MIL-HDBK-1025/2
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SUPERSEDING
See para. 1.2

MILITARY HANDBOOK

DOCKSIDE UTILITIES

FOR

SHIP SERVICE

AMSC N/A

FACR

ABSTRACT

This handbook provides design criteria and guidance are presented for use by experienced engineers in the design of utility systems for piers, wharves and drydocks. Criteria are given for repair and active berthing, supply and ammunition piers and fueling piers. Utilities covered include steam, compressed air, salt or non-potable water, potable water, electric power, telecommunications and POL. Extensive tabular information and other data are included to establish the utility requirements of ships and the locations of their points of connection.

FOREWORD

This handbook has been developed from an evaluation of facilities in the shore establishment, from surveys of the availability of new materials and construction methods, and from selection of the best design practices of the Naval Facilities Engineering Command (NAVFACENGCOM), other Government agencies, and the private sector. This handbook was prepared using, to the maximum extent feasible, national professional society, association, and institute standards. Deviations from this criteria, in the planning, engineering, design, and construction of naval shore facilities, cannot be made without prior approval of NAVFACENGCOMHQ Code 04.

Design cannot remain static any more than can the functions it serves or the technologies it uses. Accordingly, recommendations for improvement are encouraged and should be furnished to Commander, Atlantic Division, Naval Facilities Engineering Command, Code 04A4, Norfolk, VA 23511-6287, telephone (804) 444-9970.

THIS HANDBOOK SHALL NOT BE USED AS A REFERENCE DOCUMENT FOR PROCUREMENT OF FACILITIES CONSTRUCTION. IT IS TO BE USED IN THE PURCHASE OF FACILITIES ENGINEERING STUDIES AND DESIGN (FINAL PLANS, SPECIFICATIONS, AND COST ESTIMATES). DO NOT REFERENCE IT IN MILITARY OR FEDERAL SPECIFICATIONS OR OTHER PROCUREMENT DOCUMENTS.

PIERS AND DOCKSIDE FACILITIES CRITERIA MANUALS

Criteria Manual	Title	PA
MIL-HDBK-1025/1	Piers and Wharves	LANTDIV
MIL-HDBK-1025/2	Dockside Utilities for Ship Service	LANTDIV
MIL-HDBK-1025/3	Cargo Handling Facilities	LANTDIV
DM-25.4	Seawalls, Bulkheads, and Quaywalls	LANTDIV
DM-25.5	Ferry Terminals and Small Craft Berthing Facilities	LANTDIV
MIL-HDBK-1025/6	General Criteria for Waterfront Construction	LANTDIV

NOTE: Design manuals, when revised, will be converted to military handbooks.

This handbook is issued to provide immediate guidance to the user. However, it may or may not conform to format requirements of MIL-HDBK-1006/3 and will be corrected on the next update.

DOCKSIDE UTILITIES FOR SHIP SERVICE

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Section 1: INTRODUCTION

1.1 Scope. This handbook establishes criteria for the design of utility services for piers, wharves, and graving drydocks. NAVFAC DM-29.1, Graving Drydocks provides supplemental and related utility data for use specifically in drydock applications. Navy waterfront terminology is defined in the Glossary Section.

1.2 Cancellation. This handbook cancels and supersedes interim criteria of December 1984 and Chapter 3 of NAVFAC DM-25, Waterfront Operational Facilities of October 1971.

Section 2: GENERAL UTILITY REQUIREMENTS

2.1 Ships Demands. Ships demands and other pertinent data for individual ships utilities are tabulated in Section 3. Diversity factors are provided for use in determining demand in multiple berthing. This information is for use at new facilities and for use in additions, modifications, and replacements at existing facilities. While means of diversification are provided for multiple ships and multiple piers by the diversity factors, metered data from existing facilities and ships are to be used for planning and design whenever such data are available.

2.2 Utility-Connection Layout. Figure 1 shows the dimensional relationships normally encountered in placement of shore utility connections. Figures 2 through 13 provide size/shape data for typical hulls, together with reference points needed for plotting ships utility connections from dimensions given in various tables herein. Graphic Engineering Mapping System (GEMS) tapes, for computer generation of hull configurations, are available from NAVFAC HQ, Code FPO-3, for some ships. Ideally, the locations of shore utility connections for a given berth would simply correspond to their respective connection locations on the ship to be berthed. In practice, however, utility-connection locations can never be ideal, due to largely nondedicated berthing, interference with other pier or wharf activities, other deck equipment, and the grouping of connections.

2.2.1 Connection Grouping. Utility connections should be confined to specific locations along a shore facility so that interference with line handling and other facility operations is reduced. Connections may be in large groups to encompass all utilities, or may be in subgroups, such as the following:

a) freshwater, saltwater, steam, and compressed air;
b) electrical power and communications;
c) sewer and oily waste; and
d) Petroleum, Oil and Lubricants (POL), when required.

Regardless of the variations in utility groups which may be necessary to accommodate deck fittings and pier construction, sewer and oily waste connections must always be located 10 ft (3.05 m) or more from domestic water connections, and electrical outlet assemblies must be separated from other utility outlets by at least 10 ft whenver possible. Additionally, where fueling is required, separation between such connections and electrical equipment is mandatory.

2.2.2 Hose and Cable Lengths. It is apparent from para. 2.2.1 that, if utilities are to be grouped, not all of the shore connections can be placed optimally in regard to their respective ship connections, even at a dedicated berth. This being the case, the location of connections for certain utilities shall be given preference in the design, in order to minimize required hose lengths. Preference shall be given, in order of importance, to steam, fire-protection water, electrical power, and sewage.

2.2.2.1 Steam. Steam hoses have a very short life, are expensive, and usually have high pressure losses from shore to ship.

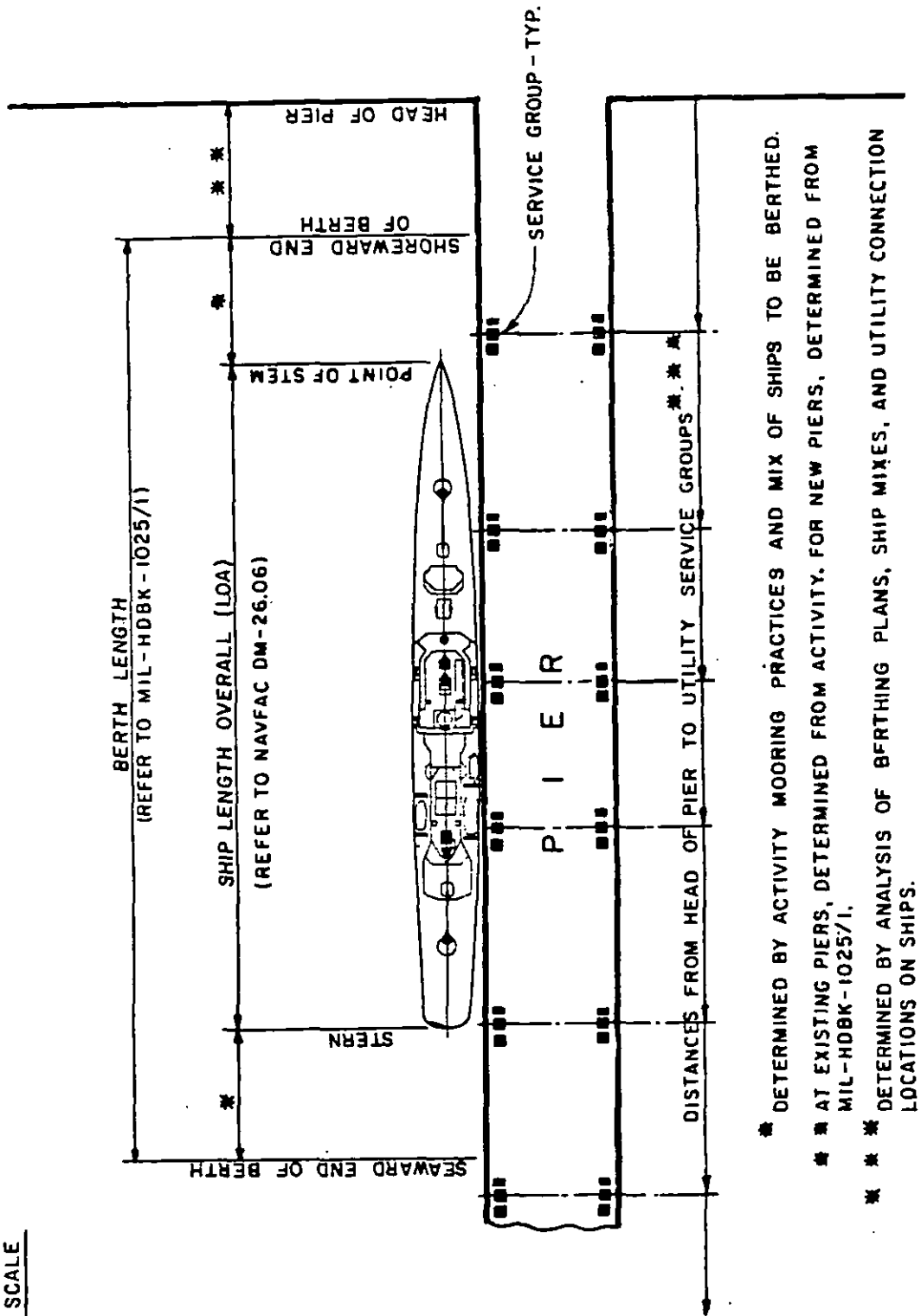

Figure 1
Typical Ship-Berth-Pier-Utility Relationships

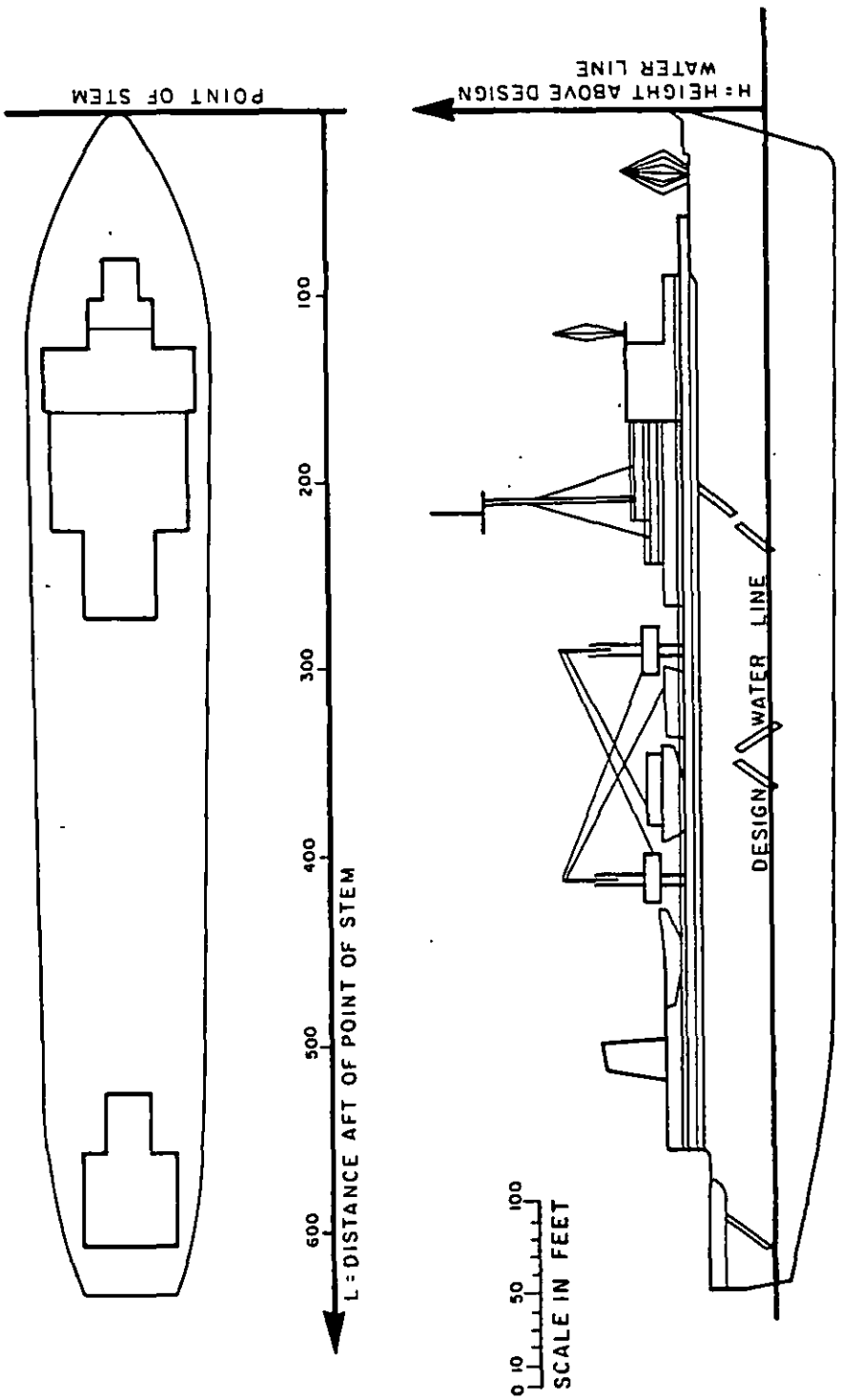

Figure 2
AD-41 and Similar Ships--Plan/Profile with Utility Location Reference Lines

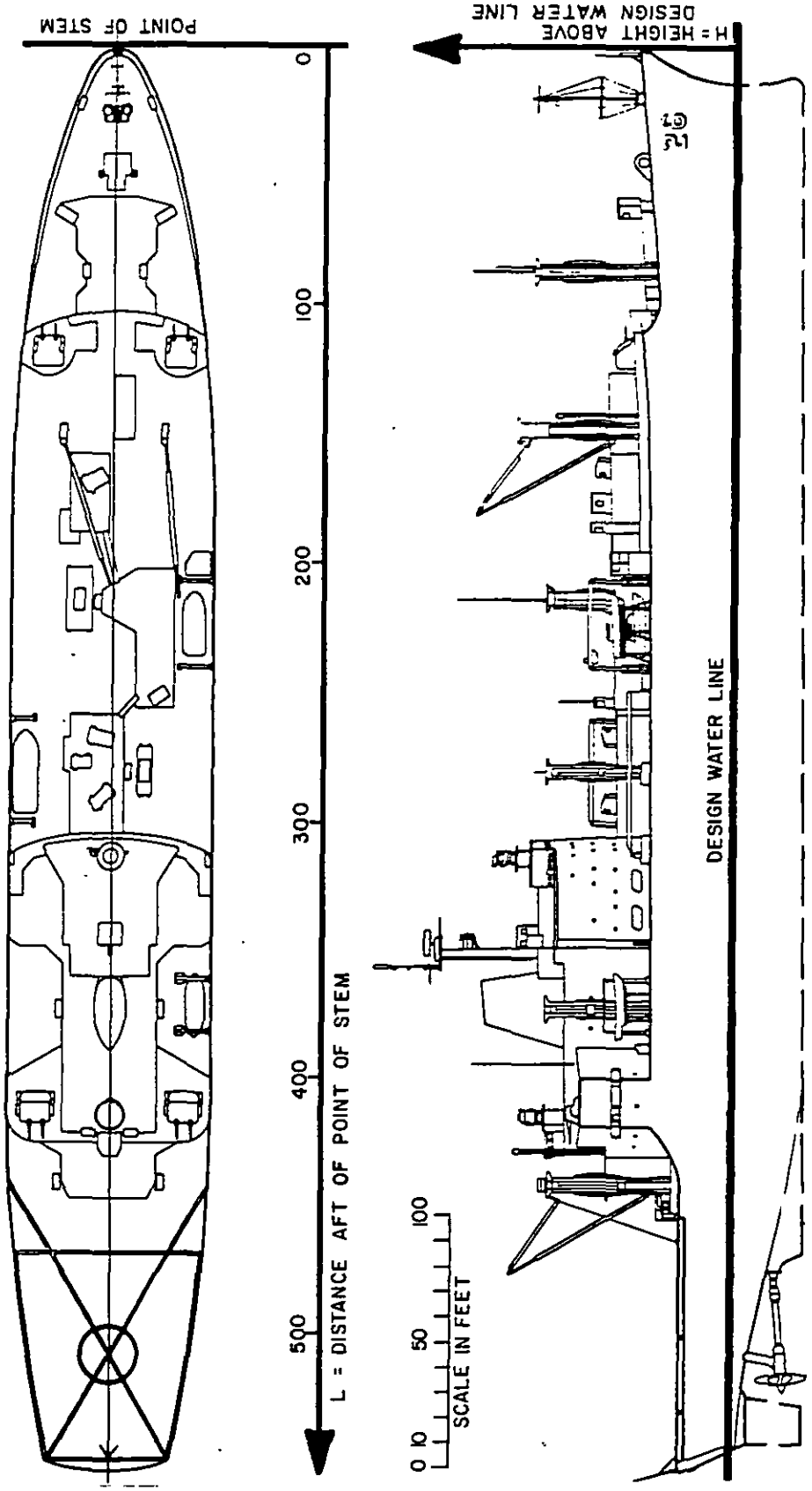

Figure 3
AE-26 and Similar Ships--Plan/Profile with
Utility Location Reference Lines

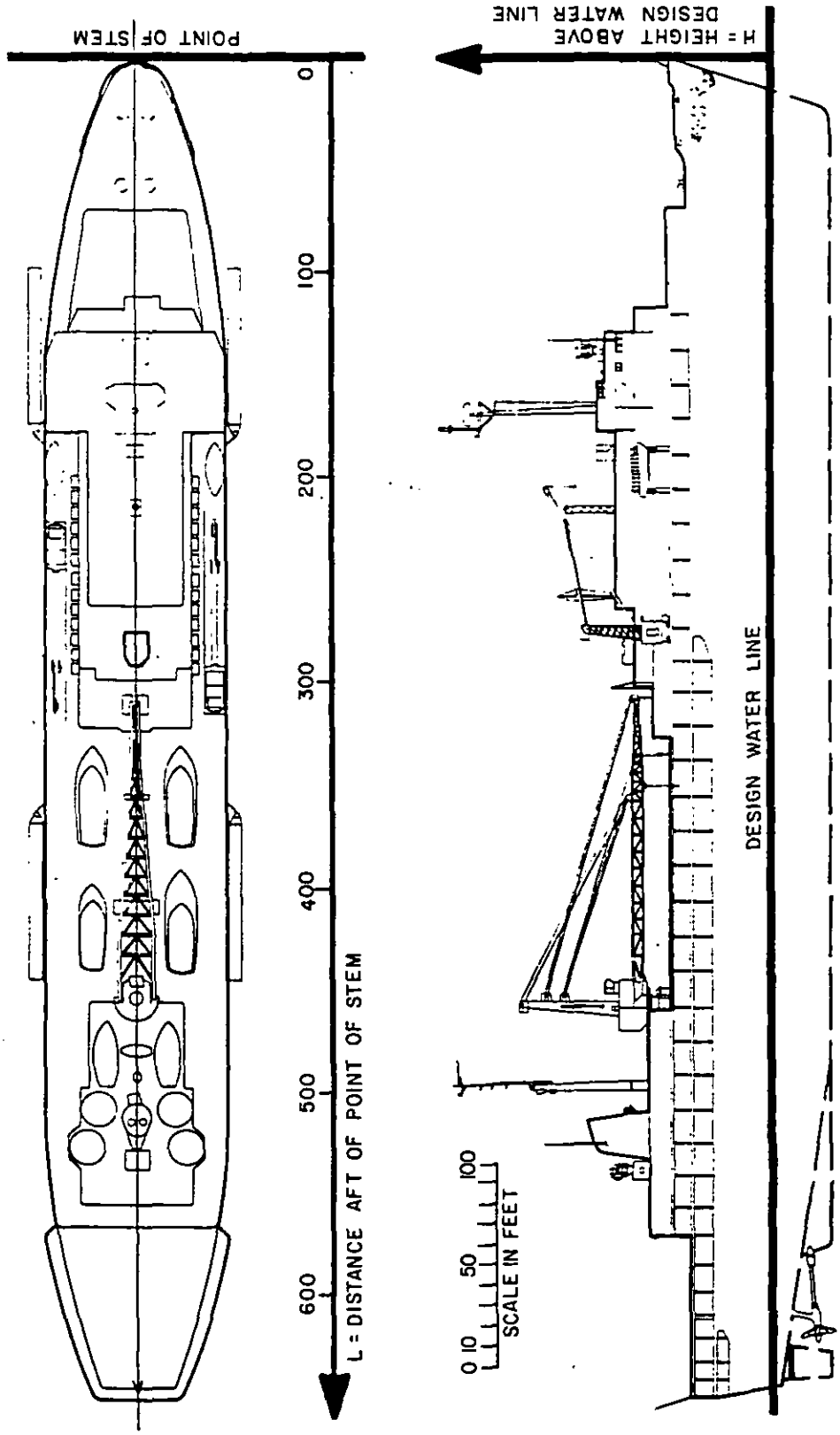

Figure 4
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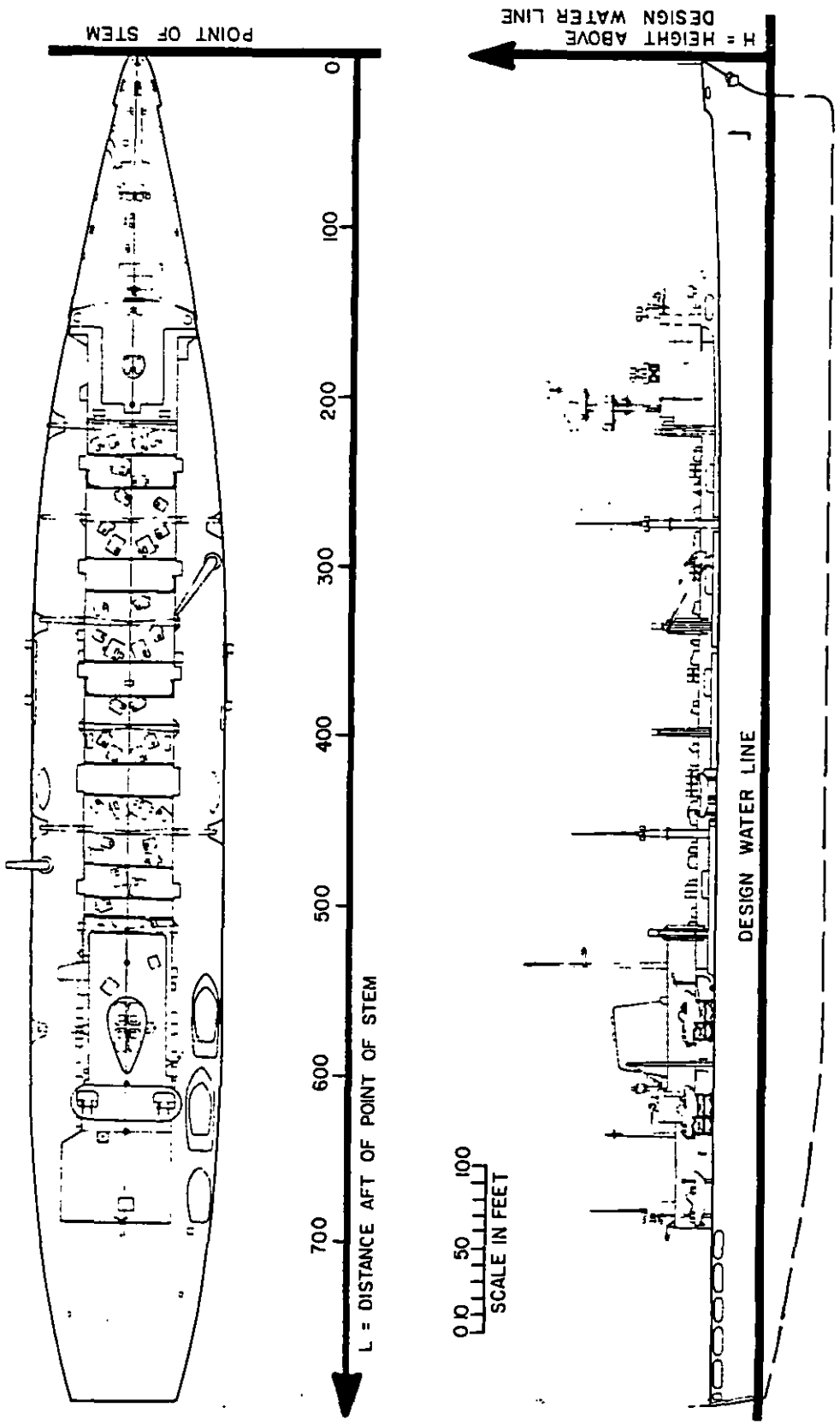

Figure 5
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Utility Location Reference Lines

