heating oil, should be included in the UST management plan if a release from the UST has the potential to cause environmental problems such as groundwater contamination. In addition, non-regulated ASTs that are likely to be included in future Federal, State, or local regulations should be included in the ST management plan.

16-5.4 Reference (e) details Navy policy and technical guidance for the implementation of the Navy's UST program. The principles therein can be expanded to include ASTs and non-regulated USTs.

16-5.5 Training. Environmental Engineers, Environmental Planners, activities, Resident Officer in Charge of Construction (ROICC), Public Works Department (PWD) Engineers, major claimant staff, and all other personnel involved in the design, construction, installation, management, and operation of storage tanks shall be trained on storage tank systems. This training shall include as applicable: corrosion protection measures, compliance records, release detection, reporting investigation and confirmation, corrective action plans, closure, site assessment, Federal, State, and local regulations pertaining to STs, monitoring, removal, repair, retrofit, replacement, remediation, leak detection and product inventory requirements, recordkeeping and operation of monitoring systems.

16-6 Responsibilities

16-6.1 COMNAVFACENGCOM shall:

a. Assist Navy activities in the preparation of ST Management Plans and Pollution Control Reports (PCRs).

b. Provide technical advice and assistance to Navy activities for leak detection services.

c. Revise technical directives and design manuals to reflect regulatory requirements for new construction of STs, including underground piping and leak detection devices.

d. Provide assistance to major commands and their installations for estimation of resource requirements.

e. Provide funding and execution of ST corrective actions that qualify for Defense Environmental Restoration Account (DERA) funding and are within current priorities.

f. Ensure funding is available to train Engineering Field Division (EFD) Environmental Engineers, Environmental Planners, and other personnel involved with STs.

16-6.2 COMNAVSUPSYSCOM shall provide technical input and assistance to COMNAVFACENGCOM concerning leak detection, construction of new STs, and the disposition of petroleum recovered during site restoration.

16-6.3 Major claimants and subordinate commands shall include requests for resources to meet ST compliance requirements in Program Objective Memorandum (POM)/budget submittals.

16-6.4 Commanding officers of shore activities shall:

a. Assemble and collate ST data including storage tank volume, type, installation date, and tank contents for achieving and maintaining compliance with all applicable Federal, State, and local laws and regulations.

b. Ensure that notification forms are completed for regulated STs and forward the notification to the appropriate State agency. Copies shall be provided to Naval Facilities Engineering Services Center (NFESC), cognizant NAVFACENGCOM EFDs, and the chain of command.

c. Prepare and maintain ST Management Plans, with assistance from NAVFACENGCOM, to document a plan of action for achieving and maintaining compliance with all applicable Federal, State, and local laws and regulations. The Plan shall include or reference compliance records demonstrating storage tank inspection/testing of corrosion protection system, release detection system, secondary containment systems, spill and overflow controls, repair documentation, site investigation results and closure.

d. Accomplish leak detection and product inventory requirements, recordkeeping and operation of monitoring systems required by Federal, State, and local ST laws and regulations.

e. Fund the installation of tank leak detection and monitoring systems required by local, State, and Federal regulatory agencies.

f. Budget sufficient resources to replace or repair STs as required by applicable Federal, State, and local laws and regulations or by best management practices.

g. Comply with applicable Federal, State, and local laws and regulations concerning the construction of new ST systems.

h. Prepare PCRs and exhibits, with the assistance of NAVFACENGCOM EFDs, for all compliance-mandated ST projects, regardless of funding source.

i. Ensure that all actions involving tank management follow all occupational health and safety requirements per reference (d).

APPENDIX E

Sample Weekly Facility Inspection Checklist

NAB Satellite Accumulation, SPCC/AST, & Stormwater Pollution Prevention Checklist