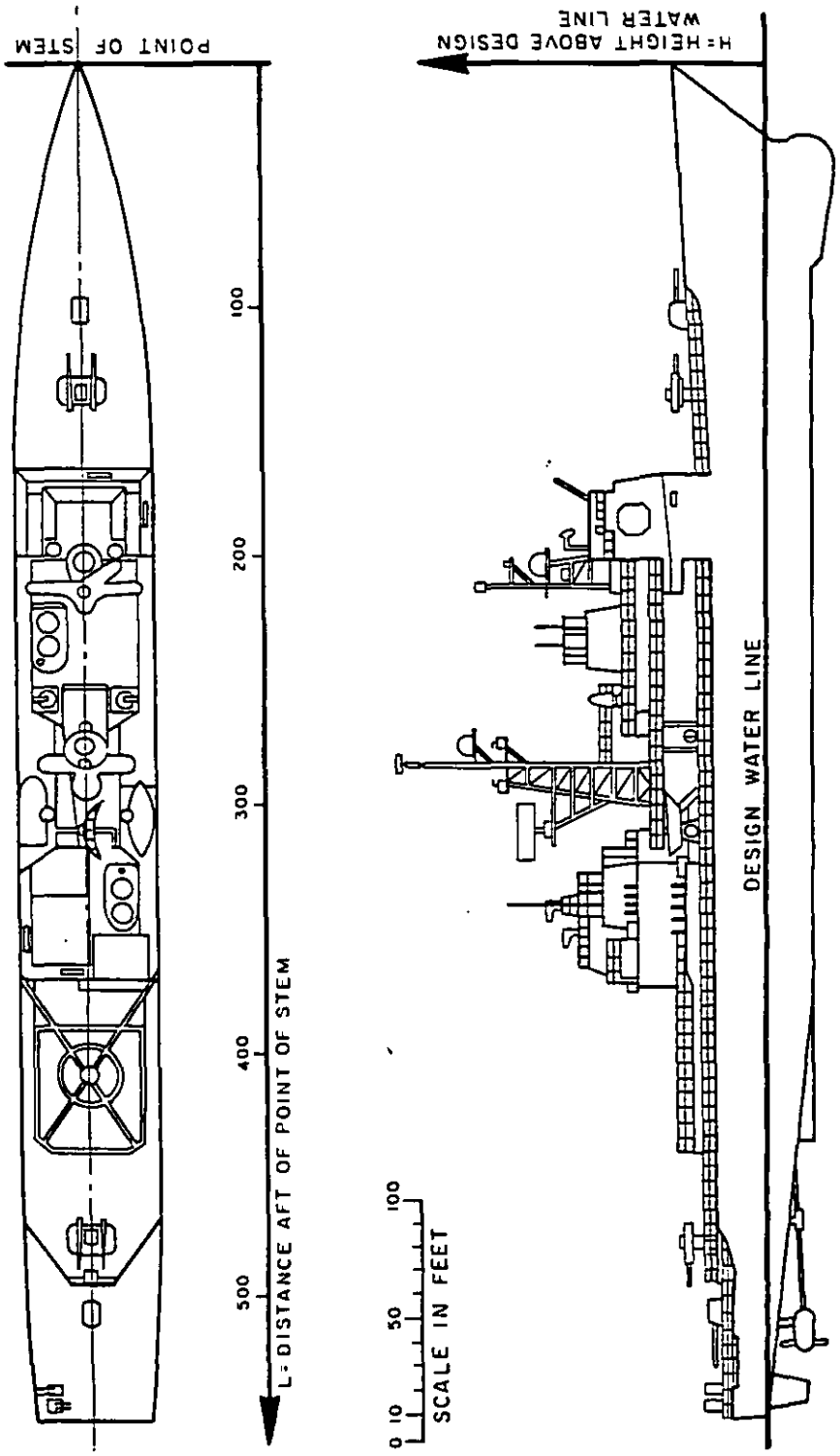

Figure 6
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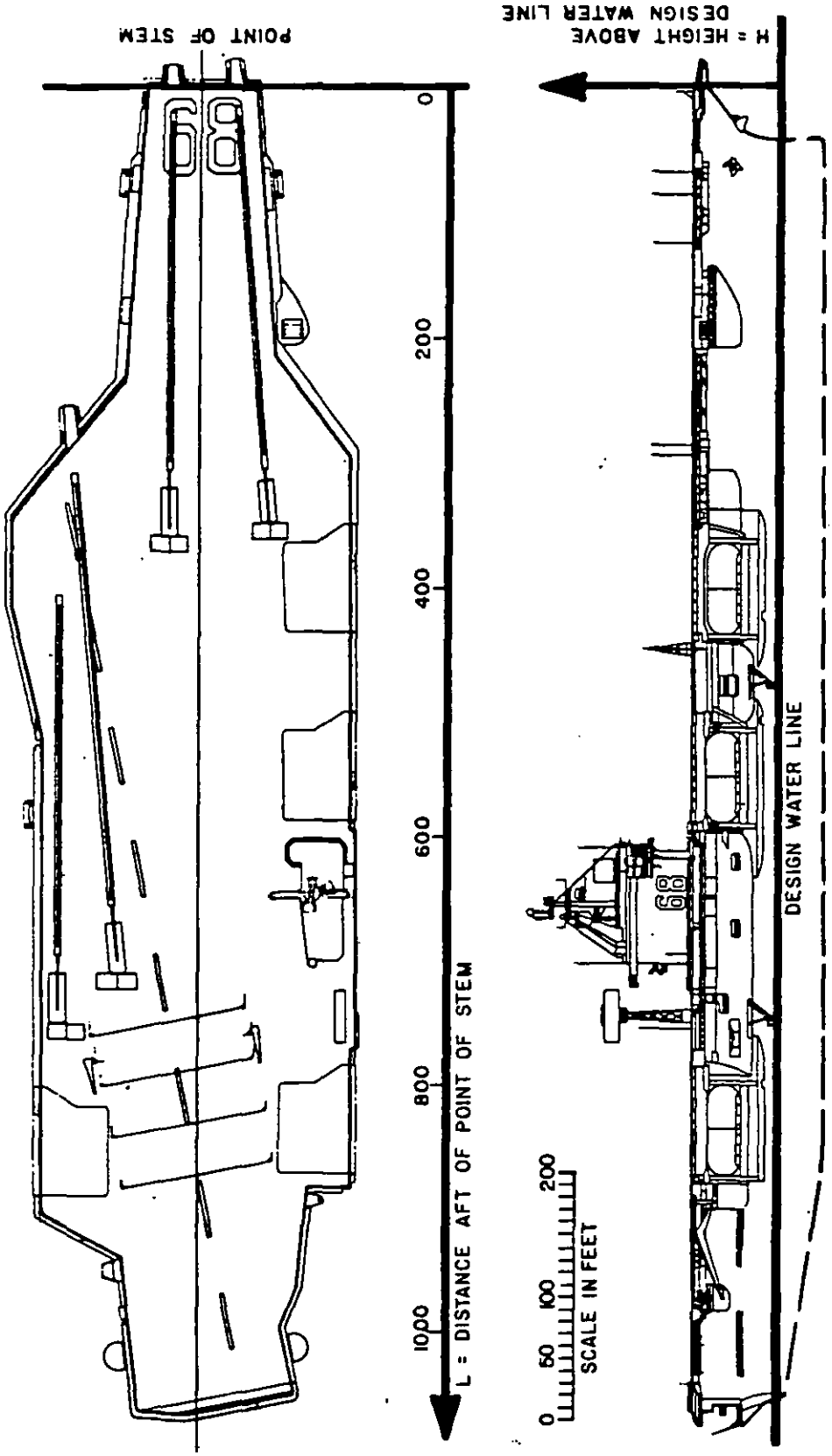

Figure 7
CVN-68 and Similar Ships--Plan/Profile with Utility Location Reference Lines

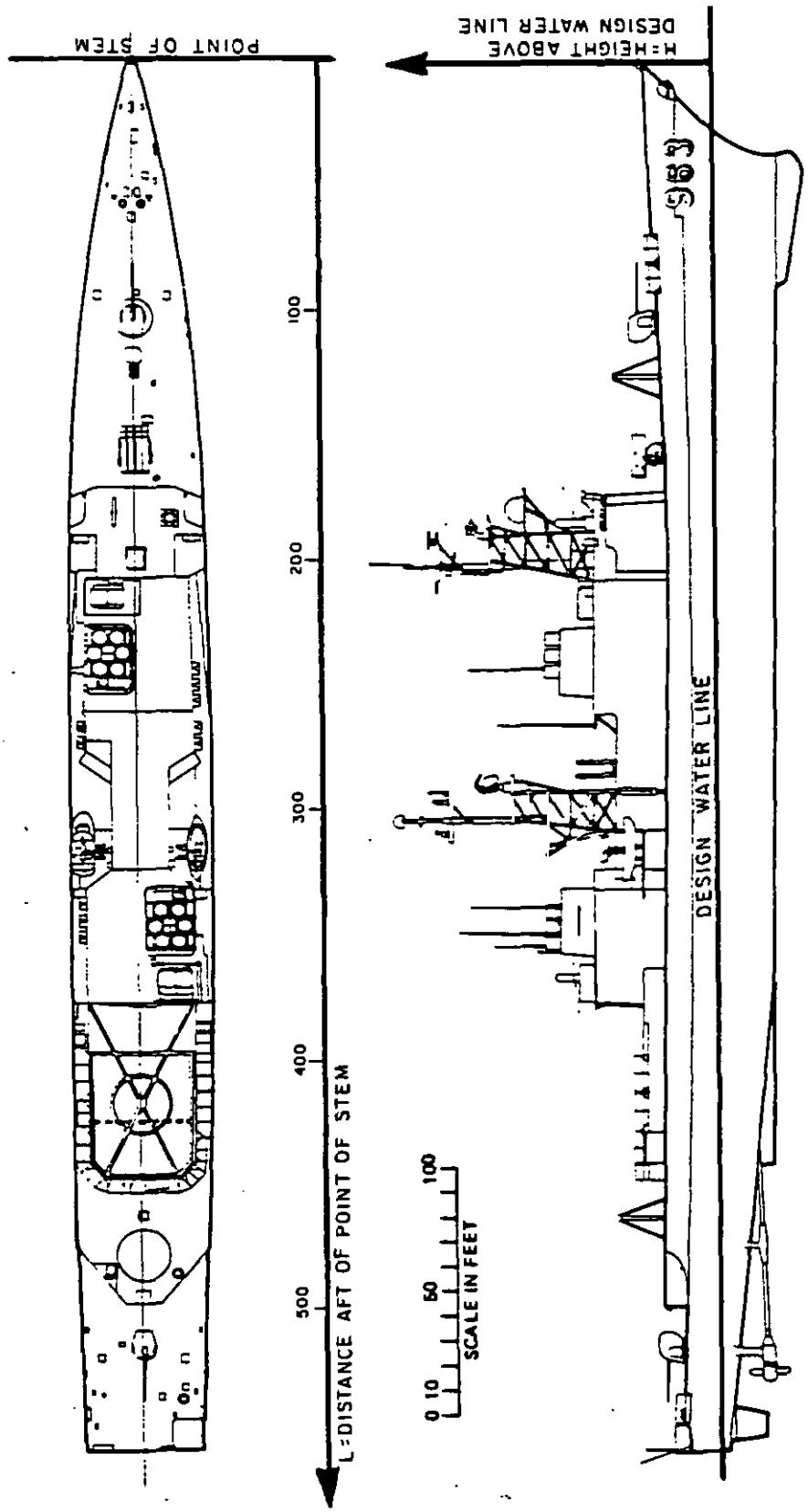

Figure 8
DD-963 and Similar Ships--Plan/Profile with Utility Location Reference Lines

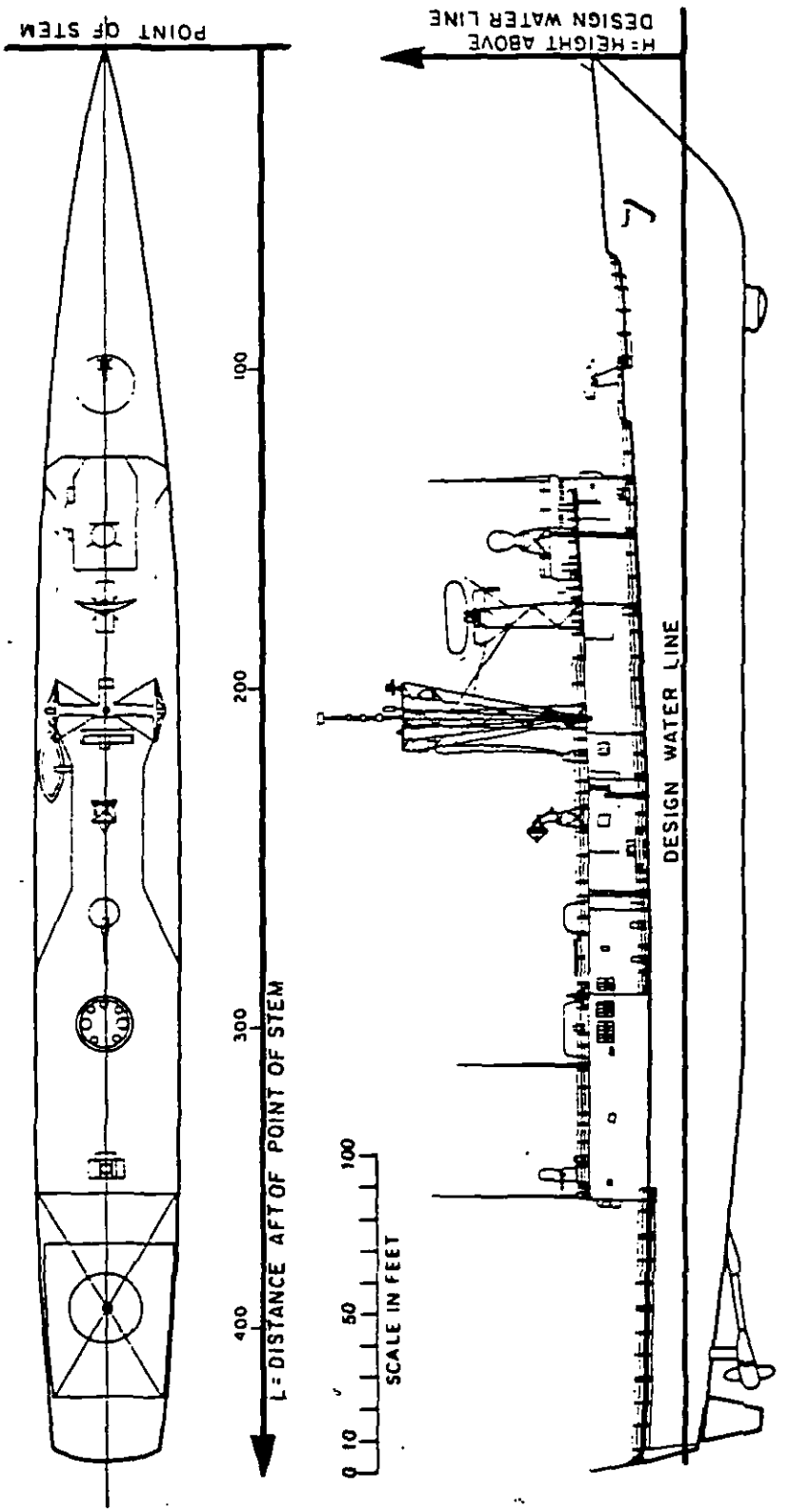

Figure 9
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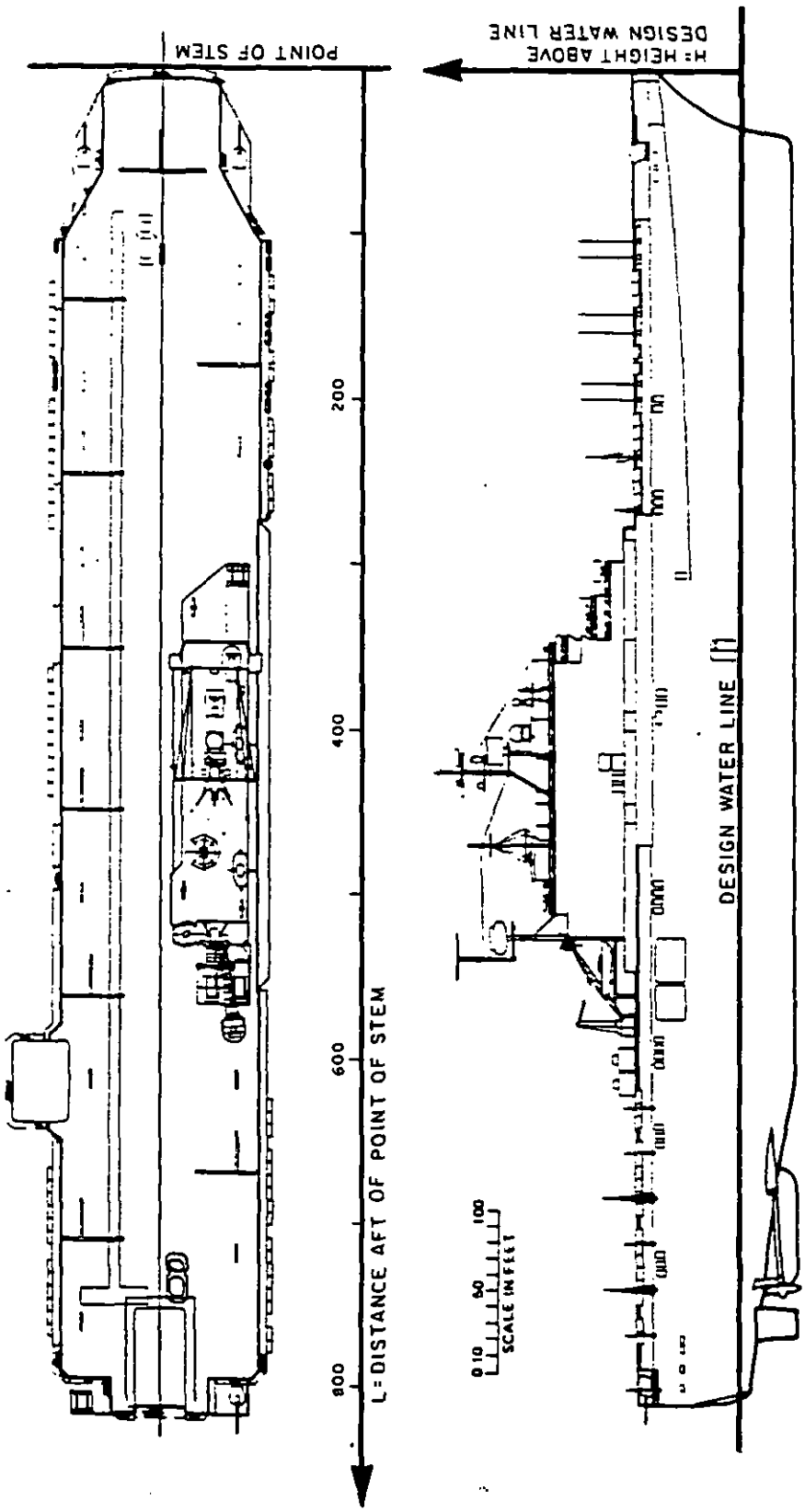

Figure 10
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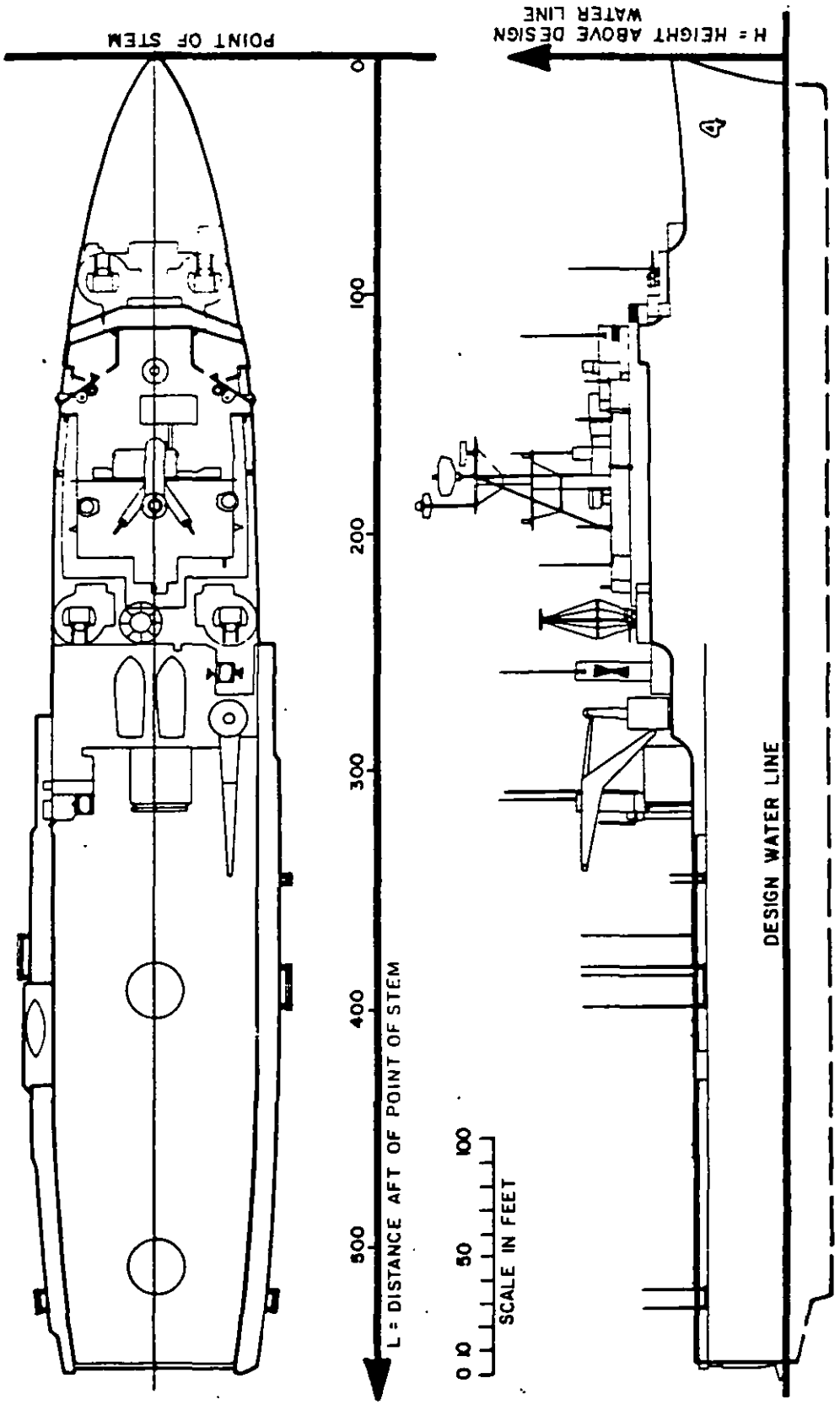

Figure 11
LPD-4 and Similar Ships--Plan/Profile with
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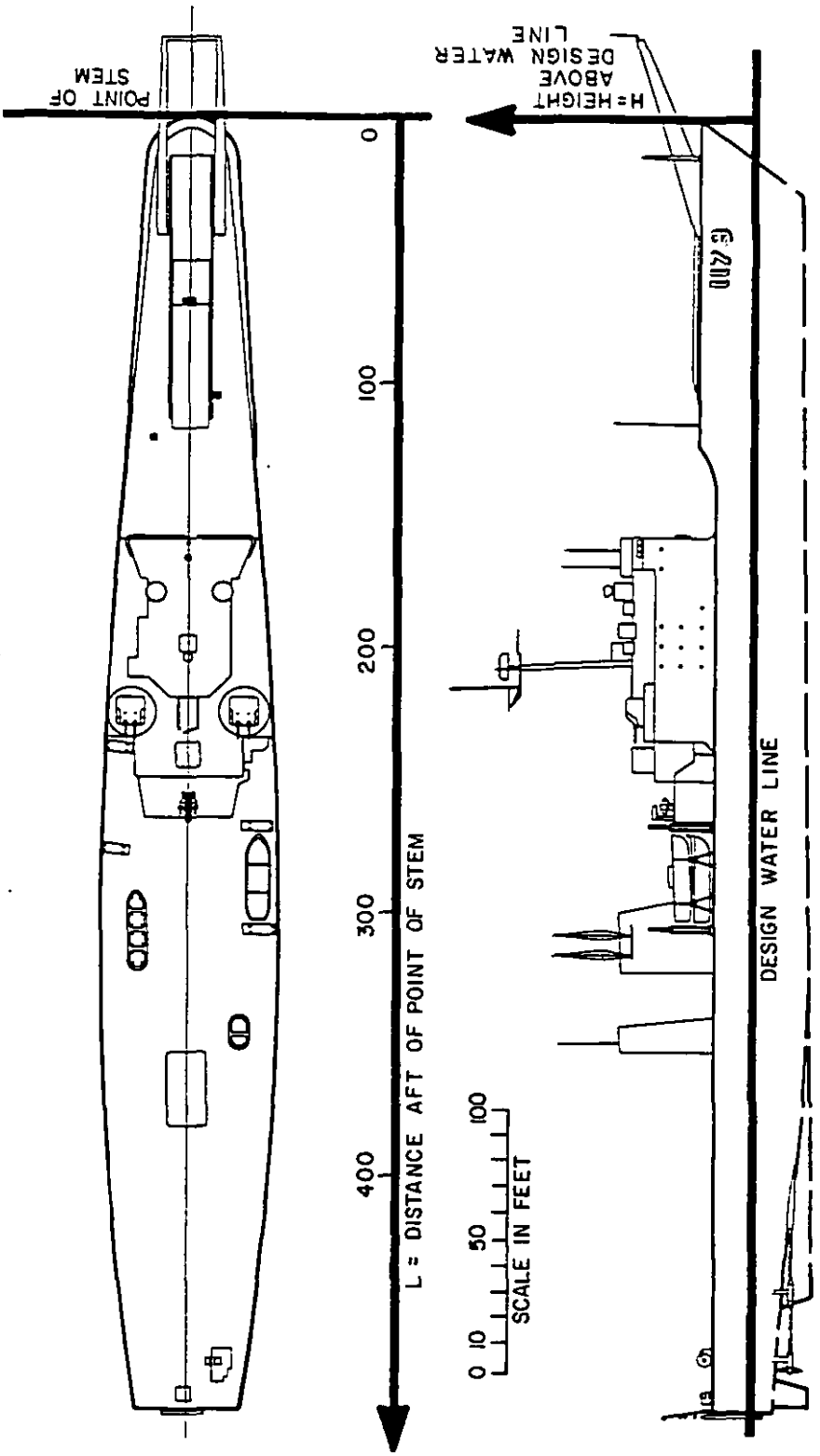

Figure 12
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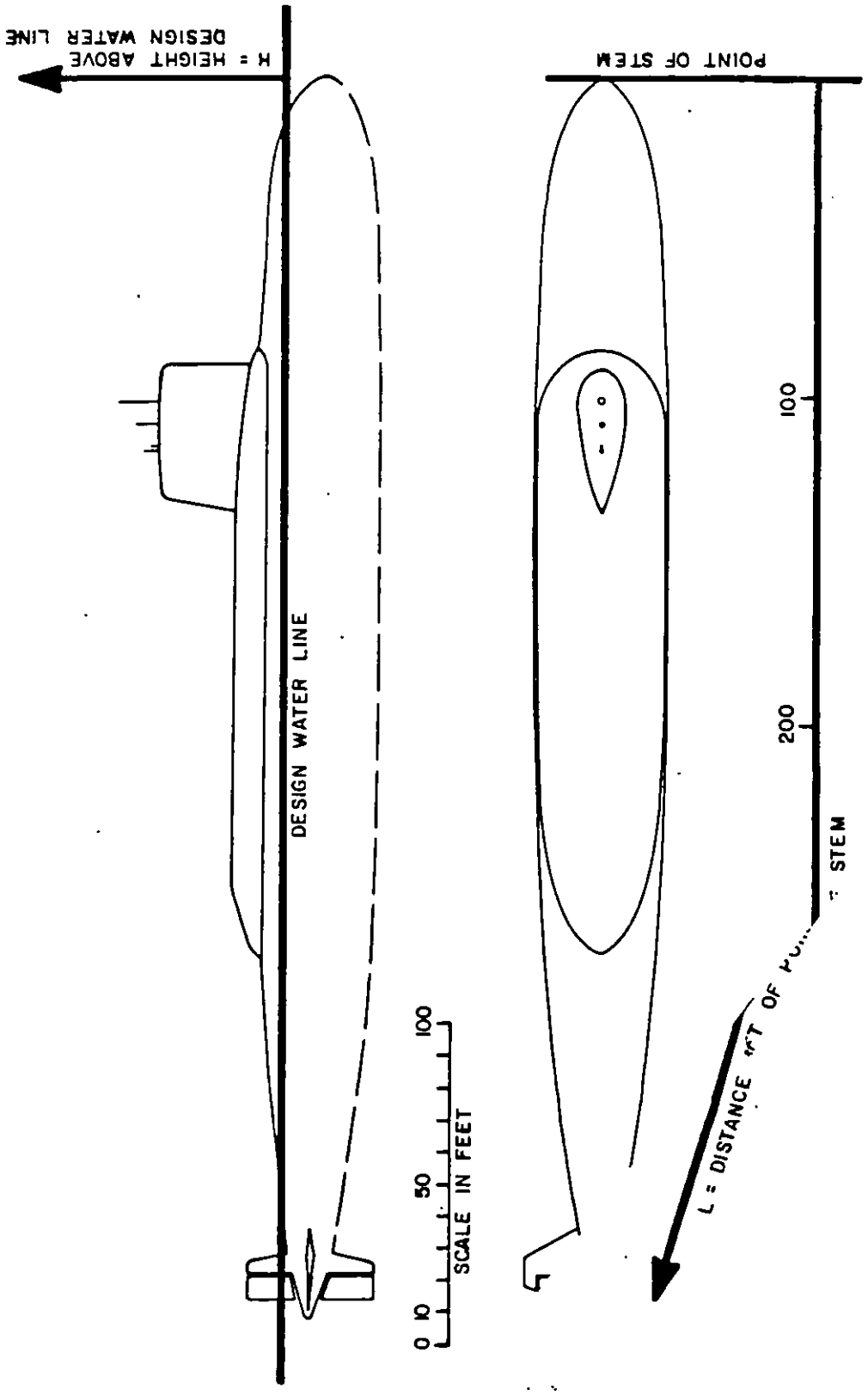


Figure 13
Submarines--Plan/Profile with
Utility Location Reference Lines

2.2.2.2 Fire-Protection Water. Losses in the fire-protection-system hoses could be critical in the event of fire, particularly when ships pumps are under repair.

2.2.2.3 Electrical Power. Excessive lengths of power cable increase the possibilities of accident, fire, and excessive voltage drop.

2.2.2.4 Sewage. Although added hose-pressure loss is not normally a problem, sewage hose is heavy, difficult to support, and must be disinfected when the ships connection is broken.

2.2.3 Group Locations and Spacing. The locating dimensions for shipboard utility connections of various ship classes are described in subsequent subsections and are presented there in tabular form. These dimensions, when used with Figures 1 through 13 and the parameters given herein, provide guidance in spacing determinations for the shore connections. The locations of required deck equipment (capstans, bollards, cleats, ladders, and railings) must always be coordinated with locations of utility connections. Design berthing plans (graphic plots) should be made for the most likely ship mixes, considering local berthing practices, such as direction of berthing and ship locations. Suitable shore-connection spacing for the range of possible ships must be provided, unless berths are intended for long-range dedication to only one ship class. Individual utilities within groups for mixed berthing should generally not be more than 200 ft (66 m) apart. Whenever possible, shore utility connection spacing should be such that connections are not offset more than 50 ft (15.24 m) from corresponding ships connections when ships occupy their prescribed berths. Where it is confirmed that ships to be berthed will be limited to surface combatants predominantly, refer to the NCEL publication entitled TM-54-01-87, Graphic Engineering and Mapping System--Pier Engineering System (GEMS--PIERS), Steven C. Gonzales.

2.3 Utility-Connection Group Design

2.3.1 Configurations To Avoid Interference. Utility-outlet groups should be designed for minimum interference of hoses and cables with each other and with pier operations. Outlet groups may be placed above deck or in deck pits; they may also be placed in open galleries below the main deck at sites where the pier has sufficient elevation to avoid submergence of connections (for example, the double-deck pier, "Zulu," at Charleston Naval Station). In general, outlet connections should have centerlines parallel with berths or at not more than a 30° angle therewith, to avoid hose-connection difficulties and interferences with pier traffic. The distance of connections from the pier face should be as short as is consistent with structural restraints and with convenience. The type of connector at outlets must be compatible with hoses in use or intended for use at a given site. The profile presented by utility groups above deck, which must also be considered, is dependent upon the height of the pier and the type of ship at berth. Mooring lines for ships such as destroyers are relatively low and present a greater hazard to utility connections. Low-profile outlet arrangements are usually preferred. Whenever possible, mooring line patterns for the specific ships to be berthed should be observed at berth before utility group design is commenced. Some typical above-deck utility-connection details are shown in figures in subsequent subsections. Many acceptable arrangements other than those shown are also possible and may be required by the cognizant Engineering Field Division where

it is desired to match existing outlet designs in successful use. Required hose- or cable-connection types and sizes are given in individual utility descriptions in subsequent subsections herein.

2.3.2 Design for Nesting. Where berthing plans indicate that nesting of ships will be practiced, a sufficient quantity of adequately sized connections must be provided, according to the number of ships which may simultaneously use each such berth. Assume that internal shipboard port-to-starboard utility headers, where present, will be utilized (see utility tables herein), except for potable water. For potable water, use dual connections with individual backflow devices in order to provide separately protected supplies to two ships at each group location.

2.4 Protection

2.4.1 Protection of Mains and Laterals. Mains and laterals serving utility connections must be protected from damage by waves, wind, floating debris or ice, and tidal immersion. Where these lines could be subjected to such damage, they must be placed in trenches or tunnels built into the pier or wharf, or special construction techniques must be used to provide a barrier. Electrical conduits may be embedded in new concrete structures. It is preferable to place electrical duct banks, manholes, and pull boxes such that they are cast integrally with the pier deck. Conduit and piping mains and laterals (except POL) may be hung exposed from the bottom of pier decks in protected locations. In such cases, it is necessary to coordinate with the structural design to secure inspection ladders and deck inserts, in order to facilitate installation of access platforms for future maintenance. New mains placed on existing piers may be placed on top of the pier deck in a trench, if other construction techniques are impractical. Trench covers may be concrete, steel plate, grating, or a combination of these, as dictated by loading, maintenance, and cost considerations. Protection from corrosion is covered in individual utility sections herein.

2.4.2 Protection of Utility Connections. Means to protect utility connections, hoses, and cables from damage due to traffic and snagging by mooring lines are essential, except at small-craft facilities or at locations where special protective construction exists, such as at double-deck piers or below-deck galleries. Protection may consist of curbs, pits, concrete structures, or railings. Where pier width is sufficient, consider the use of continuous curbs located at sufficient distance back from pier faces to exclude pier traffic (except cranes) from the areas containing utility connections, hoses, and cables. Where utility pits are used, sufficient pit length must be incorporated to assure that hoses may be connected and led from pits to ships without kinking or chafing.

Section 3: ACTIVE AND REPAIR BERTHING

3.1 Steam. Steam service at 150 psi (1034 kPa) (saturated) shall be provided along all piers and other waterfront structures used for active berthing and ship repair, and at the perimeter of graving drydocks. Provisions for returning condensate from ships will not be required except in special cases, as directed by the cognizant Engineering Field Division.

3.1.1 Demands. Steam requirements for selected ship classes are given in Table 1. Loads must be selected for the appropriate local climate, as indicated in the table. For ships not included in Table 1, use data from Table 1 for a similar ship or obtain the expected demand from NAVFACENGCOM HQ. For graving drydocks, refer to NAVFAC DM-29.01.

3.1.2 Size of Piping. Size the piping for single berths to meet the demands indicated in Table 1. Include nested ships which are indicated on berthing plans. For multiple berthing, use diversity factors determined from Table 2. Branch steam lines from main to outlet locations should be sized for the full demands obtained from Table 1 and should be no smaller than the outlet riser. For ships which require two connection locations, assume 75 percent of the flow from Table 1 in each branch. Refer to para. 3.1.5, Outlet Design, for minimum outlet-riser sizes. Determination of pipe sizes shall be in accordance with MIL-HDBK-1003/8, Exterior Distribution of Utility Steam, HTW, CHW, Fuel Gas and Compressed Air.

3.1.3 Piping System Design Criteria. For steam piping and condensate-return piping design requirements, refer to MIL-HDBK-1003/8, subject to the following exceptions and additions:

3.1.3.1 Pitch. For steam piping on or under a pier, the pitch of piping required by MIL-HDBK-1003/8 may be impractical due to elevation limitations or structural interference. In such cases, the designer must compensate by proper sizing of piping and by provision for adequate condensate removal. Tidal submergence of piping should be avoided by whatever means are practical.

3.1.3.2 Protection. For steam and condensate piping under a pier or wharf, or in a drydock (where submergence may occur), piping should be encased in a pressure-testable, prefabricated conduit system. Corrosion-resistant conduit coatings should be selected, and polyethylene heat-shrinkable sleeves and/or high temperature tape wrapping must be used at joints and fittings. Hangers and bolts must be galvanized. All specially fabricated supports and braces must be hot-dip galvanized after fabrication. Where salt spray exposure is severe, incorporate appropriate additional anticorrosion measures for hangers, such as application of epoxy coatings, use of stainless steel or monel bolting and use of fiberglass/resin composite hangers and bolting. Piping and outlets must be identified and color-coded in accordance with Section 6.

3.1.4 Location and Arrangement of Piping Mains and Branches. As a general rule, provide a single main with cross-branch piping to outlets for all active berthing piers and for all repair piers 50 ft (15.2 m) or less in width. For repair piers wider than 50 ft, provide a main on each side, with a cross connection at the outboard end. Coordinate piping with structural conditions and arrange mains for the best combination of versatility, security, and overall cost. It is normally more desirable operationally to provide a looped

Table 1
Shore Services - Steam[1 2 3]

Ship Type	Class	(a) Intermittent Heating Loads[4] (lb/hr) for Outdoor Temperatures of--				(b) Constant Load[5] (lb/hr)	Ships Connection Data[6]		
		10°F	30°F	50°F	70°F		L	H	N
Aircraft Carriers	CV-59	17,000	11,000	6,000	4,200	7,000			
	CV-63,67	17,000	11,000	6,000	4,200	7,000			
	CVN-65	42,000				7,000			
	CVN-68	22,500	15,500	10,000	7,200	5,000			4
Surface Combatants									
Battleship	BB-61	25,000				12,000			
	BB-62								
	BB-63								
	BB-64	41,000							
Cruiser	CG-16,26	4,000	2,800	1,800	1,300	1,500			
	CG-47	9,100					328S 335P		
	CGN-9	10,500				1,800			
	CGN-36	3,300	2,550	2,000	1,600	1,400			
	CGN-38	3,300	2,550	2,000	1,600	1,400			
Destroyer	DD-963	2,100	1,400	900	550	900	293S 339P	26	1 1
	DDG-2	2,750	1,800	1,150	970	900			
	DDG-37[7] DDG-51 DDG-993	2,750	2,200	1,750	1,500	1,600			
Frigate	FF-1037	1,850	1,250	750	480	400			
	FF-1040	2,500	1,670	900	600	900			
	FF-1052	2,500	1,670	900	600	900	275PS		1
	FFG-1	2,500	1,600	900	1,100				
	FFG-7						318S 326P	35	1 1
Patrol[7]	PG-84 PHM-1								
Submarines[7]									

Table 1
Shore Services - Steam[1] [2] [3] — Continued

Ship Type	Class	(a) Intermittent Heating Loads[4] (lb/hr) for Outdoor Temperatures of—				(b) Constant Load[5] (lb/hr)	Ships Connection Data[6]		
		10°F	30°F	50°F	70°F		L	H	N
Amphibious Warfare									
Command	LCC-19	7,000	5,500	4,700	4,100	3,000			
Assault	LHA-1	11,500	7,500	3,800	1,600	2,500			
	LPH-2	9,000	5,000	2,800	2,000	3,000			
Cargo	LKA-113	4,100	3,100	2,200	1,500	1,300			
Transport	LPD-4	6,000	3,700	2,200	1,300	2,200			
Landing	LSD-36	7,500	5,200	2,700	1,100	900			
	LSD-41								
	LST-1179	4,400	2,800	1,400	700	1,200			
Mine Warfare	MSO-427 MSM-1	800				200			
Auxiliary									
Tenders & Repair	AD-15	10,200				1,700			
	AD-37	12,000	8,500	6,500	5,500	4,000			
	AD-41	12,000	8,500	6,500	5,500	4,000	210PS 438PS		4 4
	AR-5	12,000				2,000			
	ARS-38 ARS-50 AS-31	23,200				3,900			
	AS-33								
	AS-36	12,500	7,800	4,000	2,700	2,500			
	ASR-9 ASR-21	1,200	860	520	260	600			
Cargo & Transport	AE-21	3,700				700			
	AE-26								
	AFS-1	4,450	3,000	1,950	1,550	1,400			
	AH-19								
	AK-280 AKR-7 AO-105	3,000				500			

Table 1
Shore Services - Steam[1] [2] [3] — Continued

Ship Type	Class	(a) Intermittent Heating Loads[4] (lb/hr) for Outdoor Temperatures of—				(b) Constant Load[5] (lb/hr)	Ships Connection Data[6]		
		10°F	30°F	50°F	70°F		L	H	N
Auxilliary (Cont'd):									
Cargo & Transport (cont'd)	AO-143								
	AO-177					-			
	AOE-1	7,600	5,600	3,600	2,600	2,000			
	AOR-1	3,400	2,800	2,800	2,800	1,500			
	AOT-168								
	AP-110								
Tugs	ATF-91	1,000				200			
	ATS-1	300				100			
Miscellaneous	AG-193	2,300				400			
	AGS-39								
	AGDS-2	1,500				300			
	AGF-11	4,100				700			
	AGM-20								
	AGOR-11								
	AGOS-1								
	AVM	6,800				1,200			

[1] Loads based on ship's peacetime complement (no air wing or troops). See text when allowance must be made for these items.

[2] Maximum single ship demand at shore connections is column (a) plus column (b).

[3] For multiple ships, see Diversity Factors, Table 2.

[4] Steam quantity required to achieve normal environmental temperature in ship spaces relative to the outdoor temperatures shown. Interpolation between temperature columns is permissible. Determine specific site design temperature from NAVFAC P-89, Engineering Weather Data, 97½ percent basis, whenever available. Design temperatures for sites not listed therein may be obtained from the ASHRAE Handbook, 97½ percent basis.

[5] Galley, laundry, hot water, etc.

[6] L and H refer to the location of connections on ships. L is the distance, in feet, of the connection aft of the point of stem of the ship and H is the height, in feet, of the connection above the design waterline; see Figures 2 through 13, as applicable. Designations "P" and "S" refer to Port side and Starboard side, respectively. Where more than one connection exists, all locations are shown. The designation "N" refers to the number of shipboard hose connections at the given locations.

[7] Steam not required.

Table 2
Diversity Factors (DF) for Steam Usage[1]

Ship Type	Outdoor Temperature Range (°F)	Diversity Factor (DF)2 for--			
		1 Ship	3 Ships	5 Ships	9 Ships
Surface Combatants	0 - 20	1	0.97	0.96	0.94
	20 - 40	1	0.93	0.89	0.86
	40 - 60	1	0.86	0.80	0.76
	> 60	1	0.80	0.73	0.68
Aircraft Carriers	0 - 20	1	0.97	0.96	0.95
	20 - 40	1	0.96	0.94	0.91
	40 - 60	1	0.93	0.90	0.86
	> 60	1	0.82	0.76	0.74
Amphibious	0 - 20	1	0.95	0.94	0.93
	20 - 40	1	0.87	0.83	0.82
	40 - 60	1	0.80	0.74	0.71
	> 60	1	0.78	0.72	0.68
Auxiliary	0 - 60	1	0.91	0.87	0.84
Aggregate	0 - 20	1	0.96	0.93	0.92
	20 - 40	1	0.93	0.90	0.88
	40 - 60	1	0.90	0.86	0.83
	> 60	1	0.86	0.81	0.78

[1]Use of Diversity Factors:

If the total number of ships in aggregate is greater than nine:

- Group the ships by types.
- Determine the maximum demand of each ship (Table 1).
- Sum the individual demands within each type.
- Multiply the total demand of each ship type by the appropriate DF, relative to the number of ships and temperature range.
- Total the demands obtained above for the different ship type groups.

If the total number of ships in aggregate is nine or less:

- Determine the maximum demand for each ship (Table 1).
- Sum the individual demands of each ship.
- Obtain the aggregate DF from Table 2.
- Multiply the total demand by the "aggregate" DF in Table.

[2]Linear interpolation is permissible for ship quantities not shown.

Table 2
Diversity Factors (DF) For Steam Usage -- Continued

[3]Example Problem:

There are nine FF-1052's and two AD-37's berthed at a location where the outdoor design temperature is 18°F (-7.7° C). In this case there exist more than one ship type and a total of 11 vessels. To find the total system demand, determine the total flow for each class and then sum the values.

FF-1052 Class

From Table 1, the intermittent demand at 18°F is interpolated between 10°F (-12.2° C) (2,500 lb/hr or 1,134 kg/hr) and 30°F (1,670 lb/hr or 757.5 kg/hr) to yield 2,168 lb/hr at 18°F. This intermittent load of 2,168 lb/hr is added to the constant load (900 lb/hr or 408.2 kg/hr) from Table 1 to obtain a total of 3,068 lb/hr (1,391.6 kg/hr).

Each of the nine FF-1052's have a peak demand of 3,068 lb/hr. Since the peaks would occur at slightly different times, the total peak demand is not directly additive, but may be acquired using the Diversity Factor. Consulting Table 2, the DF is 0.94 for the nine FF-1052's at an outdoor temperature of 18°F. Therefore, the design demand for the 9 frigates is (9) (3,068) (0.94) = 25,955 lb/hr.

AD-37 Class

From Table 1, the intermittent demand at 18°F (interpolating) is 10,600 lb/hr (4,808.2 kg/hr). The peak demand of each vessel is then 10,600 lb/hr + 4,000 lb/hr (constant load) or 14,600 lb/hr (6,622.6 kg/hr). From Table 2, the DF is 0.96 (interpolating) for two auxiliary ships. The total design demand for the two AD-37's is (2) (14,600) (0.96) = 28,032 lb/hr (12 715.3 kg/hr).

Total

The total design demand for the nine frigates and two tenders at 18°F is obtained by adding together the design demands for each group, thus: 25,955 lb/hr + 28,032 lb/hr = 53,987 lb/hr (24,488.5 kg/hr). If there were five frigates instead of nine berthed with the two tenders, then the total number of ships would be nine or less, and the DF would be selected from the "aggregate" category of Table 2. Gross demand would be (5) (3,068) + (2) (14,600) = 44,540 lb/hr (20,203.3 kg/hr). The Diversity Factor would be 0.925 (interpolating). The design demand for the seven ships would be (0.925) (44,540) = 41,200 lb/hr(18,688.3 kg/hr).

Source: CEL

main rather than an equivalent single main. Provide isolation valves at appropriate locations for reliability of service during emergency repairs. For graving drydocks, refer to NAVFAC DM-29.1. The location of ships steam connections may be determined by use of locating dimensions given in Table 1 under "Ships Connection Data," in conjunction with Figures 2 through 13 for the appropriate ship classes. For discussion of methods to be used to establish shore utility-station spacing on piers and wharves, refer to Section 2.

3.1.5 Outlet Design. Naval facilities use 2 in. (50.8 mm) hoses (from 1 to 10 per ship) almost exclusively for ship-to-shore steam connections. At locations where 1-1/2 in. (38.1 mm) and 1 in. (25.4 mm) hoses are used, design for 2 in. hoses and utilize reducing fittings at hose connections. Total numbers of shipboard connections, N, are given in Table 1. The number of hoses actually connected to shore per ship varies with the severity of the climate. For facilities in the coldest climates (see Figure 24, Regions I and II), assume that all (N) ships connections will be connected to shore. For warmer climates, obtain the demand from Table 5 for the appropriate design temperature; divide by 2500 for 2 in. hose and by 1250 for 1 1/2 in. hose. For existing facilities, the maximum number of hose connections actually made for the ships to be berthed may be obtained from the appropriate Engineering Field Division. Design the outlets to bring properly sized branch steam lines from pier main into welded steel headers which contain the required number of 2 in. connections with gate valves and hose connectors (see Figure 14). Threaded connections must be avoided, in order to prevent loosening of joints from hose tension. Minimum outlet riser sizes are as follows:

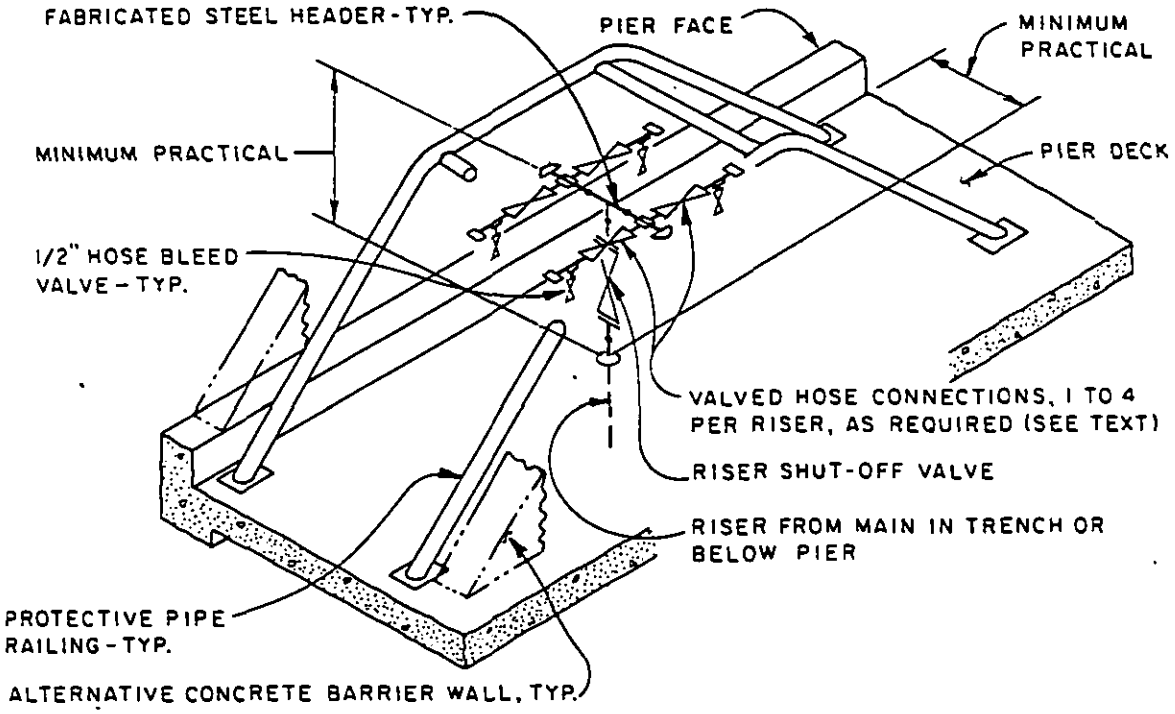
NUMBER OF HOSES CONNECTED TO RISER	RISER SIZE (in.)
1	2 1/2
2	3
3 or 4	4

Provide an accessible gate valve in each branch steam main near the outlet riser. Provide a 1/2 in. (12.7 mm) bleed cock where shown on Figure 14 at each 2 in. connection for bleeding hoses prior to disconnecting. Refer to Section 2, for a general description of the arrangement and spacing of utility outlets.

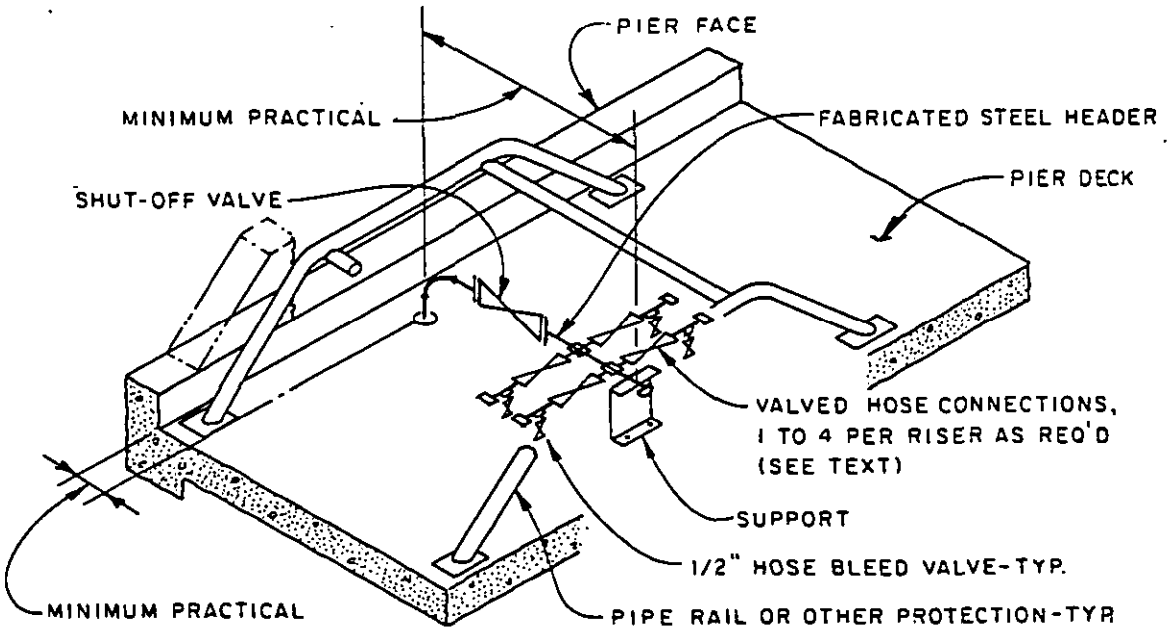
3.1.6 Specific Ship Requirements

3.1.6.1 CV and CVN Ship Requirements (All Classes). These ships are normally berthed starboard side-to. Galley and hot-water requirements (column (b) of Table 1) should be increased by 50 percent where it is reasonable to assume that the ship's air group may be on board.

3.1.6.2 Nuclear-Powered Submarine Requirements. Steam supply for nuclear-powered submarines is not required at operational berths. For ship construction or major repair activities, high-pressure steam at 2,000 to 4,000 psi (13.8 to 27.6 MPa) may be required for test purposes. This supply may be from a permanent plant or from a portable steam generator, depending upon local conditions; each location where high-pressure steam is required should be evaluated on an individual basis.



NORMAL CONFIGURATION



LOW PROFILE CONFIGURATION

Figure 14
Typical Steam Shore Connections

3.1.6.3 Troop Carrier Special Requirements (LHA, LPH, LKA, LPD, LSD, and LST). Increase galley and hot-water requirements (column (b) of Table 1) by 100 percent if it is probable that troops will be aboard while at active berths.

3.1.7 Shore-to-Ship Steam and Feedwater Requirements

3.1.7.1 Quality. Naval Sea System Command (NAVSEASYSCOM) shore-to-ship steam and feedwater quality standards are provided in Chapter 220, Volume 2, CH-1 (Revision 3) Naval Ship's Technical Manual of NAVSEA S9086-GX-STM-021. These standards are given in Tables 3 and 4.

Table 3
Shore Steam and Condensed Shore Steam Quality Requirements*

CONSTITUENT OR PROPERTY	REQUIREMENT
pH	8.0 to 9.5
Conductivity	25 µS/cm** max
Dissolved Silica	0.2 ppm max
Hardness	0.10 ppm max or 5 ppm as $CaCO_3$ total hardness

* Steam must be generated from feedwater which is either treated with a chemical oxygen scavenger or mechanically de-aerated to a maximum dissolved oxygen content of 15 parts per billion. Shore steam and condensed shore steam used as feedwater must meet the above standards. The use of filming amines is prohibited.
** µS/cm = micro-Siemens/centimeter = micro-mho/centimeter

Table 4
Bulk Shore Feedwater Quality Requirements*

CONSTITUENT OR PROPERTY	REQUIREMENT
pH	6.0 to 8.0 (process effluent) 5.8 to 8.0 (after storage)
Conductivity	2.5 µS/cm** max (at point of delivery)
Silica	0.2 ppm max

* Produced by method other than condensed steam.
** µS/cm = micro-Siemens/centimeter = micro-mho/centimeter

3.1.7.2 Use of Steam Separators. To meet the NAVSEA criteria in para. 3.1.7.1 for the purity of shore-to-ship steam in Navy ports, properly selected steam separators may be installed in steam mains at piers, wharves, and drydocks. These will provide additional protection against condensate carryover and the resultant steam contamination where such problems are known to exist. Normally, steam separators are not required on piers, wharves, or drydocks if adequate condensate removal is provided at the boiler plant and in shore mains. Steam separators should be used only when necessary, based upon a case-by-case evaluation of local conditions. Figure 15 provides a typical installation detail which should be used (where necessary) in conjunction with the guidelines of CEL Test Report No. TN-1586, Steam Separator Test and Evaluation, 1980.

3.1.7.3 Sampling. Conductivity and pH meters should not be installed permanently on piers or wharves due to the harsh marine environment. Condensate-sampling stations should be provided at piers and at steam plants. Figure 15 shows a typical installation of a sampling station.

3.1.8 Metering. Where monitoring of usage is required, provide metering of steam flows to piers, groups of piers, or drydocks. Install meters in accessible vaults or in above grade enclosures ashore or on piers. At individual piers or drydocks, use pressure compensated vortex-shedding type flow meters for good mass flow accuracy and range. Where metering is not initially required, make provision for ease of future installation by means of concrete vaults or pier access covers.

3.2 Compressed Air. Provide compressed air at all active and repair berths. Requirements for graving drydocks are given in NAVFAC DM-29.1.

3.2.1 Demands. Compressed-air requirements for selected ship classes are given in Table 5. For ships not included in Table 5, use data from Table 5 for a similar ship or obtain the expected demand from NAVFACENGCOM HQ.