SAMPLE WEEKLY FACILITY INSPECTION CHECKLIST

DATE: _____ INSPECTOR: _____

AREAS COVERED: _____

YES	NO	N/A		
___	___	___	1.	Containment dike or berm in satisfactory condition.
___	___	___	2.	Containment area free of standing water or oil.
___	___	___	3.	Containment area free of high grass, weeds and debris.
___	___	___	4.	Swales and drainage structures free of dirt and debris.
___	___	___	5.	Ground surface around tanks, containment structures and loading areas checked for signs of leakage.
___	___	___	6.	Manual drainage valves for containment areas are secured.
___	___	___	7.	Separator or drainage tanks in satisfactory condition.
___	___	___	8.	Tank shell surface, including any peeling areas, welds, rivets/bolts, seams and foundation visually inspected for leaks or areas of rust and other deterioration.
___	___	___	9.	Leak detection equipment in satisfactory condition.
___	___	___	10.	Tank water draw-off valves locked/sealed.
___	___	___	11.	Tank valves closed/locked when not in use.
___	___	___	12.	Valves inspected for signs of leakage or deterioration.
___	___	___	13.	Relief valves, expansion joints and pipe fittings inspected for leakage or deterioration.
___	___	___	14.	Inlet and outlet piping and flanges inspected for leakage or damage.
___	___	___	15.	Pipe supports in satisfactory condition.

SPECIFIC COMMENTS

ITEM #	OBSERVATION

Inspector's Signature: _____

NAB SATELLITE ACCUMULATION, SPCC/AST, & STORMWATER POLLUTION PREVENTION CHECKLIST

VIRGINIA REGULATIONS AND NAVPHIBASE BMPs

(Check SAT/UNSAT, or Mark "N/A")

	SAT/UNSAT	
1. Only 55 gallons of hazardous waste is being accumulated at or near generation point.	☐	☐
2. All Hazardous Waste and NON-Regulated Materials are labeled and filled out with the name of the material. Add start date only when HW drum is full	☐	☐
3. Excess accumulation of 55 gallons of hazardous waste has been transferred to Bldg. #106 within 72 hours.	☐	☐
4. Containers, Berms, and ASTs. Condition: No Leaking, damage, or excessive corrosion of Berms, Valves, Roofs, or Containers. Berm Valve is closed and Locked. Containers have proper lids. Water in Berm is released only after ensuring no visible sheen.	☐	☐
5. Compatibility of material with container: Container should be made of or lined with materials which will not react with the material stored in it.	☐	☐
6. Containers are kept closed except when adding or removing waste or material.	☐	☐

	SAT/UNSAT	
1. Area is clean following good housekeeping practices. Floors and Containment Areas are free of Leaks and Spills.	☐	☐
2. "NO SMOKING WITHIN 50 FEET" AND "HAZARDOUS WASTE" signs posted in HW area.	☐	☐
3. Drums are not stored near storm drains or sanitary sewers. And are stored in secondary containments (i.e. berms or lockers)	☐	☐
4. Control measures are established to prevent unauthorized use of area.	☐	☐
5. A spill response kit is kept on site that contains: 2 pairs of rubber gloves, 1 bag of oil dry, 1 bundle of rags, and 1 shovel.	☐	☐
6. The Satellite Accumulation area and NON-Regulated areas, shall be contained (i.e. paint locker, containment berm) or bermed by sand bags.	☐	☐
7. Above Ground Storage Tank(AST) overspill prevention, gauges, valves function properly.	☐	☐
8. Drum or AST tank log is maintained and up to date and weekly inspection checklists are sent to EQD.	☐	☐

Circle
Program:(SA)(SPCC/AST)(SWPP)
DATE/TIME: / /95
COMMAND/BLDG#:
PRINTED NAME:
SIGNATURE:
PHONE:
WASTE/MAT. TYPE(S):

FAX, Deliver, or Guard Mail Weekly to the Environmental Quality Division, Bldg. #3165,

FAX# 464-7060. Questions Regarding (HW) call X-4212, (SPCC/AST) call X-4571, (SWP3) call X-4348.

APPENDIX F

Recommended Personnel Training Program

RECOMMENDED TRAINING PROGRAM
FOR
FACILITY PERSONNEL

I. Training Specific to the Facility (required per VR 680-14-13)

A. Who should attend (as a minimum)
   1. Facility operations personnel
   2. Persons conducting daily and weekly inspections
   3. Maintenance personnel, applicable topics only
   4. Emergency response personnel, applicable topics only

B. Possible Instructors
   1. Supervisory personnel
   2. On-base fire department personnel
   3. Emergency response coordinators
   4. Administration personnel

C. Training Interval
   1. Continuous monthly or bi-monthly meetings
   2. On-site training program should be organized such that all of the following topics are covered within an annual time frame.
   3. Training program should be a continuous process such that sessions in following years become "annual refreshers".