3.2.2 Piping-System Design Criteria. Design compressed-air piping to conform with the requirements of NAVFAC DM-3.5 and MIL-HDBK-1003/8. In addition, for corrosion protection of steel pipe, consider an extruded polyethylene or polypropylene exterior coating. Extruded plastic coatings must contain an ultraviolet inhibitor. For coated pipe, use polyethylene, heat-shrinkable sleeves and/or tape wrapping at joints and fittings. Hangers and bolts must be galvanized. All specially fabricated supports and braces must be hot-dip galvanized after fabrication. Where salt-spray exposure is severe, incorporate appropriate additional anticorrosion measures for hangers, such as application of epoxy coatings, use of stainless steel or Monel bolting, and use of fiberglass/resin composite hangers and bolting. Piping and outlets must be identified and color coded in accordance with Section 6.

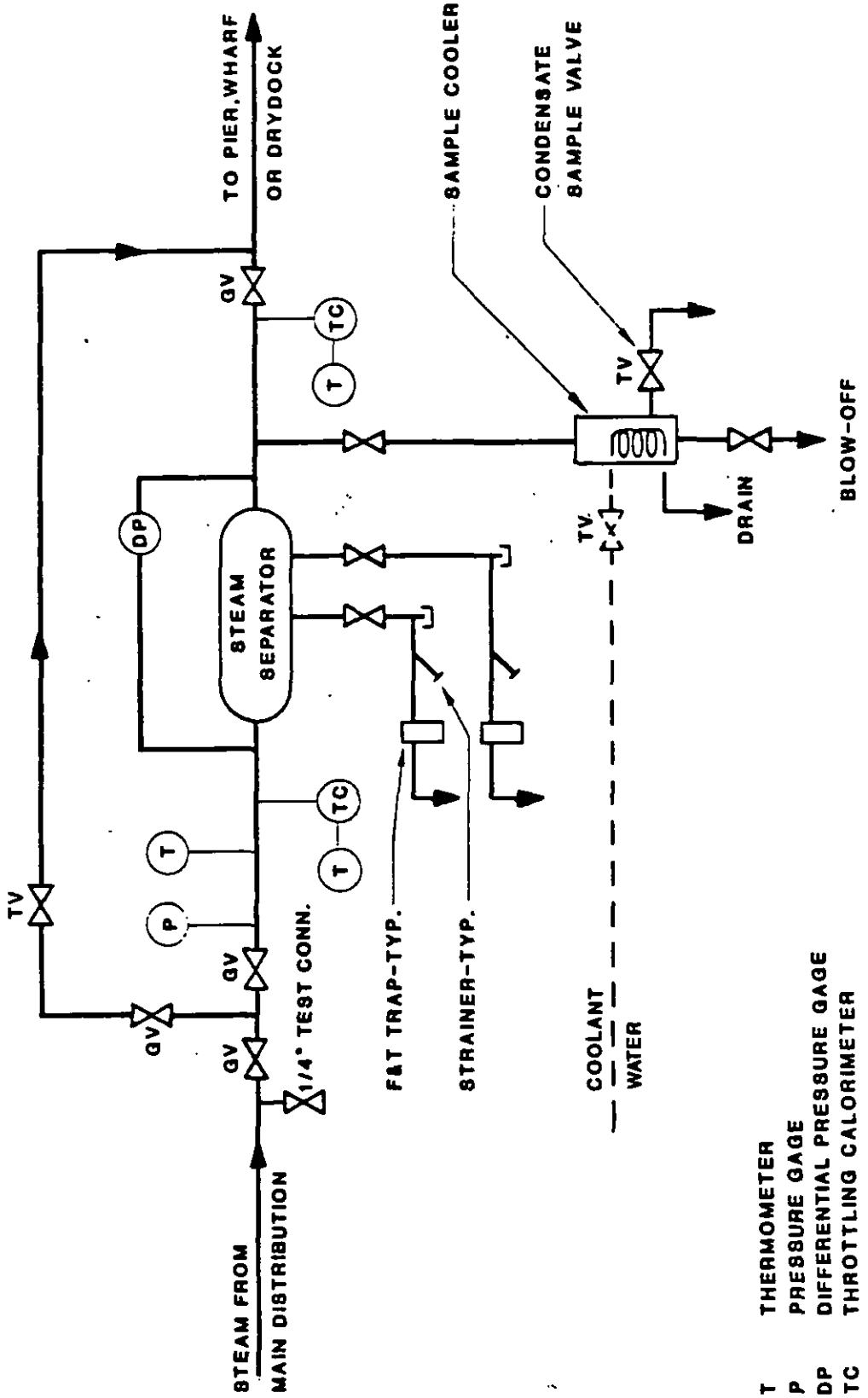


Figure 15
Schematic Steam Separator and Sampling Station

Table 5
Shore Services - Compressed Air[1]

Ship Type	Class	Quantity[2] (SCFM)	Pressure[3] (psig)	Minimum Branch Size[4] (in)	Minimum Outlet Risers Per Berth	Ships Connection Locations[5] (ft)	
						L	H
Aircraft Carriers	CV-59	2400	125	4	5		
	CV-63,67	2400	125	4	5		
	CVN-65	2400	125	4	5		
	CVN-68	2400	125	4	5		
Surface Combatants							
Battleship	BB-61	2000	125	3	5		
	BB-62						
	BB-63						
	BB-64						
Cruiser	CG-16,26	1000	125	3	4		
	CG-47	1000	125	3	4		
	CGN-9	1500	125	3	4		
	CGN-36	1000	125	3	4		
	CGN-38	1200	125	3	4		
Destroyer	DD-963	1000	125	3	3		
	DDG-2	1000	125	3	3		
	DDG-37	1000	125	3	3		
	DDG-51	1000	125	3	3		
	DDG-993	1000	125	3	3		
Frigate	FF-1037	1000	125	3	3		
	FF-1040	1000	125	3	3		
	FF-1052	1000	125	3	3		
	FFG-1	1000	125	3	3		
	FFG-7	1000	125	3	3		
Patrol	PG-85	250	125	2	1		
	PHM-1	250	125	2	1		

Table 5
Shore Services - Compressed Air[1] — Continued

Ship Type	Class	Quantity[2] (SCFM)	Pressure[3] (psig)	Minimum Branch Size[4] (in)	Minimum Outlet Risers Per Berth	Ships Connection Locations[5] (ft)	
						L	H
Submarines[6]	SS-580	500	125	2	2		
	SSN-594	500	125	2	3		
	SSN-637	500	125	2	2		
	SSN-688	750	125	2	2		
	SSBN-616	1000	125	3	3		
	SSBN-726	1000	125	3	3		
Amphibious Warfare							
Command	LCC-19	1500	125	3	4		
Assault	LHA-1	1500	125	3	5		
	LPH-2	1500	125	3	4		
Cargo	LKA-113	1000	125	3	4		
Transport	LPD-4	1000	125	3	4		
Landing	LSD-36	1000	125	3	4		
	LSD-41	1000	125	3	4		
	LST-1179	1000	125	3	4		
Mine Warfare	MSO-427	500	125	2	2		
	MCM-1	500	125	2	2		
Auxiliary							
Tenders & Repair	AD-15	1000	125	3	4		
	AD-37	1000	125	3	4		
	AD-41	1000	125	3	4		
	AR-5	1000	125	3	4		
	ARS-38	500	125	2	2		
	ARS-50	500	125	2	2		
	AS-31	1000	125	3	4		
	AS-33,36	1000	125	3	4		
	ASR9,21	500	125	2	2		
Cargo & Transport	AE-21	1000	125	3	3		
	AE-26	1000	125	3	4		
	AFS-1	1000	125	3	4		
	AH-19	2000	125	3	5		
	AK-280	1000	125	3	3		
	AKR-7	1000	125	3	3		
	AO-105	1000	125	3	4		

Table 5
Shore Services - Compressed Air[1] — Continued

Ship Type	Class	Quantity[2] (SCFM)	Pressure[3] (psig)	Minimum Branch Size[4] (in)	Minimum Outlet Risers Per Berth	Ships Connection Locations[5] (ft) L	H
Auxiliary (Cont'd)							
Cargo & Transport (Cont'd)	AO-143	1000	125	3	4		
	AO-177	1000	125	3	4		
	AOE-1	1500	125	3	5		
	AOR-1	1500	125	3	4		
	AOT-168	1000	125	3	4		
	AP-110,122	1000	125	3	4		
Tugs	ATF-91	500	125	2	2		
	ATS-1	500	125	2	2		
Miscellaneous	AG-193	1000	125	3	4		
	AGS-39	1000	125	3	3		
	AGDS-2	1000	125	3	3		
	AGF11	1000	125	3	4		
	AGM-20	1000	125	3	4		
	AGOR11	500	125	2	2		
	AGOS-1	500	125	2	2		
	AVM	1000	125	3	3		

[1]Low pressure compressed air requirements shown. High pressure compressed air may also be required; refer to text.

[2]For multiple ships, see diversity factors in text.

[3]Minimum required at connections. Higher pressures may be necessary where specifically directed by NAVFACENGCOM HQ or the using agency.

[4]This is size of pipe from main to (and including) outlet riser.

[5]L and H refer to the location of ships connections. L is the distance, in feet, of the connection aft of the point of stem of the ship, and H is the height, in feet, of the connection above the design waterline; see Figures 2 through 13, as applicable. Designations "P," "S" and "C" refer to Port side, Starboard side and Centerline, respectively. Where more than one connection exits, all locations are shown. For information not shown in this table, refer to the appropriate Engineering Field Division.

3.2.3 Quality. Compressed air should normally be "commercial" quality, in accordance with NAVFAC DM-3.5. Where breathing quality air and/or an oil-free system are necessary, use an oil-free source and/or purification systems in accordance with NAVFAC DM-3.5.

3.2.4 Size of Piping. For single berths, size the mains in accordance with air-quantity-per-ship data given in Table 5. For multiple berthing at a single pier or wharf, including nested ships, use the following diversity factors to establish demands for sizing of mains:

NUMBER OF SHIPS	DIVERSITY FACTOR
1	1.0
2	0.8
3	0.7
4	0.6
5 or more	0.5

Multiple-pier demand data for use in design of new compressed-air plants and at new facilities should be obtained by evaluating demands at operating Naval berthing and repair facilities which are similar to the proposed facility.

3.2.4.1 Branches. Branch-pipe sizes should be in accordance with Table 5. Where a variable mixture of ships is probable at a given pier, all branch lines should be 3 in. (76.2 mm); however, where carriers may be berthed, branch lines should be 4 in. (101.6 mm).

3.2.4.2 Sizing Method. Determination of pipe size should be in accordance with friction-loss tables in NAVFAC DM-3.5. Size mains for a pressure drop of not greater than 5 psi (34.47 kPa) total friction loss from pier or wharf entrance to farthest outlet, at design flows. For looped mains, assume flow in both legs of the loop. In all cases, mains should be sized to supply the most outboard ship with 100 percent of the quantity indicated by Table 5 when the pier is at full diversified demand.

3.2.5 Location and Arrangement of Piping Mains and Branches. As a general rule, provide a single compressed air main with cross branch piping to outlets for all active berthing piers and for all repair piers 50 ft (15.24 m) or less in width. For repair piers wider than 50 ft, provide a piping main on both sides, with a cross connection at the outboard end. Coordinate piping with structural conditions and arrange mains for the best combination of versatility, security, and overall cost. It is normally more desirable operationally to provide a looped compressed-air main rather than an equivalent single main. Provide isolation valves at appropriate locations for reliability of service during emergency repairs. The number of shore compressed-air outlets (risers) for various ship types is given in Table 5. Specific ships connection locations (one or two per ship) are also given in Table 5, where such exist; however, compressed air may be required at many locations both on and alongside a ship during maintenance or repair operations. The number of outlet risers per berth shown in Table 5 should therefore be integrated within utility groups which are designed and spaced as discussed in Section 2.

3.2.6 Outlet Design. The size of outlet risers should be the same as that of branch piping. Provide a full-sized accessible valve in each branch near the outlet riser. Provide a header at the outlet riser, with hose connections (valved outlets and hose couplers) sized as follows:

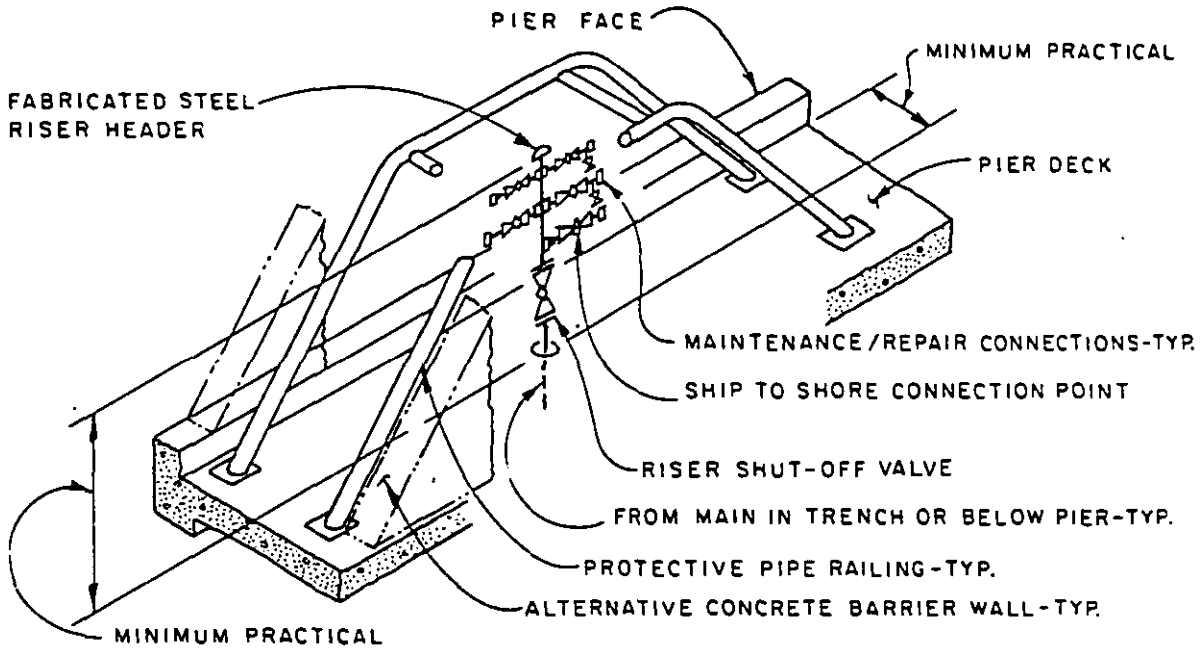
SIZE OF RISER (in.)	MAINTENANCE AND REPAIR CONNECTIONS	SHIP-TO-SHORE CONNECTION
2	Four 3/4 in.	None
3	Two 1-1/4 in. and two 3/4-in.	2-1/2 in.
4	Two 1-1/4 in. and two 3/4-in.	4 in.

Hose couplers for maintenance and repair connections shall be quick-coupler type and must match those in use by the activity. When the site is an existing facility, the number and size of maintenance and repair hose connections required to match a facility standard may be used in lieu of those given in the above table. Ship to shore connection sizes and locations are based upon a shipalts program, which will add ships connections for direct hose connections to shore compressed air. Shore couplings for 2-1/2 in. (63.5 mm) ship-to-shore connections should be male cam-locking with cap, MIL-C-17487. Shore couplings for 4-in. (101.6 mm) ship-to-shore connections should be 150-pound flanges with blind flange covers. See Figure 16 for two typical compressed-air shore outlet configurations. Refer to Section 2 for general description of the arrangement and spacing of utility outlets.

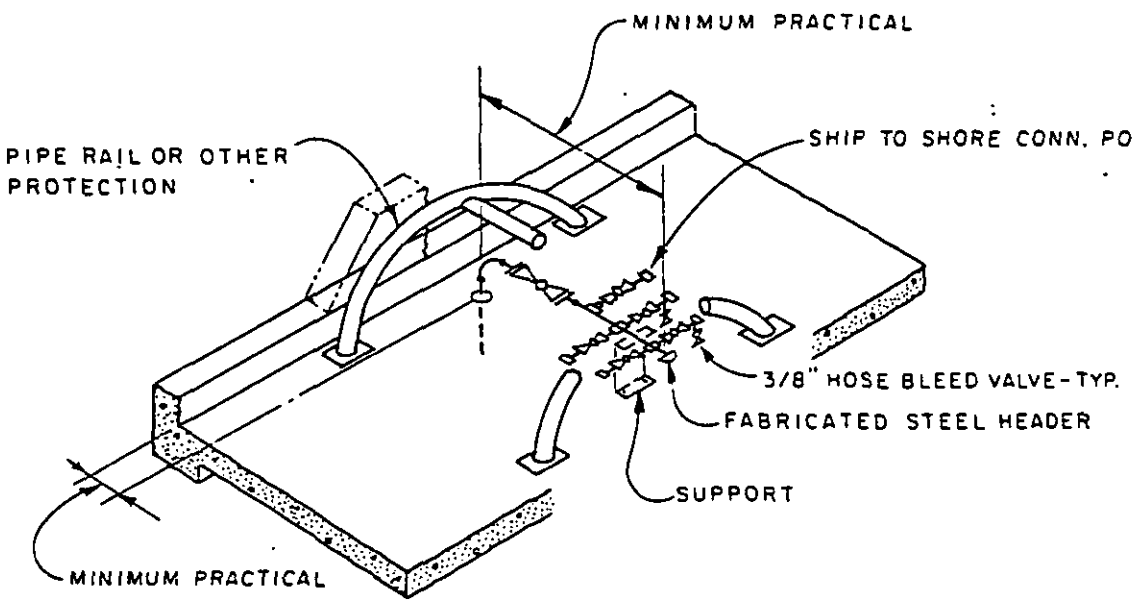
3.2.7 Requirements for High-Pressure Compressed Air. Many submarines require a high-pressure compressed-air supply, in addition to the requirements given in Table 5. This service may be provided by tapping an available 3,000 psi (20.7 MPa) or 4,500 psi (31.0 MPa) source, or by utilizing portable compressors. Required ships service size is normally 1/2 in. (12.7 mm) or 3/4 in. (19.05 mm). The ship's compressors will be used for topoff under emergency conditions. Air quality shall be in accordance with Chapter 9490 of Naval Ships Technical Manual. This chapter requires air to be oil-free and dehumidified by a desiccant type dehydrator to a dewpoint (at atmospheric pressure) of -60°F (-51°C). High pressure compressed air service is normally provided by the activity, but the need must be determined on an individual-site basis, with space allotted when locating other utilities. Because high-pressure compressed air is potentially dangerous, the operation, maintenance and field investigation of these systems should be accomplished only by those familiar with the systems.

3.2.8 Metering. Where monitoring of usage is required, provide metering of compressed-air supply to piers or groups of piers. Install meters in accessible vaults or in above grade enclosures ashore or on piers. Use vortex-shedding or turbine type flow meters which are temperature- and pressure-compensated for good accuracy and range. Where metering is not initially required, make provision for ease of future installation by means of concrete vaults or pier access covers.

3.3 Saltwater or Nonpotable Water. Shore-supplied saltwater or nonpotable water shall be provided (when approved) to piers, wharves, and drydocks in order to meet fire-protection, cooling, and flushing requirements. For drydocks, also refer to NAVFAC DM-29.01, Graving Drydocks.



NORMAL CONFIGURATION



LOW PROFILE CONFIGURATION

Figure 16
Typical Compressed Air Shore Connections

3.3.1 Justification. The use of permanent salt or nonpotable water systems must be justified and approved in advance. Use the following criteria to establish approval requirements for these systems.

3.3.1.1 Repair Piers and Drydocks. At ship repair facilities where ships do not ordinarily have use of their own pumping capabilities, permanent shore salt or nonpotable water systems are normally utilized, and do not require prior approval. Design such systems in accordance with applicable requirements herein, beginning with para 3.3.2.

3.3.1.2 Active Berthing. Permanent salt or nonpotable water systems shall not normally be provided at active berthing facilities. It is NAVFAC intent that ships at active berth will normally rely upon their own pumping capabilities to supply saltwater for flushing/cooling and fire-fighting. In the event of a major fire or other emergency, shore-based portable pumps and other available station fire apparatus would be utilized to augment the ship's saltwater pumping capabilility.

At locations where special conditions or hazards exist, permanent salt or nonpotable water systems will be allowed for active berthing facilities on a case-by-case basis, if adequately justified by the station/activity and approved in advance by NAVFAC Headquarters. Each pier or wharf at a given facility must be considered separately, unless the usage of two or more piers is identical. The station/activity shall submit the following when requesting approval for these systems:

a) Identify the type of facility and activities, and describe the special condition(s) or hazard(s) peculiar to this facility, and upon which this request is based.

b) Establish the required pier or facility demand based on the methods given in para 3.3.2.

c) Provide description and analysis of the options available to provide the required protection, such as (1) permanent system to supply the entire demand, (2) portable pumping systems(s), dedicated or otherwise, and (3) combinations of (1) and (2). All existing Navy assets must be included in the analysis, including any existing permanent systems.

d) Provide a life cycle cost analysis for all viable options on a site specific basis, and performed in accordance with NAVFAC P-442, Economic Analysis Handbook. The analysis must take into consideration the costs of owning and operating all pertinent plant, both on ships and ashore.

e) Make recommendations for the best system to meet the required demand, based on consideration of the special conditions(s) or hazards(s) and on life cycle costs.

Approved permanent salt or nonpotable water systems shall be designed as described in applicable subparas. of 3.3.2.

3.3.2 Demands and Pressure Requirements. Berthing facilities shall conform to the requirements specified below. The requirements differ for overhaul and drydock berthing and for active berthing.

3.3.2.1 Drydock and Repair Berthing. Saltwater supply shall be furnished at drydocks, piers, and wharves as described below. Requirements for selected ship classes are given in Table 6. For ships not included in Table 6, use data from Table 6 for a similar ship or obtain the expected demand for NAVFACENGCOM HQ. The following criteria shall also apply:

a) Drydock. Provide sufficient saltwater to meet the requirement of the ship with the severest saltwater demand anticipated to be docked at the drydock. Use the "Total Demand" quantity listed in Table 6. Refer to NAVFAC DM-29.1 for additional requirements at drydocks.

b) Repair Berthing. Provide sufficient saltwater to meet the "Total Demand" requirement given in Table 6 for the largest ship to be berthed at the pier (1,000 gpm [3,785 lpm] minimum for piers serving frigate ships and larger; 500 [1,892.5 lpm] gpm minimum for piers serving ships smaller than frigates), plus the aggregate cooling/flushing demand of all remaining ships at the pier (do not include nested ships), multiplied by the diversity factors given below:

NUMBER OF SHIPS	DIVERSITY FACTOR
1	1.0
2	0.9
3	0.8
4	0.7
Over 4	0.6

c) Total System Demand. Where a system serves more than one pier, assume only one ships fire will occur for the group of repair piers. The multiple pier supply system shall be designed to meet the requirement of the pier with the highest demand (computed per b), above), plus the aggregate cooling/flushing demand from ships at all remaining piers (excluding nested ships), adjusted by the same diversity factor given in b), above. To obtain an overall demand that includes drydocks, add the sum of all drydock demands to the multiple-pier demand described herein.

d) Pressure Requirement. The saltwater pressure shall be 150 psi residual pressure at the most remote drydock or pier or wharf outlet for all ships except submarines, which require only 40 psi.

3.3.2.2 Active Berthing (Single or Multiple Berths). Salt- or nonpotable-water requirements for selected ship classes are given in Table 7. For ships not included in Table 7, use data from Table 7 for a similar ship or obtain the expected demand from NAVFACENGCOM HQ.

In the criteria given below for saltwater or nonpotable-water demands, one of the following conditions of flow governs.

NOTE: EITHER THE FIRE-PROTECTION DEMAND OR THE COOLING/FLUSHING DEMAND MAY GOVERN; USE WHICHEVER IS GREATER:

a) fire demand, based on a fire occurring aboard the largest-demand ship, with remaining ships connected to the pier saltwater main operating

Table 6
Shore Services - Salt or Nonpotable Water
(Overhaul and Drydock Berthing[1])

Ship Type	Symbol	Total Demand[2] (gpm)	Fire Fighting Flow (gpm)	Cooling/ Flushing Flow (gpm)
Aircraft Carriers	CV	3750	3000	750
	CVN	3750	3000	750
Surface Combatants				
Battleship	BB			
Cruiser	CG	1250	1000	250
	CGN	1250	1000	250
Destroyer	DD	1250	1000	250
	DDG	1250	1000	250
Frigate	FF	1250	1000	250
	FFG	1250	1000	250
Patrol	PG	625	500	125
	PHM	625	500	125
Submarines		xxx[3 4]		
Amphibious Warfare				
Command	LCC	1250	1000	250
Assault	LHA	3125	2500	625
	LPH	3125	2500	625
Cargo	LKA	1875	1500	375
Transport	LPD	1875	1500	375
Landing	LSD	2500	2000	500
	LST	1875	1500	375
Mine Warfare	MSO	625	500	125
	MCM	625	500	125
Auxiliary				
Tenders & Repair	AD	1875	1500	375
	AR	1875	1500	375
	ARS	625	500	125
	AS	1875	1500	375

Table 6
Shore Services - Salt or Nonpotable Water -- Continued
(Overhaul and Drydock Berthing[1])

Ship Type	Symbol	Total Demand[2] (gpm)	Fire Fighting Flow (gpm)	Cooling/ Flushing Flow (gpm)
Auxiliary (cont'd)				
Tenders & Repair (cont'd)	ASR	750	600	150
Cargo & Transport	AE	1875	1500	375
	AFS	1875	1500	375
	AH	1250	1000	250
	AK	1875	1500	375
	AKR	1875	1500	375
	AO	1875	1500	375
	AOE	1875	1500	375
	AOR	1875	1500	375
	AOT	1875	1500	375
	AP	625	500	125
Tugs	ATF	625	500	125
	ATS	625	500	125
Miscellaneous	AG	1875	1500	375
	AGS	1250	1000	250
	AGF	2500	2000	500
	AGM	1875	1500	375
	AGOR	625	500	125
	AGOS	625	500	125
	AVM	1875	1500	375

[1]For ships connection locations, see Table 7.

[2]"Total Demand" equals "Fire Fighting" plus "Cooling/Flushing" flow.

[3]Salt water fire protection systems are not required for concrete-construction submarine piers; requirements for AFFF fire suppression systems will be determined by evaluation of fire risks involved on pier by the NAVFACENGCOMHQ Fire Protection Engineer.

[4]For submarine berthing piers, a permanent salt water system for cooling/ flushing is not mandatory if sufficient fresh water is provided to meet all operational shore water requirements.

Table 7
Shore Services - Salt or Nonpotable Water
(Active Berthing[1])

Ship Type	Class	Fire Fighting Salt Water From Shore (gpm)	Cooling/ Flushing Salt Water From Shore (gpm)	Ships Connection Locations[2] (ft)	
				L	H
Aircraft Carriers	CV-59	8750	3950		
	CV-63	8750	3950		
	CVN-65	8750	3950		
	CVN-68	9500	4100		
Surface Combatants					
Battleship	BB-61	3500	1300		
	BB-62	3500			
	BB-63	3500			
	BB-64	3500			
Cruiser	CG-16,26	3000	1150		
	CG-47	3300	1650	269 P 377 P 310 S 407 S	
	CGN-9	2500	1100		
	CGN-36	2300	1300		
	CGN-38	2300	1300		

Table 7
Shore Services - Salt or Nonpotable Water -- Continued
(Active Berthing[1])

Ship Type	Class	Fire Fighting Salt Water From Shore (gpm)	Cooling/ Flushing Salt Water From Shore (gpm)	Ships Connection Locations[2] (ft)	
				L	H
Surface Combatants (Cont'd)					
Destroyer	DD-963	2000	1250	xxx[3]	18-22
	DDG-2	1300	600		
	DDG-37				
	DDG-51	2000	1500	194 PS	23
				334 PS	23
	DDG-993	3300	1650		
Frigate	FF-1037				
	FF-1040	900	450		
	FF-1052	900	700	276 PS	
	FFG-1	900	450		
	FFG-7	1750	1750	287 PS	18
Patrol	PG-85				
	PHM-1				
Submarines	SS	xxx[4 5]			
	SSN	xxx[4 5]			
	SSBN	xxx[4 5]			
Amphibious Warfare					
Command	LCC-19	1000	750		
Assault	LHA-1	8000	3000		
	LHD-1	8000	3000		
	LPH-2	3000	1500		
Cargo	LKA-113	1000	750		

Table 7
Shore Services - Salt or Nonpotable Water — Continued
(Active Berthing[1])

Ship Type	Class	Fire Fighting Salt Water From Shore (gpm)	Cooling/ Flushing Salt Water From Shore (gpm)	Ships Connection Locations[2] (ft)	
				L	H
Amphibious Warfare (Cont'd)					
Transport	LPD-4	2000	1000		
Landing	LSD-36	1000	1000		
	LSD-41	2000	1250		
	LST-1179	1000	750		
Mine Warfare	MSO-427 MCM-1	250	150		
Auxiliary					
Tenders & Repair	AD-15	800	600		
	AD-37,41	2500	1100	110 PS 438 PS	
	AR-5	1250	550		
	ARS-38 ARS-50				
	AS-31				
	AS-33	1750	950		
	AS-36	2500	1100		
	ASR-9,21				
Cargo & Transport	AE-21				
	AE-26	2000	1100		
	AFS-1	700	450		
	AH-19				

Table 7
Shore Services - Salt or Nonpotable Water — Continued
(Active Berthing[1])

Ship Type	Class	Fire Fighting Salt Water From Shore (gpm)	Cooling/ Flushing Salt Water From Shore (gpm)	Ships Connection Locations[2] (ft)	
				L	H
Auxiliary (cont'd)					
Cargo & Transport (Cont'd)					
	AK-280				
	AKR-7				
	AO-105				
	AO-143	650	400		
	AO-177	1750	950		
	AOE-1,6	3000	1500		
	AOR-1	2250	950		
	AOT-168				
	AP-110, 122				
Tugs	ATF-91				
	ATS-1				
Miscellaneous	AG-193				
	AGS-39				
	AGDS-2				
	AGF-11				
	AGM-20				
	AGOR-11				
	AGOS-1				
	AVM				

Table 7
Shore Services - Salt or Nonpotable Water -- Continued
(Active Berthing[1])

[1] The range of values in Table 7 encompasses all ship types. Requirements or ships not specifically identified in the tables should be based on the saltwater flows for similar type ships listed, or on data available from NAVSEA or the station/activity.

[2] L and H refer to the location of ships connections. L is the distance, in feet, of the connection aft of the point of stem of the ship, and H is the height, in feet, of the connection above the design waterline; see Figures 2 through 13, as applicable. Designations "P," "S" & "C" refer to Port side, Starboard side and Centerline, respectively. Where more than one connection exists, all locations are shown.

[3] No specific connection location for this ship. Connection(s) made to most convenient main deck fire hydrant(s).

[4] Saltwater fire protection systems are not required for concrete construction submarine piers; requirements for AFFF fire suppression systems will be determined by evaluation of fire risks involved on pier by the NAVFACENGCOMHQ Fire Protection Engineer.

[5] For submarine berthing piers, a permanent saltwater system for cooling/ flushing is not mandatory if sufficient freshwater is provided to meet all operational shore water requirements.

independent ships pumps to furnish their own cooling/flushing water during the fire, or,

b) cooling/flushing demand, for the aggregate of connected ships, adjusted for diversity.

The saltwater system serving each single pier or equivalent wharf shall be designed in accordance with either of the following: (An equivalent wharf is defined as a wharf with a set of berths (four maximum) equivalent to the berthing accommodation of a single pier.)

a) For Fire Protection. For piers and wharves serving frigates or larger ships, use the "Salt Water From Shore" requirement from Table 7 for the largest ship to be berthed at the pier or 1,000 gpm (3,875 lpm), whichever is greater. For piers and wharves serving ships smaller than frigates, use the "Salt Water From Shore" requirement from Table 7 for the largest ship to be berthed at the pier or 500 gpm (1,892.5 lpm), whichever is greater.

b) For Cooling and Flushing. Use the sum of the "Cooling/ Flushing Salt Water From Shore" requirements from Table 7 for all ships to be berthed pierside (excluding nested ships), multiplied by the diversity factors given below:

NUMBER OF SHIPS	DIVERSITY FACTOR
1	1.0
2	0.9
3	0.8
4	0.7
Over 4	0.6

Design saltwater pumping systems serving more than one pier or equivalent wharf as above, except apply diversity. The capacity shall be equal to the sum of the requirements for all piers multiplied by a system diversity factor of 0.75. Increased pumping capacity at a pumping station may be added where necessary to supply a future pier or piers. Where numerous piers are involved (for which permanent systems have been approved), optional designs, such as individualized pier pumping stations, should be considered.

The pressure required for these systems shall be 150 psi residual pressure at the most remote pier or wharf outlet at design flow, except that separate systems which supply water for cooling/flushing only shall provide 40 psi (275.8 kPa) residual at design flow.

Example Problems. The example problems below are presented to illustrate the method of determining quantity and pressure requirements. Four example problems are given; the example berthing arrangements for the problems are shown on Figure 17.

- Example Problem 1: Dedicated Carrier Pier. See Figure 17, Case I. This is a single-berth pier, with no nesting. Two CVN-68 Nimitz-class, aircraft carriers are to be accommodated as shown.

a) Fire-Protection Requirement. From Table 7, the "Salt Water From Shore" requirement for a CVN-68 is 9,500 gpm (36,000 lpm).

b) Cooling/Flushing Requirement. The "Cooling/Flushing Salt Water From Shore" requirement for a CVN-68 is 4,100 gpm (15,518.5 lpm). For two CVN-68 ships, the total adjusted (diversified) demand is: (2)(4,100)(0.9) = 7,380 gpm (28,597.5 lpm).

NOTE: The fire-protection requirement governs: use 9,500 gpm for the saltwater design flow.

- Example Problem 2: Destroyer and Frigate Pier, Maximum-Density Configuration. See Figure 17, Case II. This is a multiple-berth pier with two-abreast berthing (nesting). The ship classes and numbers indicated on Figure 17 are to be accommodated at the pier.

a) Fire-Protection Requirement. Table 7 indicates that the largest "Salt Water From Shore" requirement is 2,500 gpm (9,462.5 lpm), for the AD-41.

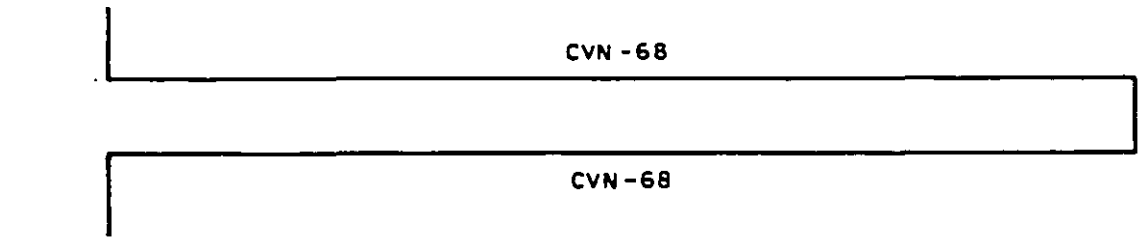
b) Cooling/Flushing Requirement. For the ship mix indicated, and providing saltwater for the inboard ships only, the cooling/flushing requirements are: 1,100 gpm (4,163.5 lpm) for the inboard AD-41, 1,250 gpm (4,731.25 lpm) for the inboard DD-963; and 1,750 gpm (6,623.75 lpm) for each inboard FFG-7. The total requirement is: 1,100 + 1,250 + (2)(1,750) = 5,850 (22,142 lpm) gpm. The total adjusted (diversified) demand is: (5,850)(0.7) = 4,095, say 4,100 (15,518.5 lpm) gpm.

NOTE: The cooling/flushing requirement governs: use 4,100 gpm for the saltwater design flow.

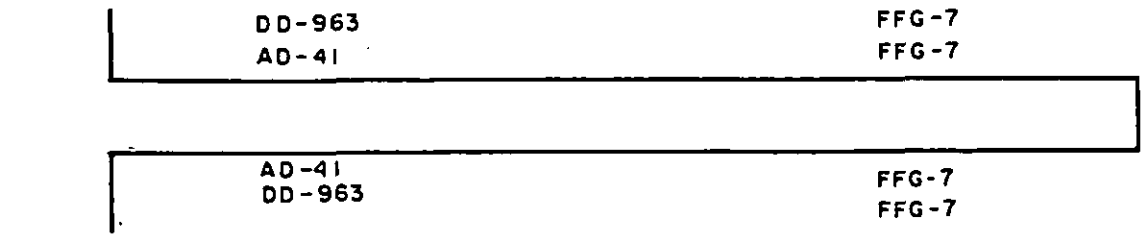
- Example Problem 3: Wharf Design (Two Equivalent Wharves). See Figure 17, Case III. This is a multiple-berth wharf, including nesting conditions, with the indicated ships and berthing assignments.

The wharf may be analyzed as being the equivalent of two berthing piers, separated into two ship groupings, since more than four ships are adjacent to the wharf. Group 1 ships are FF-1052, DDG-2, and AD-41, and group 2 ships are FF-1052, DD-963, and CGN-38. While other groupings are possible, the grouping resulting in the highest overall demand is used.

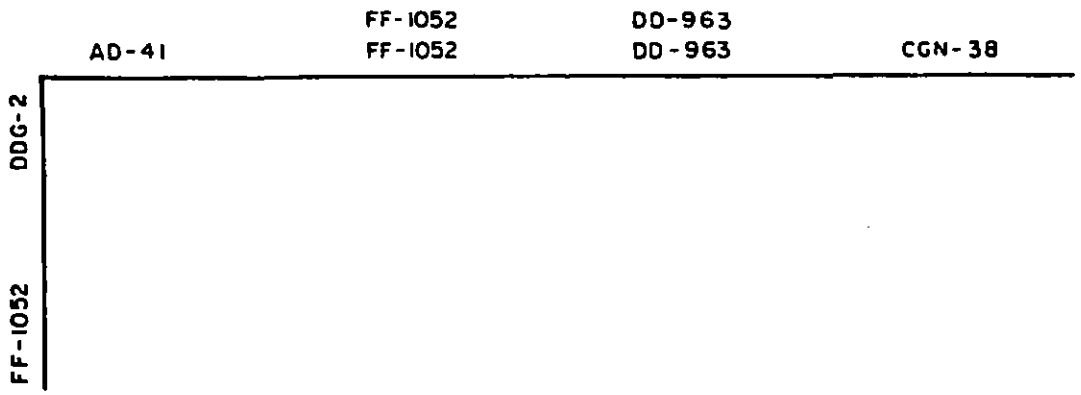
a) Fire-Protection Requirement. In group 1, the largest-demand ship is the AD-41, with a requirement of 2,500 gpm (9,462.5 lpm). In group 2, the largest-demand ship is the CGN-38, with a requirement of 2,300 gpm (8,705.5 lpm).



CASE I



CASE II



CASE III

Figure 17
Example Arrangements for Saltwater Demand

b) Cooling/Flushing Requirement. The group 1 cooling/flushing requirements are: FF-1052 (700 gpm or 2,649.5 lpm), DDG-2 (600 gpm or 2,271 lpm), and AD-41 (1,100 gpm or 4.163.5 lpm). Group 1 total adjusted (diversified) demand is: (2,400 or 9,084 lpm)(0.8) = 1,920 gpm (7,267.2 lpm). The group 2 cooling/flushing requirements are: FF-1052 (700 gpm or 2,649.5 lpm), DD-963 (1,250 gpm), and CGN-38 (1,300 gpm). Group 2 total adjusted (diversified) demand is: (3,250)(0.8) = 2,600 gpm (984.1 lpm).

NOTE: Governing demands are 2,500 gpm (fire protection) for group 1 ships and 2,600 gpm (cooling/flushing) for group 2 ships. Gross demand for the two equivalent wharves is: 2,500 + 2,600 = 5,100 gpm (19,303.5 lpm). Using the multiple-pier system diversity factor from above, (Saltwater System Serving More Than One Pier or Equivalent Wharf), the saltwater design flow for the entire wharf is: (5,100)(0.75) = 3,825 gpm (14,477.6 lpm).

- Example Problem 4: Saltwater System Serving More Than One Pier or Equivalent Wharf. In this example problem, a common pumping station is to supply saltwater for the piers and wharves of Example Problems 1, 2, and 3. The saltwater design flow requirements previously determined are: dedicated carrier pier (9,500 gpm or 35,957.5 lpm); destroyer and frigate pier (4,100 gpm); and two equivalent wharves (5,100 gpm). Thus, the central pumping facility shall have a minimum capacity of (18,700)(0.75) = 14,025 gpm (53,084.6 lpm).

3.3.3 Pumping Equipment. Pumps may be permanent, portable or mobile as approved (refer to para. 3.3.1). In general, pump capacities and heads should be selected to provide for both fire-protection and cooling/flushing requirements. Use separate pumps for the two requirements only when specifically allowed or as stated in para. 3.3.5.2. Refer to MIL-HDBK-1008, Fire Protection for Facilities Engineering, Design and Construction, for requirements of fire pumps and associated equipment. Centrifugal fire pumps shall comply with NFPA 20, Centrifugal Fire Pumps. Refer also to NAVFAC DM-5.7, Water Supply Systems, for pumping equipment criteria.

3.3.3.1 Drives. Fire pumps may be driven entirely by electric motors if either a single reliable power source or two independent power sources are available, as defined by NFPA 20. Single reliable power sources need not include dual substations nor starting equipment. If the above conditions for use of electric drive only cannot be met, design the system such that a minimum of 50 percent of pumping capacity is driven by approved alternative drives, such as diesel engines. Portable or mobile pumping equipment is normally driven by remote-starting electric motors (when appropriate) or by diesel or gas-turbine engines.

3.3.3.2 Pressure Control. Pressure must be controlled under varying demands by staging of pumps and by incorporation of surge tanks and/or other suitable equipment to prevent excessive surges due to starting and stopping of pumps. Use a small pressure-maintenance pump to handle low flows. Fire pumps must be equipped for automatic startup upon pressure drop, manual stop, and provison for manual override startup.

3.3.3.3 Alternative Pump Drive. When a separate cooling/flushing water system is used, a variable-speed electric drive may be used to control

pressure. Variable-speed equipment may also be used for combined fire-protection and cooling/flushing systems when approved by the appropriate Engineering Field Division. Variable-speed-drive equipment should be selected from types which have been proven by successful use. Adjustable- frequency type variable-speed systems are preferred because of their higher efficiency.

3.3.3.4 Location. Permanent pumping equipment for individual piers, wharves, or drydocks should normally be located ashore, as near as possible to the structure. Where it is impractical to build a wet sump and intake for use of vertical pumps on shore, pumps may be placed in an enclosure on or alongside a pier or wharf, with pump columns adequately protected from wave action and floating debris. Portable or mobile pumping equipment may be placed on pier decks or on floating platforms, moored to the pier.

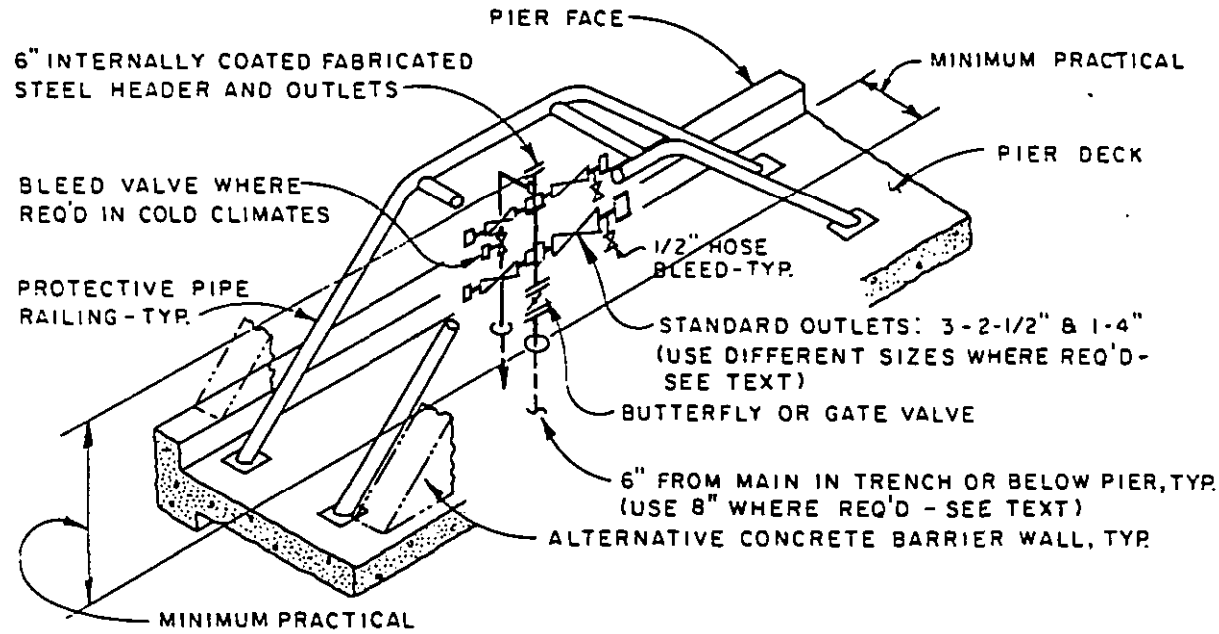
3.3.4 Piping and Outlets

3.3.4.1 Size of Mains. Piping systems must be designed to provide the required residual pressure, at design flow conditions, to the berths which are farthest from the pumping system. Where a common shore pumping and distribution system feeds several piers or drydocks, the shore distribution system must be sized to deliver the design firefighting flow to any one of the piers or drydocks while cooling/flushing flows continue to all other locations.

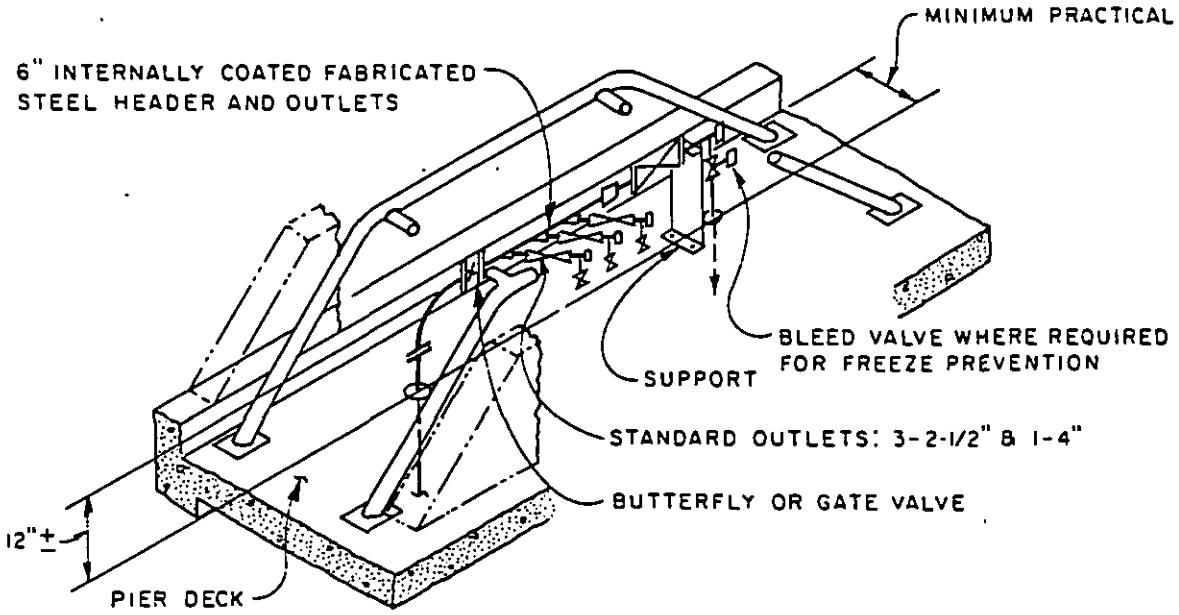
3.3.4.2 Location and Arrangement of Mains. As a general rule, when permanent mains are placed on piers 50 ft (15.24 m) or less in width, provide a single main with branch lateral pipes for outlets on both sides of the pier; for piers wider than 50 ft, provide a looped main with outlets on both sides. Coordinate piping with structural conditions and arrange mains for the best combination of versatility, security, and overall cost. It is normally more desirable operationally to provide a looped main than an equivalent single main. Provide isolation valves at appropriate locations for reliability of service during emergency repairs.

3.3.4.3 Location and Spacing of Outlets. The pier location of ships saltwater connections may be determined by use of the locating dimensions for ships connections given in Table 7, in conjunction with Figures 2 through 13 for the appropriate ship classes. For a description of the methods to be used in establishing shore utility-station spacing on piers and wharves, refer to Section 2. For spacing in drydocks, refer to NAVFAC DM-29.1.

3.3.4.4 Outlet Design. The typical outlet shall consist of a 6-in. (152.4 mm) branch main and riser feeding a manifold arrangement of three 2-1/2 in. (63.5 mm) and one 4-in. (101.6 mm) valved hose connections. See Figure 18 for typical details. Where portable pumping systems are used, standpipe connections may be provided on some (or each) of the outlet risers for connection to the portable pumping system discharge hose. For certain large ships the above outlet requirements shall be modified; refer to para. 3.3.5, CV, CVN, LHA and LHD Requirements (All Classes). Provide four 4-in. valved hose connections in a manifold arrangement at the outboard end of large piers for fire boat or large-volume portable-pump connections. Where berthing is designed exclusively for tugboats, work boats, or other small craft having a "Salt Water From Shore" requirement of not more than 625 gpm, properly spaced 4-in. (101.5 mm) risers having two to three 2-1/2 in. (63.45 mm) connections may be used in lieu of the above. All connections shall be protected by a chained cap. At each



NORMAL CONFIGURATION



LOW PROFILE CONFIGURATION

Figure 18
Typical Salt or Nonpotable Water Shore Connections

designated pier in each naval station where oceangoing U.S. merchant and foreign ships are expected, two international shore connections shall be provided (see Figure 19).

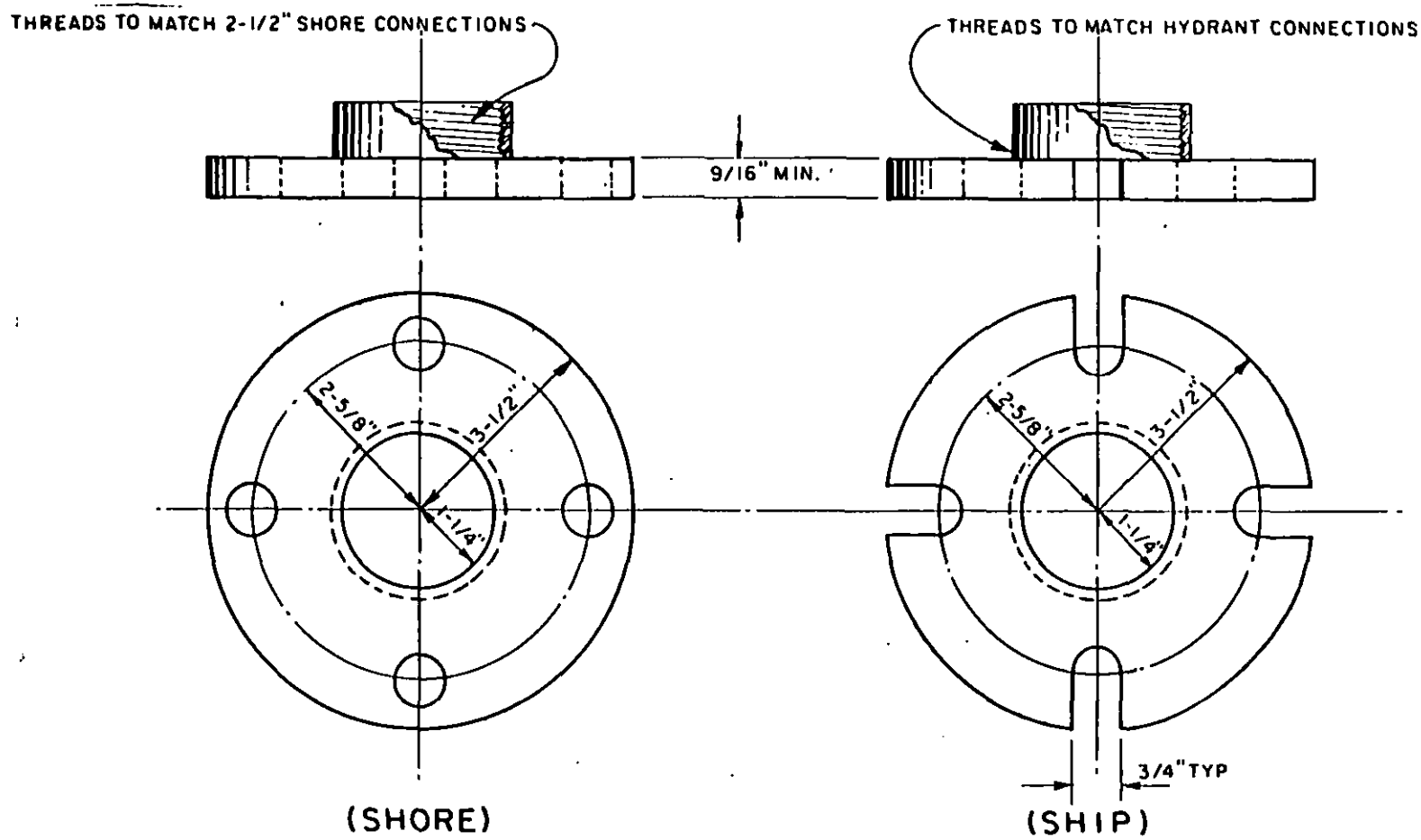
3.3.4.5 Materials and Installation Criteria. Pipe and fittings shall conform to NAVFAC DM-5.7, as applicable to piers and wharves. Use pipe, fittings and valves pressure-rated at 250 psi (1,724 kPa) minimum. Hose threads shall be National Standard hose-coupling threads, 7-1/2 threads/inch, or as approved by the responding fire department. For piping on a pier or wharf, evaluate the relative advantages of cement-lined ductile iron and cement-lined steel pipe with an extruded polyethylene or polypropylene exterior coating. An ultra violet inhibitor must be used in polyethylene coatings which will be exposed to sunlight. For coated pipe, use polyethylene heat-shrinkable sleeves and/or tape wrapping at joints and fittings. Hangers and bolts must be galvanized. Where saltspray exposure is severe, incorporate appropriate additional anticorrosion measures for hangers, such as application of epoxy coatings, use of stainless steel or Monel bolting, and use of fiberglass/resin-composite hangers and bolting. Provide means of pipe movement due to thermal expansion, preferably by use of expansion loops and offsets. Also provide for differential movement of piping at pier expansion joints. Piping and outlets must be identified and color coded in accordance with Section 6, MISCELLANEOUS PROVISIONS.

3.3.5 CV, CVN, LHA and LHD Requirements (All Classes). At existing installations where insufficient saltwater pressure exists, the pressure shall be increased to provide 150 psi (1,034 kPa) residual pressure at the pier outlets. Pump-discharge pressure must be sufficient to provide the required residual at design flow. The following special requirements apply to these ships:

3.3.5.1 Special Outlets: Provide four 4-in. (101.5 mm), gate valved hose connections in an 8 in. (203 mm) manifold arrangement with an 8 in. riser (in lieu of the typical outlet) at each of two locations. Approximate locations of outlets for aircraft carriers shall be as indicated on Figure 20. For LHA and LHD ships, determine locations from NAVSEA or from the station/activity. Outlet design and configuration shall be similar, except for size, to outlets at other locations.