D. Training Session Topics:
   1. Fuel Department Operations Manual
      a. Material Safety Data Sheet (MSDS) information for all products stored at the facility.
      b. Standardized Fuel Department Procedures (FDP's)
         1) Fuel transfers
         2) Safety issues
            a) Personnel protection
            b) Fire prevention
   2. Spill Prevention, Control, and Countermeasures (SPCC) Plan
      a. Site specific information
      b. Required inspections
   3. Facility Response Plan
      a. Procedures to follow upon hazard recognition
      b. Inventory and locations of spill response equipment
   4. Aboveground Storage Tank (AST) Management Plan
      a. Performance of daily visual inspections
      b. Procedures for conducting weekly facility inspections

II. Other Training Mandated by Regulations

A. Evaluation of Aboveground Storage Tanks (Required per VR 680-14-13)

1. Who should attend (as a minimum)
   a. Persons conducting daily and weekly inspections
   b. Maintenance personnel
   c. Operations personnel

2. Possible Instructors
   a. Certified American Petroleum Institute (API) Tank Inspector
   b. Experienced tank inspector
   c. Design professional with experience in tank renovation

3. Training Interval
   a. Detailed initial training class for all new employees
   b. Annual refresher sessions

4. Training session topics
   a. API publications 650 and 653 information
   b. API "Guide for Inspection of Refinery Equipment", Chap. XIII
   c. Safety issues

B. Hazardous Waste Operations and Emergency Response (HAZWOPER)

Required per OSHA Regulation 29 CFR 1910.120

1. First Responder Awareness Level Training ("Right-to-Know")

a. Who should attend (as a minimum)
   1) All full- or part-time facility personnel
   2) Contractors working on-site

b. Possible instructors
   1) Facility personnel with prior training and competent knowledge of topics.
   2) On-base fire department personnel
   3) Qualified training instructor

c. Training interval
   1) Initial training class
   2) Annual refresher courses are required

d. Training session topics
   1) Materials stored at facility
   2) Potential risks
   3) Hazard identification
   4) Hazard communication/Notification of Hazard
   5) Monitoring and Detection

2. First Responder Operations Level Training

a. Who should attend (as a minimum)
   1) Facility operations personnel
   2) Supervisory personnel
   3) Maintenance personnel
   4) Administration personnel that are on-site at any time
   5) On-site contractors left unescorted
   6) Base security personnel that patrol fuel storage areas
   7) Initial emergency response personnel
   8) Personnel conducting daily and weekly inspections

b. Possible instructors
   1) Facility personnel with prior training and competent knowledge of topics.
   2) On-base fire department personnel
   3) Qualified training instructor

c. Training interval
   1) Initial training class
   2) Annual refresher courses are required

d. Training session topics
   1) Work-site safety
   2) Basic hazard and risk assessment techniques
   3) Medical surveillance program (OSHA 29 CFR 1910.20)
   4) Personnel protective equipment
   5) Basic control and containment operations
   6) Monitoring and Detection
   7) Contingency Planning
   8) Decontamination
   * 9) Confined Space Entry (Req'd per 29 CFR 1910.146)
   * 10) Lockout/Tagout Requirements (per OSHA 29 CFR 1910.147)

* Note: It is most advantageous to cover Confined Space Entry and Lockout/Tagout procedures in a separate, more detailed course.

3. **Hazardous Materials Technician, Hazardous Materials Specialist, and On-Scene Incident Commander Training.**

Note: These 24-hour training courses are mandatory per OSHA 29 CFR 1910.120 for individuals who can be considered as emergency response personnel. The course required is dependent upon an employee's defined role in the emergency response operations.

C. **Hazardous Waste Management Training**
(Required per 40 CFR 262, 264, and 265)

1. Who must attend (as a minimum)
   a. Employees involved in handling hazardous wastes as defined by 40 CFR 261 and 262 (includes generated wastes such as spilled gasolines or solvents).

2. Instructor
   a. Qualified training instructor

3. Training interval
   a. Initial course
   b. Annual refresher course

4. Training session topics:
   a. Hazardous waste identification
   b. Marking of hazardous wastes
   c. Contingency plans
   d. Personal protective equipment
   e. Monitoring and detection
   f. Hazards posed