3.3.5.2 Upgrading. Permanent changes to existing pier systems for upgrading of fire protection (where permanent system has been justified) shall be by installation of a separate high-pressure system using pipe, fittings, and valves with a pressure rating of 250 psi ((1,724 kPa) minimum. Existing low-pressure saltwater systems may remain in place for cooling/flushing and for fighting fires on piers when handheld hose lines are required.

3.3.5.3 Portable or Mobile Pumps. Supplemental large-volume portable or mobile pumps may be utilized for these ships to augment the salt-water supply from a permanent system. Existing systems which can supply a portion of the requirement at 150 psi (1,034 kPa) residual may remain unchanged. However, when portable or mobile systems are used at drydocks or repair facilities, the capacity of the permanent system shall be no less than 5,000 gpm (18,925 lpm).



MATERIALS (APPLICABLE TO SHIP OR SHORE CONNECTIONS):

FLANGES: BRONZE, ASTM B61, FLAT FACE

GASKET MATERIAL: ANY SUITABLE FOR 250 PSI

BOLTS, NUTS & WASHERS: BRONZE, MINIMUM YIELD STRENGTH 35 KSI

Figure 19
International Shore Connection for Ship Fire Mains

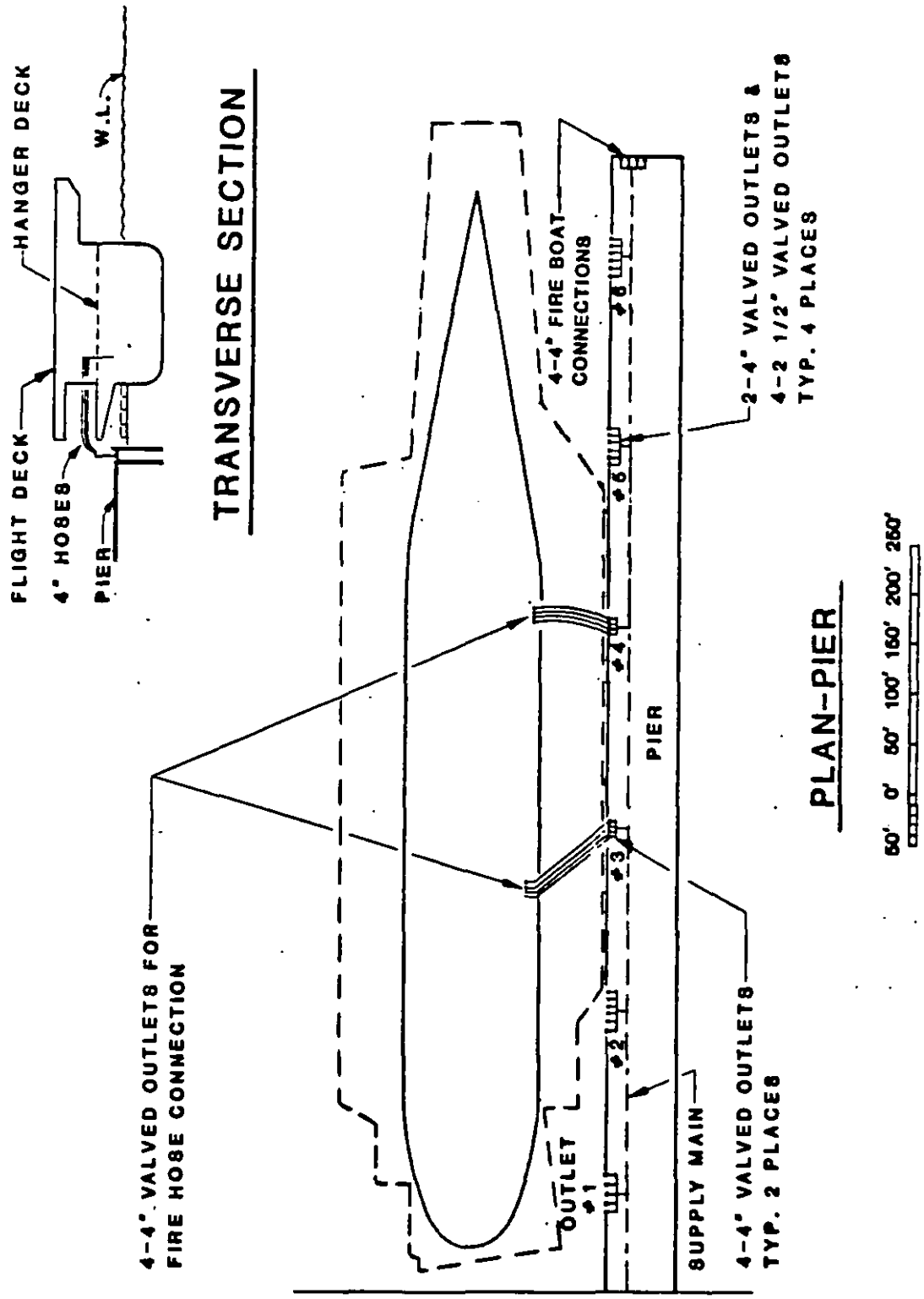


Figure 20
Salt or Nonpotable Water for CV, CVN Classes at Pier

3.3.6 Other Nuclear-Powered Ship Requirements. For active and repair berthing or docking, the requirements are the same as those for conventionally powered ships of similar type.

3.3.7 Protection From Freezing. In climates subject to freezing temperatures, salt and nonpotable water lines and outlets must be protected (refer to Section 6).

3.4 Potable Water. Potable water shall be provided for all berthing spaces so that ships may take on water. For graving drydocks, refer to NAVFAC DM-29.1.

3.4.1 Quantity and Pressure Requirements

3.4.1.1 Active Berthing (Single or Multiple Berths). For single berths, provide a potable water supply of 1,000 (gpm) (3,785 lpm) for all berth lengths up to 2,000 linear ft (610 m), with a minimum residual pressure of 40 (psi) (276 kPa) at the most remote outlet on the pier. Where the pier length accommodates more than one berth, provide a potable water supply of 1,000 gpm for the first 2,000 linear ft of berth, plus 500 gpm (1,893 lpm) for each additional 2,000 linear feet up to a maximum of 2,000 gpm (7,570 lpm), with a minimum pressure of 40 psi at the most remote outlet.

3.4.1.2 Repair Berthing. The potable-water requirements for repair piers are indicated in Table 8 for selected ship classes. The quantities indicated for each ship to be berthed at a pier, including nested ships, shall be added together, and the total quantity shall be available on the pier. The peak rate of flow for main sizing shall be based upon providing the entire daily-flow requirement from Table 8 for all ships on a pier or wharf, at a constant flow rate, within an 8-hour period, and at a residual pressure of 40 psi minimum at the shore connections.

3.4.1.3 Multiple Piers. Total usage for multiple piers in gallons per day shall be determined by summing daily flows for all ships at all piers or wharves. The peak-flow rate for multiple piers shall be determined by summing peak-flow rates for all piers or wharves, as determined by the method described above, and multiplying the sum by a diversity factor of 0.75.

3.4.2 Piping System Design Criteria. For piping materials and installation requirements, refer to NAVFAC DM-5.7. Additionally, for piping under a pier or wharf, evaluate the relative advantages of cement-lined ductile iron and cement-lined steel pipe with an extruded polyethylene or polypropylene exterior coating. Provide an ultra violet inhibitor in polyethylene or polypropylene coatings which will be exposed to sunlight. For coated pipe, use polyethylene, heat-shrinkable sleeves and/or tape wrapping at joints and fittings. Hangers and bolts must be galvanized. Where salt-spray exposure is severe, incorporate appropriate additional anticorrosion measures for hangers, such as application of epoxy coatings and use of stainless steel or Monel bolting. Provide means of pipe movement due to thermal expansion, preferably by use of expansion loops or offsets. Also provide for differential movement of piping at pier expansion joints.

3.4.3 Location and Arrangement of Piping Mains. As a general rule, provide a single water main with cross-branch piping to outlets for all

Table 8
Shore Services - Potable Water[1]
(Repair Berthing)

Ship Type	Class	Normal Requirement With Ships Complement (gpd)	Requirement With Air Wing or Troops Aboard (gpd)	Ships Connection Locations[2] (ft)	
				L	H
Aircraft Carriers	CV-59		125,000		
	CV-63		125,000		
	CVN-65		140,000		
	CVN-68		185,000		
Surface Combatants					
Battleship	BB-61	50,000			
	BB-62	50,000			
	BB-63	50,000			
	BB-64	50,000			
Cruiser	CG-16,26	14,500			
	CG-47	12,000		279 PS	
	CGN-9	13,200			
	CGN-36	19,700			
	CGN-38	16,100			
Destroyer	DD-963	17,000		273 S 333 P	
	DDG-2	12,000			
	DDG-37	13,200			
	DDG-51	9,500		202 PS 52S	22 34
	DDG-993	18,200			

Table 8
Shore Services - Potable Water[1] -- Continued
(Repair Berthing)

Ship Type	Class	Normal Requirement With Ships Complement (gpd)	Requirement With Air Wing or Troops Aboard (gpd)	Ships Connection Locations[2] (ft)	
				L	H
Surface Combatants (Cont'd)					
Frigate	FF-1037	5,900			
	FF-1040	14,200			
	FF-1052	14,200		276 PS	
	FFG-1	7,500			
	FFG-7	10,800		318 PS	35
Patrol	PG-85				
	PHM-1	700			
Submarines	SS-580	2,500			
	SSN-594				
	SSN-637				
	SSN-688	5,000 Max			
	SSBN-616				
	SSBN-726				
Amphibious Warfare					
Command	LCC-19		44,100		
Assault	LHA-1		85,000		
	LPH-2		81,700		
Cargo	LKA-113		18,800		
Transport	LPD-4		48,300		
Landing	LSD-36		23,800		
	LSD-41		20,800		
	LST-1179		23,500		
Mine Warfare	MSO-427	2,400			
	MCM-1	2,200			

Table 8
Shore Services - Potable Water[1] -- Continued
(Repair Berthing)

Ship Type	Class	Normal Requirement With Ships Complement (gpd)	Requirement With Air Wing or Troops Aboard (gpd)	Ships Connection Locations[2] (ft)	
				L	H
Auxiliary					
Tenders & Repair	AD-15	31,000			
	AD-37				
	AD-41	85,500		110 PS 314 S 322 P 534 PS	
	AR-5	40,000			
	ARS-38	3,600			
	ARS-50	3,000			
	AS-31	77,000			
	AS-33	43,000			
	AS-36	35,000			
	ASR-9,21	7,000			
Cargo & Transport	AE-21	11,900			
	AE-26	12,300			
	AFS-1	14,600			
	AH-19	40,000			
	AK-280	2,700			
	AKR-7	2,600			
	AO-105	4,600			
	AO-143	4,500			
	AO-177	4,800			
	AOE-1	18,000			

Table 8
Shore Services - Potable Water[1] -- Continued
(Repair Berthing)

Ship Type	Class	Normal Requirement With Ships Complement (gpd)	Requirement With Air Wing or Troops Aboard (gpd)	Ships Connection Locations[2] (ft)	
				L	H
Auxiliary (Cont'd)					
Miscellaneous (Cont'd)	AOR-1	12,000			
	AOT-168	1,200			
	AP-122	62,000			
Tugs	ATF-91	3,400			
	ATS-1	4,500			
Miscellaneous	AG-193	6,200			
	AGS-39	4,600			
	AGDS-2	4,800			
	AFG-11	41,000			
	AGM-20	6,600			
	AGOR-11	2,500			
	AGOS-1	1,600			
	AVM	13,400			

[1]The range of values in Table 8 encompasses all ship types. Requirements for ships not specifically identified in the table should be based on the requirement for similar type ships listed, or on data available from NAVSEA or the station/activity.

[2]L and H refer to the location of ships connections. L is the distance, in feet, of the connection aft of the point of stem of the ship and H is the height, in feet, of the connection above the design waterline; see Figures 2 through 13, as applicable. Designations "P," "S" & "C" refer to port side, starboard side and centerline, respectively. Where more than one connection exits, all locations are shown.

active berthing piers and for all repair piers 50 ft (15.2 m) or less in width. For repair piers wider than 50 ft, provide piping mains on both sides with a cross connection at the outboard end. Coordinate piping with structural conditions and arrange mains for the best combination of versatility, security, and overall cost. It is normally more desirable operationally to provide a looped main rather than an equivalent single main. Provide isolation valves at appropriate locations for reliability of service during emergency repairs.

3.4.4 Piping and Outlets. See Figure 21 for typical outlet details. Provide at least one 2-1/2 in. (63.45 mm) connection at each service outlet, except as specified in para. 3.4.6, Specific Ship Requirements and except where nesting is anticipated. Branch piping from mains to outlet risers shall be not less than 2-1/2 in. size, and not less than 4-in. size where dual 2-1/2 in. connections are fed by a common branch (see Figure 21). Terminate shore connections with a 2-1/2 in. gate valve with hose threads (National Hose Threads) on outlet and chained cap. All potable-water outlets on piers and wharves and all individual potable water hose connections usable for potable water, including all outlets of dual connections where used, shall have a reduced-pressure type backflow-prevention device, in accordance with NAVFAC DM-5.7. All such outlets on piers and wharves shall be identified and color coded in accordance with Section 6. If static pressure in the supply mains is greater than 80 psi (552 kPa) for any portion of the day, provide regulators set at 80 psi maximum.

3.4.5 Location and Spacing of Outlets. The pier locations of ships potable water connections may be determined by use of the locating dimensions for ships connections given in Table 8, in conjunction with Figures 2 through 13 for the appropriate ship classes. For a description of methods to be used in establishing shore-utility station spacing on piers and wharves, refer to Section 2.

3.4.6 Specific Ship Requirements

3.4.6.1 CV and CVN Ship Requirements (All Classes). Design systems as specified above, except provide a 4-in. (101.52 mm) branch line, a 4-in. backflow prevention device, and outlet at each of locations 3 and 4 of Figure 20. Provide a 4-in. to 2-1/2 in. (63.45 mm) reducer for each location to allow use of these outlets by ships other than carriers.

3.4.6.2 LHA, LHD, LPH-2 and AD-41. Design systems as specified above, except provide dual outlets at each utility connection group, and provide one 4-in. backflow prevention device and outlet near the center of the berth. Provide a 4-in. to 2-1/2 in. reducer to allow use of the 4 in. outlet with a 2-1/2 in. hose.

3.4.6.3 Additional Requirement for Nuclear-Powered Ships. A "pure" water supply is required for all nuclear-powered ships. Due to the quantities involved and the problems of contamination and quality control, tank truck delivery will normally be used rather than the installation of piping and outlets on the pier.

3.4.7 Quality. Refer to NAVFAC DM-5.7.

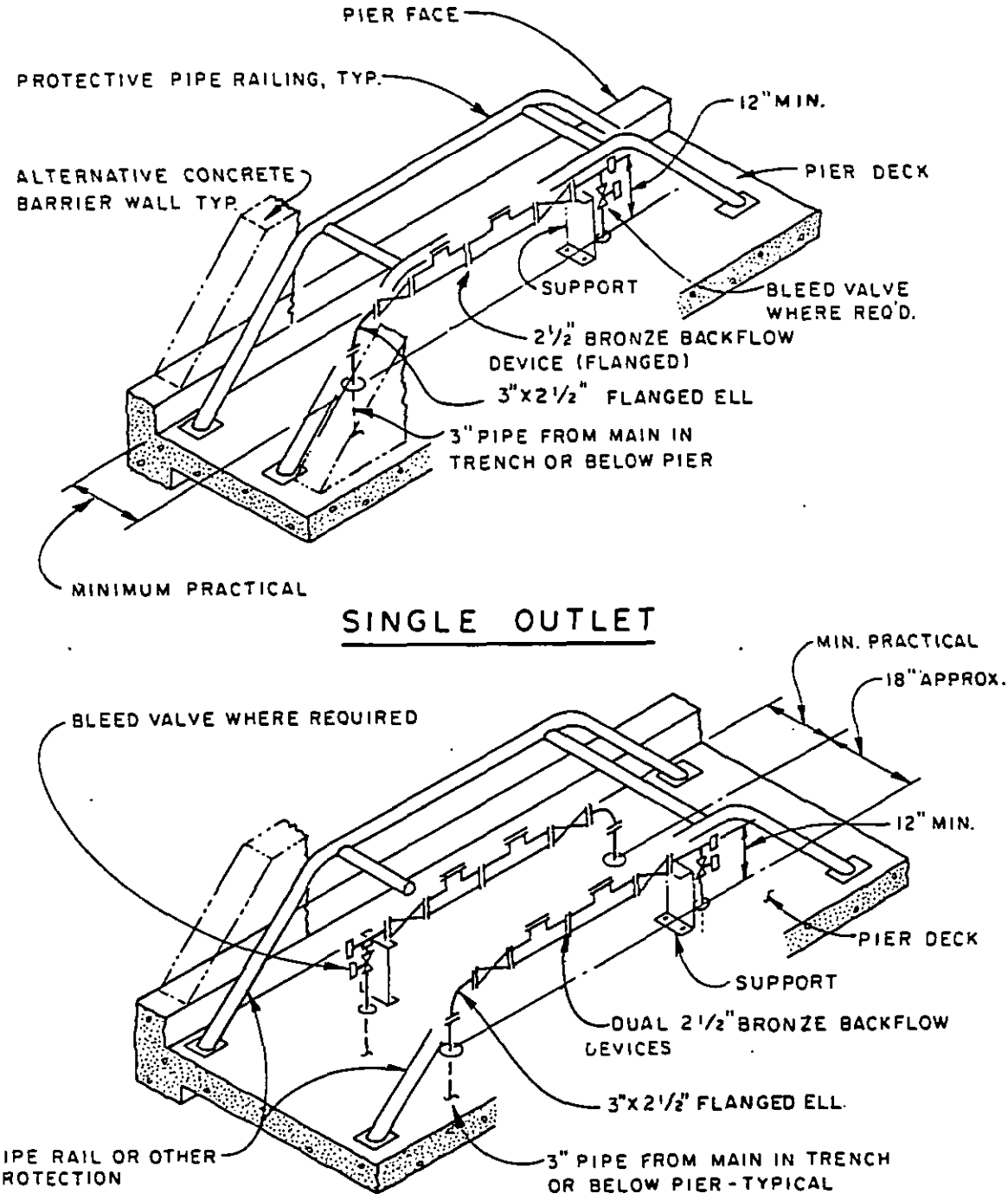


Figure 21
Typical Potable Water Shore Connections

3.4.8 Protection from Freezing. In climates subject to freezing temperatures, potable water lines and outlets must be protected refer to Section 6.

3.4.9 Metering. Where monitoring of usage is required, provide metering of potable-water supply to piers or groups of piers. Install meters in accessible vaults ashore or on piers. Use compound-disc or magnetic-flow meters to achieve a high range of registration. Where metering is not initially required, make provision for ease of future installation by means of concrete vaults or pier access covers.

3.5 POL Systems. Refer to NAVFAC DM-22, Petroleum Fuel Facilities, for information on piping and other appurtenances, including manifolds, hoses and shelters, connections and adapters, hose handling equipment, bilge and ballast lines, stripper pumps, and other equipment, except as modified below.

3.5.1 Modifications and Exceptions to NAVFAC DM-22

3.5.1.1 Ship Connections and Piping. Berthing piers at which one or more POL products are available at the berths need not utilize articulated loading arms as described by Chapter 2 of NAVFAC DM-22. In such cases, above deck, valved pier connections and direct ship-to-shore hoses may be used. Such piping may be either above or below the pier deck on berthing piers with POL capabilities, if proper spillage precautions are taken. For piers constructed and utilized for POL operations exclusively, refer to Section 5 herein.

3.5.1.2 Water Pollution Measures. Spill control measures required for berthing piers where POL is available may be different than those for piers used exclusively for POL. Oil spill containment booms and appurtenances are required to control spills on water; refer to NAVFAC Definitive Drawing Number DD-1404371 Oil Spill Containment for Berthing Facilities. Piping must be contained, either by trench or by secondary conduit. Also refer to Coast Guard Regulations (33 CFR 154) for design criteria to be used in design of piping, containment, ship-to-shore transfer equipment, emergency shutdown, and communications.

3.5.2 Locations of Shore Fuel and Lube Oil Connections. Fuel and lube oil connection locations on various ships are given in Table 9, to aid the designer in the overall utility layout and design process. Shore POL connections should be located to be compatible with ships POL connections and with other utilities described herein. Refer to Section 2 for a description of utility spacing considerations. Pier fueling connections and hoses must be kept a minimum of 25 ft (7.6 m) away from any possible ignition sources, such as pier power mounds, telephone boxes, and fire-alarm equipment. Required POL connection sizes must be obtained from specific ship data available from NAVSEA. Refer to Mil. Spec. MIL-F-19488 Fitting, Hose Water, and Steam (other than Flexible, Metallic) for POL connection type.

3.6 Sewer and Oily Waste. Design ships sewage-collection systems and shore connections in accordance with NAVFAC DM-5.8, Pollution Control Systems. Design ships oily waste (bilge water) systems in accordance with NAVFAC DM-5.9, Industrial and Oily Waste Control. Obtain criteria for each project from the cognizant NAVFAC Engineering Field Division. Connection locations for ships sewage and oily waste are given in Table 9, to aid the

designer in the overall utility layout and design process. Refer to section 2 herein, for a description of utility spacing considerations. In climates subject to freezing temperatures, sewer lines must be protected (refer to Section 6).

3.7 Fire Protection. Piers, wharves and associated structures shall be protected in accordance with the provisions of MIL-HDBK-1008 with the modifications listed in paras. 3.7.1 through 3.7.6. Refer to para 3.8 for a description of fire alarm service.

3.7.1 Firewalls and Sprinklers. Provide firewalls, fire stops, and sprinklers in pier sheds and under combustible decks, in accordance with National Fire Protection Association (NFPA) 307, Construction and Fire Protection of Marine Terminals, Piers and Wharves.

3.7.2 High-Pressure Water. High-pressure water and outlets shall be provided for fire protection, in accordance with para. 3.3.

3.7.3 Foam. On piers where petroleum fuels are transferred from shore to ship, if foam extinguishing systems exist for the protection of other exposures (such as storage tanks), the foam system shall be extended to hydrants located adjacent to ships alongside the pier.

3.7.4 Protection From Freezing. Protect fire mains as described in Section 6.

3.7.5 Portable Firefighting Equipment. Firefighting equipment shall be provided in accordance with NFPA 307 and NFPA 10, Portable Fire Extinguishers.

3.7.6 Exception. Saltwater fire-protection systems shall not be required for piers dedicated solely to submarine use, provided the pier structure is essentially noncombustible and evaluation of activity operations with the NAVFACENGCOM Fire Protection Engineer determines that: water can be made available to the pier from a quaywall hydrant; fire department response times are adequate; and significant quantities of flammables are not stored on the pier. The requirement, if any, for provision of an AFFF fire-suppression system or other alternative method of fire protection shall be determined by the NAVFACENGCOM Fire Protection Engineer.

3.8 Electrical Systems. Electrical power is required on piers and at drydocks for ships services, including hotel service (shore to ship power), ship repair (industrial power), ships systems testing, pier weight-handling equipment, pier lighting, and miscellaneous pier receptacles. Materials and installation shall conform to the requirements given in NAVFAC DM-4 series, Electrical Engineering, in MIL-HDBK-1004/3, Electrical Engineering, Switchgear and Relaying, and in NFPA 70, National Electrical Code. For drydocks, refer to additional criteria in NAVFAC DM-29.1

3.8.1 Types of Service. Design electrical-distribution systems for piers, wharves, and drydocks for either or both of the two types of service listed below, as directed by the appropriate Engineering Field Division.

Table 9
Shore Services - Miscellaneous[1]

Ship Type	Class	Ships Connection Locations[2]							
		Sewer		Oily Waste		Fuel Oil		Lube Oil	
		L	H	L	H	L	H	L	H
Aircraft Carriers	CV-59								
	CV-63								
	CVN-65								
	CVN-68								
Surface Combatants									
Battleship	BB-61								
	BB-62								
	BB-63								
	BB-64								
Cruiser	CG-16,26						26 25		
	CG-47					220P 227S 413PS		228PS	
	CGN-9								
	CGN-36								
	CGN-38						33 24		
Destroyer	DD-963	230PS 212P		217S 224P 431PS		217S 224P 431PS	43 43	217S 224P	
	DDG-2						43		
	DDG-37								
	DDG-51		22	244PS	22	106P 160PS 356PS	25 29 21	35C 334C	20 29
	DDG-993								

Table 9
Shore Services - Miscellaneous[1] — Continued

Ship Type	Class	Ships Connection Locations[2]							
		Sewer		Oily Waste		Fuel Oil		Lube Oil	
		L	H	L	H	L	H	L	H
Surface Combatants (Cont'd)									
Frigate	FF-1037								
	FF-1040								
	FF-1052	130PS 328PS		275P 280S		156PS 290PS 433PS	27 26 26	268S 280P	
	FFG-1								
	FFG-7	203S 206P	18	248PS		165PS 317PS	35 35	322PS	35
Patrol	PH-85								
	PHM-1								
Submarines	SS-580 SSN-594 SSN-637 SSN-688 SSBN-616 SSBN-726								
Amphibious Warfare									
Command	LCC-19								
Assault	LHA-1								
	LPH-2								
Cargo	LKA-113								
Transport	LPD-4								
Landing	LSD-36								
	LSD-41								
	LST-1179								

Table 9
Shore Services - Miscellaneous[1] -- Continued

Ship Type	Class	Ships Connection Locations[2]							
		Sewer		Oily Waste		Fuel Oil		Lube Oil	
		L	H	L	H	L	H	L	H
Amphibious Warfare (Cont'd)									
Mine Warfare	MSO-427								
	MCM-1								
Auxiliary									
Tenders & Repair	AD-15								
	AD-37								
	AD-41	606PS		606PS		250PS 538PS		454S	
	AR-5								
	ARS-38								
	ARS-50								
	AS-31								
	AS-33								
	AS-36								
	ASR-9&21								
Cargo & Transport	AE-21								
	AE-26								
	AFS-1								
	AH-19								
	AK-280								

Table 9
Shore Services - Miscellaneous[1] — Continued

Ship Type	Class	Ships Connection Locations[2]							
		Sewer		Oily Waste		Fuel Oil		Lube Oil	
		L	H	L	H	L	H	L	H
Auxilliary (Cont'd)									
Cargo & Transport (Cont'd)	AKR-7								
	AO-105					190P 294PS 502PS			
	AO-143					142PS 253PS 373PS 453PS			
	AO-177					172S 190PS 264PS 299PS 326P 390PS 408P			
	AOE-1					219P 276S 336P 397S 457P 578P			
	AOR-1					157PS 215PS 273PS 311PS 396PS 457PS			
	AOT-168					306PS 422PS			
	AP-110 122								
Tugs	ATF-91 ATS-1								
Miscellaneous	AG-193								
	AGS-39								

Table 9
Shore Services - Miscellaneous[1] — Continued

Ship Type	Class	Ships Connection Locations[2]							
		Sewer		Oily Waste		Fuel Oil		Lube Oil	
		L	H	L	H	L	H	L	H
Auxilliary Cont'd)									
Miscellaneous (Cont'd)	AGDS-2								
	AGF-11								
	AGM-20								
	AGOR-11								
	AGOS-1								
	AVM								

[1]For demands and other design data, refer to DM-5.08, DM-5.09 and DM-22. Although their design is not covered by this handbook, other services such as jet fuel, chilled water, pure water and various gases may be required for specific ships. Obtain these requirements from NAVSEA or the station/activity.

[2]L and H refer to the location of ships connections. L is the distance, in feet, of the connection aft of the point of stem of the ship, and H is the height, in feet, of the connection above the design waterline; see Figures 2 through 13, as applicable. Designations "P," "S" and "C" refer to Port side, Starboard side and Centerline, respectively. Where more than one connection exists, all locations are shown.

3.8.1.1 Permanent Service. At naval stations, repair piers, drydocks, and other continuously occupied facilities, provide fixed substations and associated facilities to accommodate the normal maximum demand due to ships power requirements (hotel service) and other loads, such as pier or drydock lighting, weight-handling equipment and pumps. For planning and estimating purposes, refer to Appendix A, Figure numbers 25A, 25B, 25C, 26A, 26B and 26C, for a typical permanent installation on a pier. Refer to NAVFAC DM-29.01, Graving Drydocks, for additional criteria for drydocks.

3.8.1.2 Temporary Service. At facilities not continuously occupied, or at any facility where a substantial portion of the peak load will be occasional or intermittent, provide primary feeders and couplers to accommodate mobile or portable substations as required to satisfy power requirements anticipated for the temporary loads. Examples of high temporary loads are power for certain ships weapons-systems testing and ships plant nuclear testing. For planning and estimating purposes, refer to Appendix A, Figure numbers 27A, 27B, 27C, 28A, 28B and 28C, for a typical temporary installation on a pier. That portion of the load serving basic pier, wharf, or drydock lighting, weight-handling equipment, and receptacles not related to ship service or repair should normally be fed from permanent equipment.

3.8.2 Primary Power System. The primary distribution system normally operates in the medium-voltage range between 5 kV and 35 kV, depending upon the service voltage available. The system should be selectively coordinated to minimize downtime of critical ships systems due to external or internal electrical-system faults.

3.8.2.1 Shore Primary System. Where economically feasible, a loop primary-radial system ashore shall be provided to minimize system downtime, improve overall system reliability, and simplify system maintenance. Refer to NAVFAC DM-4.1, Electrical Engineering, Preliminary Design Considerations, for a description of system types. Locate the primary voltage service as near as possible to the pier transformer(s) to optimize voltage regulation. Consider voltage regulation and power-factor correction at the shore primary distribution substation.

3.8.2.2 Pier, Wharf, or Drydock Primary Systems. For permanent service, provide dual primary feeders from the shore primary system at piers, wharves, and drydocks to substations serving the ships hotel and industrial loads. For temporary service, provide dual primary feeders from the shore system to appropriate locations, and provide primary voltage couplers to serve mobile or portable substations utilized by the shore activity. Conduits, duct banks, and manholes cast integrally with pier construction are the preferred construction on new piers. Conduits on piers may also be installed in dedicated electrical trenches, or in piping trenches where these are required for other utilities. To avoid insulation damage, electrical conduits should not be placed in close proximity to steam piping. Refer to Section 2 for conduit-protection requirements.

3.8.2.3 Special Primary-System Requirements. Refer to para. 3.8.9, for additional primary-system criteria.

3.8.3 Secondary Power Systems

3.8.3.1 Ships Power. The electrical system providing power for ships shall be nominal 480 Vac, 3-phase, 60 Hz, ungrounded, supplied from substations located on piers, and connected through dedicated receptacles located at the pier, wharf, or drydock perimeter. The system design must be such that fault current will be limited to 100 kA rms at 480 V for any single ship.

3.8.3.2 Other Ships Power Requirements. Direct current and 400 Hz power for ships service, when required, will be supplied from the 480 V ships-power system by utilizing portable rectifiers or conversion equipment provided by the shore activity. If required, nominal 4,160 V, 3-phase, 60 Hz power for ships service shall be supplied from substations in addition to the 480 V requirement (refer to para. 3.8.7).

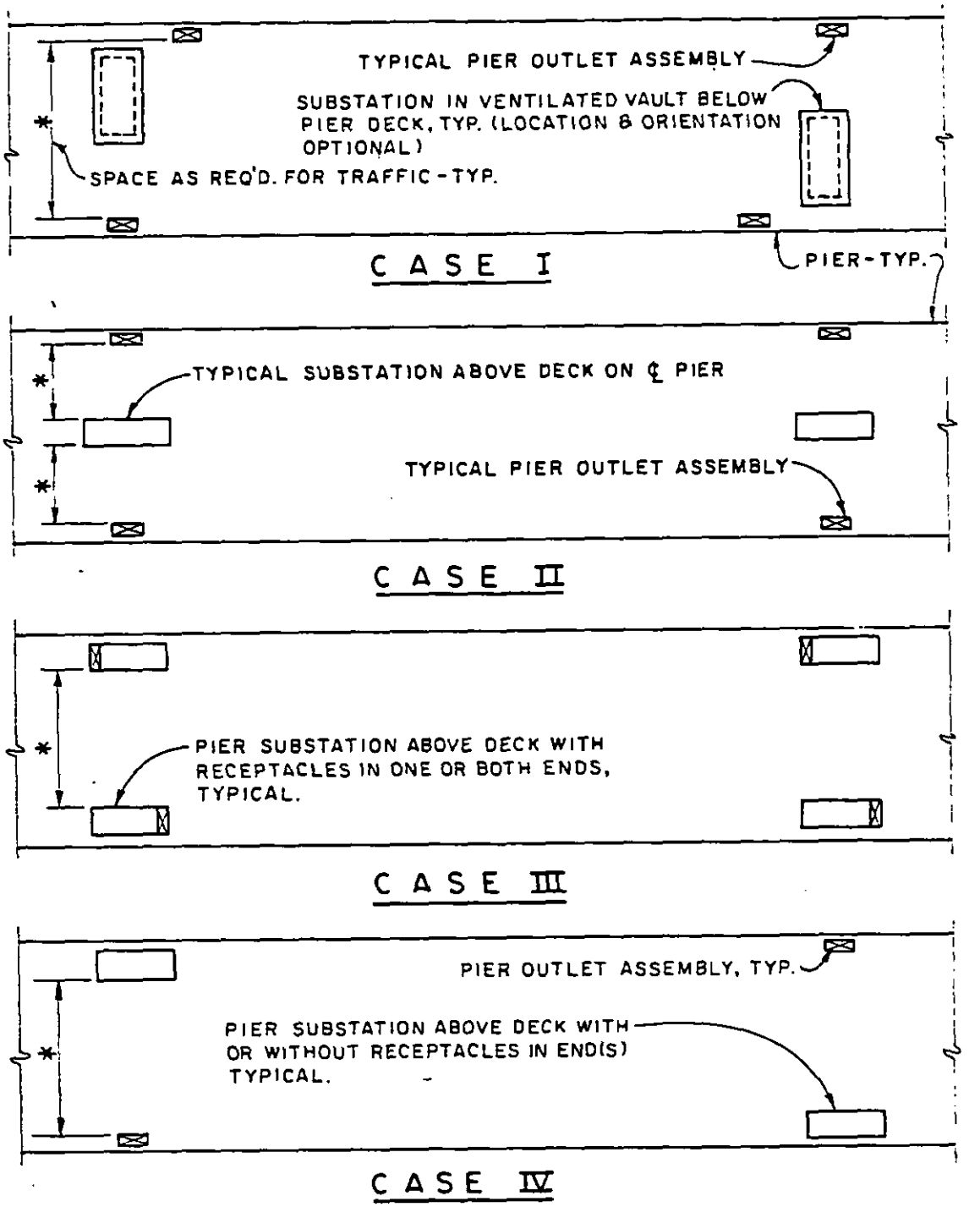
3.8.3.3 Industrial (or Overhaul) Power. Where it is a stated requirement, electrical service shall be provided specifically for equipment utilized in ship modernization, alteration, and repair. Supply such power from dedicated components of the secondary distribution system. The services shall include only solidly grounded systems. These receptacles should be integrated where possible with ships pier-outlet assemblies (or with pierside substations). Arrange industrial receptacles to provide a natural separation from ships-power receptacles. Usage for ships hotel loads must be prevented by use of noncompatible plugs. All temporary power for industrial repair loads should normally be supplied from grounded 480 V, 3-phase receptacles, with portable equipment and cabling provided by the activity to secure other voltages and/or multiple outlets.

3.8.3.4 Permanent Pier Loads. Requirements other than for ships power and industrial power, such as for pier lighting, receptacles, and weight handling equipment, shall be fed from fixed substations located either on the pier or ashore.

3.8.4 Location and Arrangement of Equipment

3.8.4.1 Substations. Pier substations for permanent service, where feasible, shall be located in ventilated under-pier vaults to provide clear deck space for cranes and vehicular traffic during homeport or repair operations. Should above-deck substations be required due to economic, structural, or other constraints, transportable or relocatable substations should be considered. The locations of fixed substations, whether above or below deck, should be carefully considered. Restraints are more numerous when installation is on an existing pier. See Figure 22 for typical alternative arrangements. For a double-deck pier, electrical vaults should be placed on the pier centerline (Example: Charleston Naval Station, Pier Zulu). Selection of the alternative arrangement and exact locations of equipment should be made on a pier-by-pier basis; selection must be coordinated with other pier requirements.

3.8.4.2 Vault Environmental Control. For protection of critical equipment, substation vaults must be ventilated and flood resistant. Flooding shall be prevented by dual sump pumps which discharge at a point above highest tides; a separately powered float switch and alarm must be provided to alert personnel to sump pump failure and resultant high sump-water level. Freeze protection must be provided in climates where any element of the pumping system could freeze up. Ventilation cooling shall be provided, with air quantity based on



NOTE: LOCATION, SPACING & NUMBER OF SUBSTATIONS & PIER OUTLET ASSEMBLIES REQUIRED VARY WITH SITE.

Figure 22
Typical Alternative Pier Electrical Equipment Arrangements

the highest site temperature and the highest vault temperature which can be tolerated by the equipment. One approved method of vault ventilation is shown in Figure 23. Ventilation air intake and exhaust louvers should be separated from each other by as much distance as possible; they may be on opposite sides of a pier if ducts between louvers and the vault can be installed such that they will not undergo immersion at high tides. Provide an access hatch at each end of the vault, for safety.

3.8.4.3 Outlet Assemblies. The pier locations of electrical outlet assemblies (receptacles) for service to ships may be determined by use of locating dimensions for ships connections given in Table 10, in conjunction with Figures 2 through 13 for the appropriate ship classes. Electrical equipment locations must be coordinated with the locations of other pier utilities. For a discussion of methods to be used to establish shore utility station spacing on piers and wharves, refer to Section 2. For spacing at drydocks, refer to NAVFAC DM-29.1.

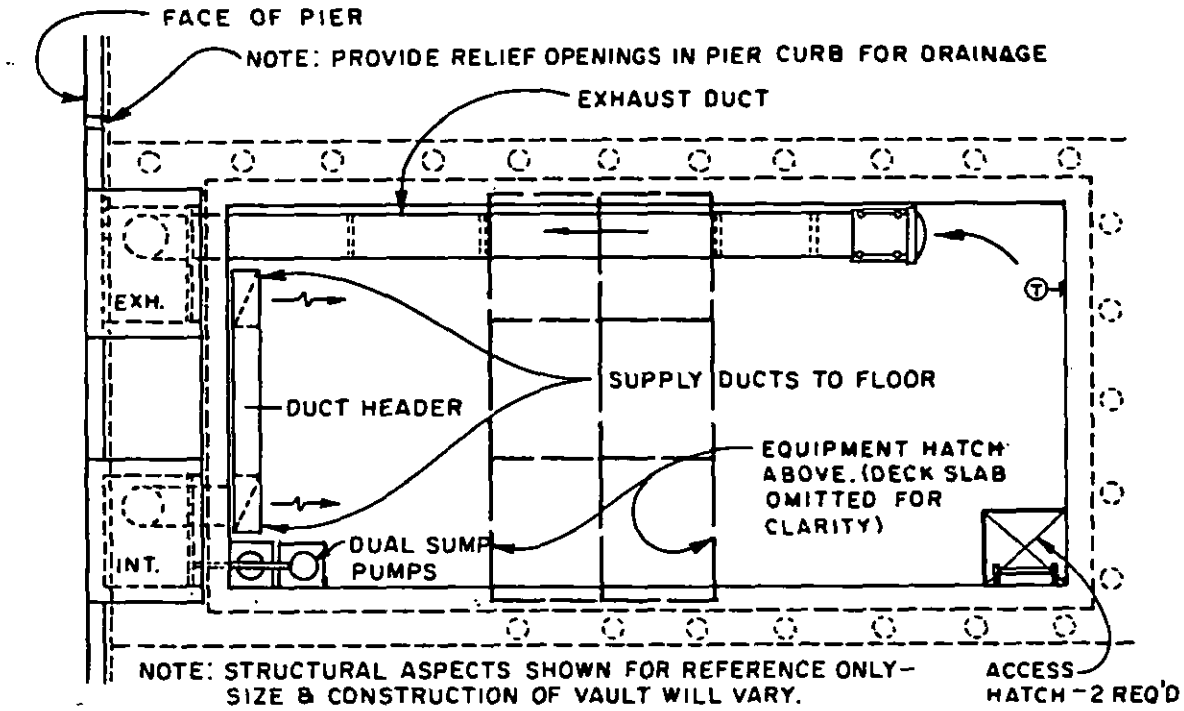
3.8.4.4 Cable Lengths. For some ships, shore-to-ship cables from more than one pier outlet assembly may be utilized to feed the receiving bus of the same ship. For this reason, whenever two electrical outlet assemblies on the same side of a pier are fed by a common substation, the design must be such that cable lengths from substation to pier outlet assemblies are approximately equal (within 10 percent), to avoid cable overload.

3.8.4.5 Combined Equipment. In some cases, spatial, structural, or economic constraints may be such that above-deck substations and outlet assemblies must be combined. In such cases, outlet receptacles may be placed in the side (or sides) of the substation enclosure, and combined units may be spaced as necessary along the pier or drydock perimeter (see Figure 22, cases III and IV.)

3.8.4.6 Primary (High-Voltage) Couplers. Where it is intended to supply all ships loads from mobile or portable equipment, locate high voltage outlets in the same manner as that for ships service assemblies. High voltage outlets provided for temporary high ships loads should be placed in the vicinity of their intended use. Obtain locations from the appropriate Engineering Field Division.

3.8.5 Distribution System Equipment and Materials. Equipment and materials selected for pier and wharf electrical systems should be as specified in NAVFAC Guide Spec Number 16304, except as modified in subparas. below.

3.8.5.1 Fixed Substations for 480 V Service. Generally, substations for permanent 480 V service on piers should be fixed, should be equipped for forced-air cooling, and should be as compact as practical to conserve space. Substations shall contain primary, secondary, auxiliary, and transformer sections. The primary section shall provide primary switchgear and a service cable selector switch. The 480 V secondary section shall be designated for the ships hotel loads, overhaul power (if required), and other pier power requirements. The auxiliary section shall be designated for, and shall provide appropriate voltage reductions for lighting (pier and vault), batteries and charging system for other sections, meters, and power for the



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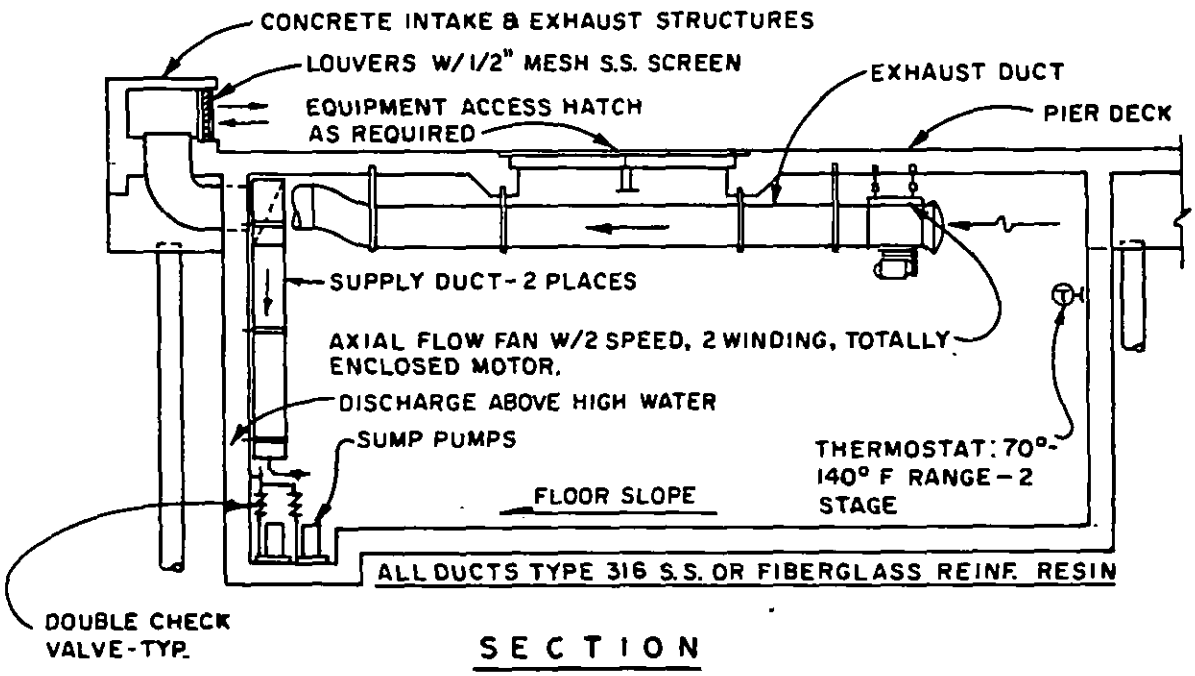


SECTION

Figure 23
Electrical Vault Ventilation and Drainage

vault environmental equipment and sump pump (if a vault installation). Auxiliary-section transformers may be mounted on the vault wall. Main transformers should be of the liquid-cooled type, standard 3-phase, 480 V, with six full-capacity, 2-1/2-percent taps. Load taps should be arranged for operation above and/or below the nominal primary voltage, depending upon observed system deviations. In general, provide two taps above and four taps below the nominal primary voltage. Where it may be difficult to maintain a stable secondary voltage, specify automatic load tap changers. Substations shall be designed to allow momentary parallel operation of two shipboard generators with the shore power system. Shipboard generator and other equipment ratings are available, upon request from NAVSEA. Equipment shall provide 3-phase, nominal 480 V, 60 Hz power, as defined in ANSI C84.1-1982, voltage range "A."

All substation low voltage circuit breakers shall be electrically operated, drawout-type units, with integral current-limiting fuses. Provide one 600 V, 400 A drawout-type circuit breaker for each individual 500 A-rated shore power receptacle. Breakers must be specified with adjustable trips. Breakers for ships service must be capable of operation locally and also remotely at pushbutton stations adjacent to individual remote cable receptacles. Breakers shall include 200 kA current-limiting fuses. Fuses, which may be mounted integrally or separately, shall coordinate with the breaker trip device so as to avoid unnecessary blowing of the fuses. Where combined substations and receptacles are utilized in fixed above-deck equipment, refer to receptacle-system design requirements in subsequent subsections. Space heaters shall be incorporated within individual sections to prevent condensation. Consider special, factory-applied coating systems, such as epoxy or fiberglass, for enclosures for this equipment. Standardization of all substations on individual piers should be obtained where possible. Where dedicated berthing is practiced, consider the use of dedicated transformers for each ship. Transformers having a 2,500 kVA to 3,750 kVA nominal rating are preferred.

3.8.5.2 Mobile and Portable Substations for 480 V Service. Mobile and portable substations will be used for temporary service and will be provided by the shore activity to interface with properly designed and protected primary feeders and couplers. Mobile or portable substations shall have a suitable number of 3-pole, 500 A receptacles which are integral with the equipment package. Refer to para. 3.8.5.4 for a description of the required receptacle system. Design of mobile and portable substations, when required, should be as for fixed substations, except for portability provisions and weatherproofing. For information, planning and estimating purposes, refer to Appendix A, Figures 28A, 28B and 28C.

3.8.5.3 Substations for 4,160 V Service. Refer to para. 3.8.7.

3.8.5.4 Pier-Outlet Assemblies. Ships hotel service receptacles shall be in multiples of 3-pole, 500 A connectors and shall be provided in weatherproof, corrosion-resistant pier outlet assemblies, unless combined equipment is used, as described in para. 3.8.4.4. For information, planning, and estimating purposes, refer to Appendix A, Figures 26A and 26B. Refer to para. 3.8.6 to determine the proper number of receptacles needed at each outlet assembly to serve corresponding stations on ships. The standard connector shall be in accordance with Mil. Spec. MIL-C-24368 (NAVY). NAVSEA publication entitled Electric Plant Installation Standard Methods (EPISM), Section 2, Group E, Sheets 13 through 19, provide typical details of the MIL-C-24368 receptacle

system. Refer to NAVFAC DM-25.6, General Criteria for Waterfront Construction, for typical pier outlet assembly details. Shipboard alternating current systems have a standard phase rotation. To minimize the phasing procedure and to reduce the time required to connect shore-to-ship power cables, shore power connectors should be phased so that they are compatible with the shipboard system. Refer to EPISM, Section 2, Group E, Sheets 14 and 15, to determine phase rotation required for shore power connections. Grounded receptacles for industrial or overhaul power should be integrated into the enclosure for the ships hotel service receptacles or, alternatively, provided in separate, weatherproof, corrosion resistant enclosures. Standardization of all outlet assemblies on individual piers shall be obtained where possible.

3.8.5.5 Pier Primary Voltage Outlets. Primary voltage outlets shall have weatherproof, corrosion resistant enclosures and couplers. Couplers shall match the standard primary voltage coupler in use by the activity or as required by the appropriate Engineering Field Division. Disconnecting means for primary voltage couplers shall be located ashore. Disconnects shall have an interlocking key which can only be removed when the switch is opened. Design shall be such that, after the disconnect has been opened, the interlocking key may be carried out onto the pier to unlock and make possible the insertion or removal of the corresponding primary voltage pier coupler plug. For information, planning, and estimating purposes, refer to Appendix A, Figure numbers 27A, 27B and 27C.

3.8.5.6 Conduit Systems. For electrical conduit exposed under or on a pier, wharf, or drydock, evaluate the relative advantages of Schedule 80 PVC, plastic-coated steel, and fiberglass-reinforced epoxy conduit. Avoid the use of plastic coatings where they will be exposed to sunlight. For coated-steel conduit, consider the use of polyethylene, heat-shrinkable sleeves and/or tape wrapping at joints and fittings. Galvanized or fiberglass cable trays may be used in lieu of conduit where adequately protected from physical damage and the elements. Hangers and bolts must be galvanized. All special supports and braces must be hot-dip galvanized after fabrication. Where salt-spray exposure is severe, incorporate appropriate additional anticorrosion measures for hangers, such as application of epoxy coatings, use of stainless steel or Monel bolting, and use of fiberglass/resin composite hangers and bolting.

3.8.5.7 Cables For Shore-to-Ship Service. For 480 V, 3-phase, 3-wire service, cable(s) shall be ungrounded standardized lengths of 3/c Type THOF-500, conforming to Mil. Spec. MIL-C-915 (FSN 6145-01-008-5468), and shall be used for loads not exceeding 400 A. For 4,160 V, 3-phase service to nuclear aircraft carriers, cable(s) shall be SHD350GC 8 kV, nonshielded insulated, PVC-jacketed cable, in accordance with Insulated Cable Engineers Association (ICEA) S-66-524. Cables are normally provided by the activity.

3.8.6 Ships Shore Power Requirements. Table 10 provides a listing of shore electrical loads of ships while homeported or undergoing alteration and repair at naval station activities. These data will be updated at intervals to reflect new ship-load requirements. Substation and feeder sizing on piers and wharves must be based upon the electrical loads given in the "Design Load" column for the largest ship or largest number of ships of all classes which could be berthed at the pier. The minimum number of receptacles provided per pier electrical outlet assembly should match the number of receptacles in respective ships receptacle stations (refer to Table 10,

footnote 5). When an entry in the "Design Load" column of Table 10 is greater than the sum of individual "Per Station" entries, consider providing an appropriate number of additional receptacles at each pier electrical outlet assembly. Nested ships must also be considered in the electrical outlet assembly design where indicated by the facility berthing plan or where conceivable at a future date.

3.8.6.1 Alternating Current Power. Hotel-service loads include electronics, weapons systems, cargo booms, galley equipment, space heating, and miscellaneous lighting and power loads. These loads are supplied with either nominal 480 V or nominal 4,160 V power, ungrounded. For 4,160 V requirements, refer to CVN requirements in para. 3.8.7. The 480 V system should supply approximately 480 volts at no load and 450 volts plus or minus 5 percent under loaded conditions, at the ships load center. Where nesting of ships is practiced, voltage tolerances at outboard ships shall be maintained as closely as is practical.

3.8.6.2 Direct Current Power. When required, dc power shall be provided for certain ships, in accordance with Table 10. Portable rectifier units will be provided by the activity. Sufficient ac power and receptacles to serve such equipment must be available.

3.8.6.3 400 Hz Power. 400 Hz power for ship service may be supplied from the 480 V system, utilizing portable generating equipment furnished either by the activity or by the ship. Provide 60 Hz power and receptacles for this equipment.

3.8.6.4 Shipboard Equipment Ratings. Most ship distribution circuit breakers operate at 440 V and are protected with 100,000 A, current-limiting fuses in series with the breakers. In most cases, these circuit breakers are type AQB-LF400, as described in NAVSHIPS Publication 362-2333, Air Circuit Breakers (Fused), Navy Type AQB-LF400. Some ships do not have current-limiting fuses installed. The shore system must be designed to selectively coordinate and to contribute not more than 100 kA rms short-circuit current to the ship. Use current-limiting reactors or other means to reduce fault levels. Contact the appropriate Engineering Field Division for information on fault current data to determine the interrupting capacity of shipboard equipment. The shore distribution system must be designed in accordance with NAVFAC DM-4 series, Electrical Engineering, to ensure that available fault is within the capability of the ship distribution system. Fault calculations should also consider fault-current contribution from a maximum of two ship generators. Specific information on shipboard generators should be requested from NAVSEA. Ships normally require momentary parallel operation of shipboard generators with shore transformers.

3.8.7 Supplemental Requirements for Specific Ships

3.8.7.1 Special Shore Power Requirements for Nuclear Submarines (SSN, SSBN). Nuclear submarines (SSN, SSBN) shall conform to the following shore power requirements:

a) Substations for 480 V Service. Substations serving hotel loads at submarine piers must be designed in accordance with para. 3.8.5.1 or 3.8.5.2 herein, and in accordance with the supplemental requirements below. The primary switchgear section shall be built with dual primary feeders. Switchgear and breaker equipment shall be designed so that automatic reset and

Table 10
Shore Services-Electrical[1]

Ship Symbol	No. Of Stations	Station Location[2]	Station Height[3]	Capacity[4] (amps)		
				Per Station[5]	Maximum Receivable[6]	Design Load[7]
AD-15,18	2	348 P/S	28	3200	3200	A 2300 B 3200
AD-19	2	348 P/S	28	1600		
	2	348 P/S	28	4800	6400	A 2300 B 6400
AD-37,38	4	320 P/S	17	1600		
	2	381 S,Q	28	1600		
	2	413 P,Q	28	1600		
	2	413 P/S	17	[5a]3200 D	6400	A 3400 B 6400
AD-41,42 43,44	2	416 P/S	22	1600 D 3200		
	1	516 P,Q	22	3200 D 3200		
	1	540 S,Q	22	3200 D 3200	11200	A 5200 B 11200
AE-21CL	1	348 C	26	[5b]1200	[6a]1200	1300
AE-26,27 28,29 32,33 34,35	2	406 P/S	24	[5c]1600	[6b]1600	1700
AFS-1CL	1	364 C	34	2400	2400	2200
AGDS-2	1	236 C	38	1200	1200	1200
AG-193 T-AGS-39	1	167 C	19	1600	1600	1400
AGF-3,11	2	253 C	50	1600	3200	3200
AGM-20 AGOR-11 AGOR-23 T-AGOS-1	1	144 C	30	800	800	700
T-AGOS-19	1	90 C	53	1600	1600	1582
AH-19	1	650 C	45	3200		
	1	750 C	35	800	4000	4000
AK-280 AKR-7						

Table 10
Shore Services-Electrical[1] -- Continued

Ship Symbol	No. Of Stations	Station Location[2]	Station Height[3]	Capacity[4] (amps)		
				Per Station[5]	Maximum Receivable[6]	Design Load[7]
AO(J)-51, 98,99 AO-105 AO-143	2	442 P/S	24	1200	1200	1200
AO-177CL	1	390 C	24	2400	2400	2400
AO-177 Jumbo	1	498 C	24	3200	3200	2900
T-AO-187	2	458 P/S	30	2400	2400	2400
AOE-1CL	1	524 C	34	3200	3200	2800
AOE-6	2	435 C	55	4000	8000	7000
AOR-1,2 3,4 5,6	1	630 C	28	[5c]1600	[6b]1600	1700
AOR-7 AOT-168	1	630 C	28	2000	2000	1900
AP-122						
AR 5,6,	2	224 P/S	32	1600		
7,8	2	340 P/S	32	1600	3200	A 2400 B 3200
T-ARC-7	2	366 P/S	50	2000	2000	1700
ARD-30	2	50 P/S	38	800 1200	2000	
ARDM-4	1	170 S	55	1600	1600	
ARDM-5	1	158 S	59	4800	4800	
ARL-24	1	190 P	24	400	400	150
	1	190 S	24	+400	+400	+900
ARS-8	1	113 P	17	100	100	100
	1	113 P	17	+800	+800	+800
ARS-38CL	1	113 P	17	100	100	100
	1	113 P	17	+800	+800	+800
ARS-50CL	1	92 P	30	800	800	640
AS-11	2	356 P/S	28	3600		
	2	356 P/S	28	2000	5600	A 2100 B 5600
AS-18	2	356 P/S	28	3600		
	1	512 ST	35	4800		
	1	512 ST	35	2800	7600	A 2800 B 7600

Table 10
Shore Services-Electrical[1] — Continued

Ship Symbol	No. Of Stations	Station Location[2]	Station Height[3]	Capacity[4] (amps)		
				Per Station[5]	Maximum Receivable[6]	Design Load[7]
AS-19	2	208 P/S	35	2400		
	2	330 P/S	35	2400		
	1	545 ST	35	2400		
	1	545 ST	35	3200	5600	A 3600 B 5600
AS-31,32	2	298 P/S	32	2400		
	2	524 P/S	32	2400		
	1	560 P	32	4000		
	1	576 S	32	4800	8800	A 4000 B 8800
AS-33	2	246 P/S	46	2400		
	2	518 P/S	46	2400		
	1	626 ST	40	8800	8800	A 3400 B 7200
AS-34	2	246 P/S	46	2400		
	2	518 P/S	46	2400		
	1	626 ST	40	8800	8800	A 3400 B 7200
AS-36,37	2	350 P/S	38	1600		
	2	350 P/S	48	4800		
	1	612 ST	28	8000	8000	A 3000 B 8000
AS-39,40 41	2	370 P/S	38	4000		
	2	370 P/S	48	4000		
	1	610 ST	28	8000	8000	A 4200 B 8000
ASR-9	1	166 C	12	200	175	100
	1	166 C	12	+1200	+1200	+1200
ASR-13,14 15	1	166 C	12	100	100	100
	1	166 C	12	++600	++600	++600
ASR-21CL	2	115 P/S	17	1600	1600	800
ATF-113	1	118 C	12	100	100	100
	1	118 C	12	++600	++600	++600

Table 10
Shore Services-Electrical[1] -- Continued

Ship Symbol	No. Of Stations	Station Location[2]	Station Height[3]	Capacity[4] (amps)		
				Per Station[5]	Maximum Receivable[6]	Design Load[7]
ATF-91	1	118 C	12	100	100	100
	1	118 C	12	++400	++400	++400
ATS-1CL	2	164 P	21	300	600	600
AVM-1	2	208 P/S	28	1600		
	2	288 P/S	28	1600	3200	3000
BB-61,62 63,64	2	546 P/S	23	3200	3200	2800
CG-16	1	282 P	25	1600		
thru	1	372 C	33	1600	3200	3000
CG-24						
CG-26CL	1	243 P	27	2400	2400	2300
CG-47,48 49,50, 51	2	316 P/S	44	[5d]1200 D 4000	5200	4100
CG-52 up	1			[5e]4000	4000	4000
CGN-9	2	405 S	32	3200	6400	5600
CGN-25	1	230 S	28	3200		
	1	310 S	34	3200	6400	
CGN-35	1	177 S	34	3200		
	1	310 S	32	3200	6400	
CGN-36CL	1	152 P	24	4000		
	1	395 S	32	4000	8000	4200
CGN-38CL	1	236 C	35	4000		
	1	342 S	33	4000	8000	4200
CV-41	1	404 S	30	4800		
	1	472 S	30	4800	9600	6000
CV-43	1	428 S	30	1600		
	1	444 S	30	1600		
	1	448 S	30	3200		
	1	448 S	30	1600		
	1	520 S	30	1400		
	1	524 S	30	3200	9600	9200

Table 10
Shore Services-Electrical[1] — Continued

Ship Symbol	No. Of Stations	Station Location[2]	Station Height[3]	Capacity[4] (amps)		
				Per Station[5]	Maximum Receivable[6]	Design Load[7]
CV-59	1	388 S	30	1600		
	1	392 S	30	1600		
	1	488 S	30	1600		
	1	492 S	30	1600		
	1	720 S	30	1600		
	1	724 S	30	1600	9600	7400
CV-60	1	380 S	30	1600		
	1	388 S	30	1600		
	1	480 S	30	1600		
	1	612 S	30	1600		
	1	720 S	30	1600		
	1	728 S	30	1600	9600	8200
CV-61	2	348 S	30	1600		
	1	496 S	30	1600		
	1	628 S	30	1600		
	2	724 S	30	1600	9600	7400
CV-62	2	390 S	30	1600		
	1	500 S	30	1600		
	1	600 S	30	1600		
	2	726 S	30	1600	9600	7400
CV-63	1	352 S	30	1600		
	2	450 S	30	1600		
	1	592 S	37	1600		
	2	718 S	30	1600	9600	8600
CV-64	1	352 S	30	1600		
	2	450 S	30	1600		
	1	592 S	37	1600		
	2	718 S	30	1600	9600	8600
CV-66	1	476 S	30	3200		
	1	748 S	30	3200		
	1	760 S	30	3200	9600	7400
CV-67	1	444 S	40	3200		
	1	584 S	40	3200		
	1	728 S	40	3200	9600	8600
CVN-65	1	440 P	30	[5f]3200		
	1	460 S	30	3200		
	1	520 S	30	3200		

Table 10
Shore Services-Electrical[1] — Continued

Ship Symbol	No. Of Stations	Station Location[2]	Station Height[3]	Capacity[4] (amps)		
				Per Station[5]	Maximum Receivable[6]	Design Load[7]
CVN-65 (Cont'd)	1	640 S	30	[5f]3200		
	1	664 P,Q	30	[5f]3200		
	1	704 S,Q	30	3200	16000	11800
CVN-68	1	548 S	30	*1440		
	1	704 S	30	*1440	*2880	*1800
	1	300 S	30	4000		
	1	312 S	30	4000		
	1	1000 S	40	4000		
	1	1016 S	40	4000	[6c]16000	16000
CVN-69	1	548 S	30	*1440		
	1	704 S	30	*1440	*2880	*1800
	1	300 S	30	4000		
	1	312 S	30	4000		
	1	1000 S	40	4000		
	1	1016 S	40	4000	16000	16000
CVN-70	1	548 S	30	*1440		
	1	704 S	30	*1440	*2800	*1800
	2	296 S	30	4000		
	2	1016 S	40	4000	16000	16000
DD-963 thru DD-982	1	228 C	47	3200	3200	3200
DD-983 thru DD-992, 997	1	260 C	47	3200	3200	3200
DDG-2CL	1	189 S	22	1200		
	1	283 S	22	1200	2400	1800
DDG-37CL	1	232 P	26	1200		
	1	312 S	24	1600	2800	2300
DDG-51CL	1	265 C	25	4800	4800	4500
		265 C	25	4800	4800	2700
DDG-993CL	1	260 C	47	3200		
	1	460 C	28	3200	6400	4000
FF-1037CL	1	202 C	23	800	800	800

Table 10
Shore Services-Electrical[1] -- Continued

Ship Symbol	No. Of Stations	Station Location[2]	Station Height[3]	Capacity[4] (amps)		
				Per Station[5]	Maximum Receivable[6]	Design Load[7]
FF-1040CL	1	202 C	25	800	800	900
FF-1047	1	202 C	25	1200	1200	1300
FF-1049	1	202 C	25	1200	1200	1300
FF-1052CL	1	228 C	30	1200	1200	1300
FF-1098	1	228 C	25	1200	1200	1300
FFG-1CL	1	175 C	35	1200	1200	1300
FFG-7CL	1	252 C	35	2800	2800	2800
LCC-19,20	2	442 P/S	28	3200	3200	2800
LHA-1CL	2	445 P/S	37	4000		
	1	791 P	57	3200	7200	5400
LKA-113	1	244 C	34	1600	1600	1400
LPD-1,2	1	240 C	50	1600	1600	1400
LPD-4CL	1	240 C	50	1600	1600	1400
LPD-7,8 9,10 12,13	1	240 C	50	1600	1600	1400
LPD-14,15	1	240 C	50	1600	1600	1400
LHD-1	1	420 P,Q	25	4000		
		440 S,Q	25	4000		
		800 C	48	4000	[6d]8000	
LPH-2	1	276 P,Q	20	3200		
	1	324 S,Q	20	3200	3200	1800
LPH-3	1	260 P,Q	20	1600		
	1	388 S,Q	20	1600	1600	1800
LPH-7	1	248 P,Q	20	1600		
	1	372 S,Q	20	3200	3200	1800
LPH-9	1	248 P,Q	20	1600		
	1	388 S,Q	20	3200	3200	1800
LPH-10	1	248 P,Q	20	1600		
	1	388 S,Q	20	1600	1600	1800
LPH-11	1	272 P,Q	20	2400		
	1	372 S,Q	20	2400	2400	1800
LPH-12	1	248 P,Q	20	3200		
	1	388 S,Q	20	3200	3200	1800
LSD-36,37	1	244 C	40	2000	2000	2000

Table 10
Shore Services-Electrical[1] — Continued

Ship Symbol	No. Of Stations	Station Location[2]	Station Height[3]	Capacity[4] (amps)		
				Per Station[5]	Maximum Receivable[6]	Design Load[7]
LSD-38,39						
40	1	244 C	40	2000	2000	1900
LSD-41CL	1	282 C	40	2400	2400	2150
LST-1179 CL	1	260 C	30	1600	1600	1800
MCM-1 MSO-427CL MSO-443, 488, 490	2	80 P/S	17	225	225	225
PHM-1CL	1	Note 8		200	200	200
SS-576	1	208 C		+++450	+++450	+++450
	1	208 C		**400	**400	**400
SS-580CL	1	158 C		+++450	+++450	+++450
	1	157 C		**400	**450	**400
SSBN-598 CL	1	286 C		1200	1200	X 1200 Y 2930
SSBN-616 CL	1	307 C		1200	1200	X 1200 Y 1825
SSBN-640 CL	1	307 C		1200	1200	X 1200 Y 3140
SSBN-726	1	137 C		***400	***400	***400
CL	1	137 C		1600		
	1	406 C		1600	3200	X 3200 Y 6400
SSN-575	1	274 C		800	800	X 800 Y 1825
SSN-578CL	1	168 C		800	800	X 800 Y 1825
SSN-585CL	1	152 C		800	800	X 800 Y 3200
SSN-588	1	152 C		800	800	X 800 Y 2930
SSN-594CL	1	177 C		1200	1200	X 1200 Y 3200

Table 10
Shore Services-Electrical[1] -- Continued

Ship Symbol	No. Of Stations	Station Location[2]	Station Height[3]	Capacity[4] (amps)		
				Per Station[5]	Maximum Receivable[6]	Design Load[7]
SSN-597	1	165 C		800	800	X 800 Y 1350
SSN-609	1	295 C		1200	1200	X 1200 Y 1825
SSN-611	1	295 C		1200	1200	X 1200 Y 1825
SSN-637CL	1	188 C		1200	1200	X 1200 Y 2200
SSN-671	1	192 C		1200	1200	X 1200 Y 2740
SSN-685	1	220 C		1200	1200	X 1200 Y 1825
SSN-688CL	1 1	146 C 210 C		1600 1600	3200	X 3200 Y 8000
T-AGS-39	1	NA	NA	1600	1600	1420
T-AGOS-1 CL	1			800	800	
YTT-9	1					
YOG-78	1			60	60	

[1]Detailed information on the electrical system of any ship in this table may be obtained from NAVSEA Code 56Z1, Autovon 222-3615, Commercial (202) 692-3615.

[2]Station location is shown in feet from point of stem.

P Port-side station location
S Starboard-side station location
P/S Two station locations, one port and one starboard, at an equal distance from the bow, of which only one may be used at a time to receive power; one half of the total number of stations given are on port side, one half are on starboard.
C Centerline station location

Table 10
Shore Services-Electrical[1] — Continued

ST Stern station location; if power is delivered to the stern station, the port and starboard stations would normally not be used for receiving power

Q Stations so identified are pairs, located at different distances from the bow (usually on opposite sides of the ship), of which only one may be used at a time

[3]Station height is shown in feet above design waterline.

[4]Capacity is given in amperes. Unless otherwise indicated, power to load center is 450 V, 3-phase, 3-wire, 60 Hz, ungrounded. Power factor is approximately 0.8. Where capacity is given for other types of power, the requirement is indicated as follows:

*4160 V, 3-phase, 3-wire, 60 Hz, ungrounded
**120 V, 3-phase, 3-wire, 60 Hz, ungrounded
***120 V, 3-phase, 3-wire, 400 Hz, ungrounded
+120 V, dc, 2-wire, ungrounded
++120/240 V, dc, 3-wire, ungrounded
+++500 V, dc, 2-wire, ungrounded

[5]Per-station capacity is the rated capacity of each shipboard shore-power station based upon smallest device or cable rating of that station. This value may be exceeded due to momentary motor starting currents. The number of receptacles per station may be obtained by dividing per station capacity by 400. Table entries followed by "D" are feed-through circuits to the tended ship, and do not connect to the tender's electrical system.

[5a]These two direct feed-through stations are scheduled to be added by SAR-519.

[5b]Capacity scheduled to be uprated to 1,600 A by SAR-519.

[5c]Capacity scheduled to be uprated to 2,000 A by SAR-519.

[5d]CG-47 through CH-51: A total of 13 shore power receptacles are provided at each of these two (port and starboard) stations. Three receptacles (1,200 A) are used for a feed-through circuit to a tended ship and ten receptacles (4,000 A) are used for the ship's shore power station. The shore power station is equipped with 20 circuit breakers, and can receive shore power from either port or starboard side shore receptacles.

[5e]CG-52 and following: No feed-through circuits. Ship's shore power station is equipped with ten circuit breakers, and can receive shore power from ten shore power receptacles.

Table 10
Shore Services-Electrical[1] — Continued

[5f]CVN-65: The two portside stations shown are used only when the ship is in drydock.

[6]Maximum receivable capacity is the maximum steady-state current which the ship can accept due to ships power distribution system, and thus does not always equal the total capacity of all stations given. All ships except tenders can split their shore power loads so that common secondary source current does not exceed 5,000 A. Tenders may require up to 6400 amperes from a common secondary source.

[6a]Capacity scheduled to be uprated to 1,600 A by SAR-519.

[6b]Capacity scheduled to be uprated to 2,000 A by SAR-519.

[6c]CVN-68: Power source must be capable of supplying an inrush current of 40,000 amperes when energizing (or reenergizing) 450 V shore power terminals on CVN 68 class ships.

[6d]LHD under construction; data is preliminary.

[7]Design load represents the current required to support the functions normally performed while connected to shore power. These loads will include hotel, electronics, and weapons alignment for surface combatants and submarines; and hotel and cargo booms for auxiliaries. In many cases, Design Load entries are higher than Maximum Receivable entries, to allow for ship alterations which are pending or in process. For certain ships, design loads are broken down by function, as shown below:

AD, AR, and AS:

A - Requirement shown represents the demand of the tender while not tending
B - Requirement shown represents the demand of the tender while tending; this includes the requirements of the tender plus the maximum requirements of the ships being tended

SSBN and SSN:

All nuclear submarines require additional power (super shore power) when the ship is under testing or checkout mode of operation at naval shipyards only. Super shore power is not fed through ships shore-power stations (load centers), but is supplied from a separate source (see text).

X - Hotel requirements only
Y - Super shore power requirement

Table 10
Shore Services-Electrical[1] -- Continued

[8]PHM 1CL: Location varies. Requirement is to support an existing portable motor generator set which converts the 60 Hz power to 400 Hz power. The motor generator set normally accompanies the ships support facilities.

restoration of power to submarine services will be delayed a minimum of 5 seconds and a maximum of 10 seconds after loss of power due to external fault, in order to prevent submarine electric-plant malfunctions. Required circuit protective devices for substations shall also include undervoltage and underfrequency relays. Relay types and set points for undervoltage and underfrequency should be evaluated separately for each installation, with input from NAVFAC HQ.

b) Standby Power. Power requirements for normal operation are given in Table 10. A permanent standby generator plant sized to provide all submarines at a pier with emergency power for normal hotel demands shall be provided. One spare generator for each plant shall be supplied. The generator plant shall incorporate automatic load-shedding and load priority selection features. Generator plants should be located ashore whenever possible.

c) Maximum Downtime. The base and pier power systems at facilities where submarines are berthed shall be designed to provide a maximum downtime of 5 minutes. System downtime is defined as the time required to restore power to the pier when maintenance or repair activities are required, or the time required to transfer from one power source to another after system disturbances. This includes the time required for protective devices to operate and the time to start emergency generators.

d) Super Shore Power. Table 10 lists super shore power requirements for nuclear submarines for testing and checkout operations; these super shore power requirements are in addition to the normal requirements. If super shore power is required, supply from a separate substation which supplies no other loads. Portable or mobile substation units connected to temporary service outlets are recommended for this service. Extend primary service and provide connections for this use when required. The special requirements for submarine piers given in subpara. a), b), and c), above, do not apply to super shore power.

3.8.7.2 Special Shore Power Requirements for Nuclear Carriers (CVN). Certain nuclear carriers require shore-to-ship service at 4,160 V as well as at 480 V. Currently, only CVN-68 Class carriers can accept either a 4,160 V or a nominal 480 V shore power service (refer to Table 10).

a) Power Description. Power shall be ungrounded, 3-phase, nominal 4,160 V, 60 Hz, as defined in ANSI C84.1-1982, voltage range "A." System design shall be such that 4,160 V plus or minus 5 percent is provided at the shore receptacles.

b) Substations. This equipment should normally be fixed-type, but may be mobile or portable-type when appropriate. Fixed substations may be located either on the pier or ashore. Design should be similar to that for substations for 480 V service as described in para. 3.8.5 unless stated otherwise below. Provide six manual, full-capacity, 2-1/2-percent taps, two above and four below nominal transformer-output voltage. Circuit breakers shall be 4.16 kV air or vacuum drawout type, with current rating based on available fault, and shall be key interlocked with receptacles in the pier-outlet assemblies to prevent use of receptacles unless respective breakers are open. Design substations for momentary parallel operation of the

4,160 V, turbine-type shipboard generator with the shore power system. Substations for 4,160 V may be integrated with 480 V substations to produce common equipment and to conserve space.

c) Shore-Power Receptacles. The receptacle system utilized for nominal 480 V systems is not suitable and shall not be used for 4,160 V systems. Ascertain manufacturers of approved equipment from NAVFAC HQ, or match the system in current use by the activity. Provide 500 A receptacles at each 4,160 V pier-outlet assembly, or incorporate into substations where applicable.

d) Shipboard Equipment. The main breaker for the shipboard system on nuclear carriers is an air-type rated at 250,000 A asymmetrical interrupting capacity, without current-limiting fuses installed in series with the breaker.

3.8.8 Diversity of Usage. Pier, wharf, and drydock outlet assemblies and low voltage feeders shall be designed for "Design Load" values given in Table 10. With respect to substations dedicated to ships services, the diversity factors normally applied to buildings are not applicable to ships usage and must not be used. Studies are in progress to determine applicable ships-usage factors. However, diversity factors may be applied to the primary feeder sizing. NAVFAC HQ must be consulted for utilization factors to be used for individual piers, wharves, or drydocks. For graving drydocks, also refer to NAVFAC DM-29.1.

3.8.9 Pier, Wharf, and Drydock Lighting

3.8.9.1 Floodlighting. Provide floodlighting where required by the project directive. For general requirements relating to configuration of lighting standards, height of pole, controls, wiring, and appurtenances, refer to MIL-HDBK-1004/4, Electrical Utilization Systems. Poles shall be clear of any ship overhang, trunk lines, and railroad tracks, and shall not interfere with shore-to-ship or waterfront support operations. For wharf areas, poles should be located back from the wharf face and spaced to provide optimum distribution of lighting while minimizing shadows. For piers, poles should be designed to provide for the most operationally efficient and energy-efficient lighting based upon pier size, pier operations, and the need to minimize shadows.

Provide lighting levels for Navy waterfront facilities equal to 2 to 5 footcandles in work areas and a minimum of 1 footcandle in nonwork areas. Lighting levels as low as 0.5 footcandle provide adequate lighting for foot traffic, entrances to piers and wharf areas, corners of piers, and isolated spots between berths. Lighting shall be high-pressure sodium type. Provide lighting for cranes to conform to the requirements of NAVFAC DM-38.01, Weight Handling Equipment.

3.8.9.2 Other Lighting. Special-purpose lighting which is supplemental to floodlighting should be considered on a site-by-site basis. Provide curb lighting in pier curbs as directed or necessary for nighttime personnel safety. Provide additional local security lighting around critical buildings or equipment where not adequately illuminated by floodlighting. Obstructions which could cause vehicle damage or personnel injury should be highlighted by supplemental fixtures as necessary. Navigational lights are required at the

outboard ends of piers and at other locations as determined by analysis of ship traffic. Types and locations of navigational fixtures required should normally be obtained from the activity or the cognizant Engineering Field Division. Refer to NAVFAC DM-26.1, Harbors, for a description of navigational lighting.

3.8.10 Fire-Alarm Service. Fire-alarm service shall be in accordance with the requirements of MIL-HDBK-1008. Provisions shall be made for coded or auxiliary fire-alarm boxes at each ships hotel-service outlet location, but not over 300 ft (91.4 m) apart. Noncoded fire-alarm boxes shall be provided on the pier itself and arranged to trip a coded fire-alarm box at the head of the pier. All boxes shall be plainly visible. Box housings shall be UL-listed or FM-approved as weatherproof. Activation of any box shall transmit a coded fire-alarm signal to the facility fire department. Where normal means of signal transmission are not available, use an RF transmission system.

3.8.11 Ground System. At piers, wharves, quaywalls, and other waterfront structures, a ground system that will measure not more than 3 ohms shall be provided for all permanent electrical equipment. Ground systems should be in accordance with NFPA 70, National Electric Code except where it is required or recommended to be otherwise herein or by project specifications.
The metallic water piping on a structure is recommended as a ground for electrical-equipment enclosures on the structure. However, the effect of this usage on the cathodic-protection system (if present) for the water mains should be explored. If adverse effects are possible, use alternative grounding means described below. Stranded-copper-wire ground conductors should be used to interconnect all electrical-equipment enclosures and the water-pipe ground. The sizes of the ground conductors from enclosures, cable sheaths, steel conduits, transformer cases, and other devices are determined by the American Wire Gauge (AWG) sizes of the conductors enclosed, as shown in the following tabulation:

SIZE (AWG) OF LARGEST CONDUCTOR OR EQUIVALENT FOR MULTIPLE CONDUCTORS	GROUND CONDUCTOR SIZE (AWG)
2 or smaller	8
1 or 0	6
00 or 000	4
Over 000 to 350,000 cm[1]	2
Over 350,000 cm to 600,000 cm	0
Over 600,000 cm to 1,100,000 cm	00
Over 1,100,000 cm	000

[1]cm = circular mils

3.8.11.1 Ground Conductors. The ground conductor for a structure should be protected at all places subject to mechanical damage. It is preferable to install ground conductors in conduits or in duct systems in order to provide mechanical protection, but ground conductors may be installed in the open if the installation is such that a conductor cannot readily be damaged. Where lead-covered cables are installed in ducts, the ground conductor in the duct

line should be insulated with not less than 1/32 in. (0.8 mm) of a PVC type of insulation. Use this insulation reduces the possibility of corrosion of the lead sheaths.

3.8.11.2 Alternative Grounds. Structures that cannot use a water-piping ground system should have a ground conductor system extended from the ground devices to a driven ground-rod system. Ground conductors in this case should be Number 6 AWG minimum and need be no larger, except where a larger size is required to provide additional mechanical strength. Where it is not practical to properly maintain an onshore ground-rod system adjacent to a pier, metal plates laid on the bottom, underwater, should be used. The conductor connecting these plates to the Number 6 AWG conductor on the structure should be at least Number 2 AWG stranded copper wire in order to provide sufficient mechanical strength. Ground systems for waterfront structures that have gasoline piping systems should be designed in accordance with NAVFAC DM-22.

3.8.12 Lightning Protection. Provide primary or secondary lightning protection as required in lightning-prone areas. Design in accordance with NAVFAC DM-4.6, Lightning (and Cathodic) Protection, and NFPA 78, Lightning Protection Code. Consider protection of cranes, abovedeck substations, pier-located buildings, and lighting-system masts.

3.9 Telecommunication Systems. Materials and installation shall conform to the requirements of NAVFAC DM-4 series, Electrical Engineering, and to NAVFAC Guide Spec Number 16740. Information is given below as a guide to the design of equipment and to requirements for conduit sizes and cable sizes. However, wiring and cable should not be provided for by the designer unless specifically required. Designs should include telecommunications outlet assemblies and receptacles, manholes, terminal cabinets, other related equipment, and conduit systems. Before commencing design of these systems, obtain specific requirements from the activity and from the Activity Providing Telephone Service (APTS) regarding equipment space, point of connection to the base system, and size of incoming duct or conduit. Verify the required number of telephone lines shown in Table 11, column (a), with the using activity.

3.9.1 Telephone Systems. A telephone distribution system shall be provided to each berth on piers and at drydocks to enable ships to be connected to the shore-activity telephone system. Provision shall be made for the telephone cable to be terminated in a telecommunications outlet assembly adjacent to each berth. This assembly must provide a secure and weather-tight enclosure for a cable cross-connect device, and must include bulkhead-mounted connectors to the exterior of that enclosure to receive the shore end of the ship-to-shore telephone cable. These ship-to-shore connectors shall conform to Mil. Spec. MIL-C-28840/12 BF1S1 for 30-pair cable and to MIL-C-28840/12 BD1S1 for 15-pair cable. If the telephone-cable system on the pier is Navy-owned, an additional cross-connect cabinet must be provided beyond the pierhead line where the Navy cable system connects to the commercial telephone cable system. A ships berthing switching system (preferably electronic) shall be provided in the shore-activity telephone-distribution system to enable activity operators to match telephone numbers to ships locations in order to provide maximum continuity of telephone numbers to each ship during in-port periods.

3.9.1.1 Ships Demand. Table 11 provides the number of dial-telephone shore

Table 11
Shore Services - Telecommunications

Ship Type	Class	Telephone Lines (pairs) (a) Active Lines[1]	Telephone Lines (pairs) (b) Cable Size at Berth	Location[2]
Aircraft Carriers	CV-59	60	200	
	CV-63,67	60	200	
	CVN-65	60	200	
	CVN-68	60	200	
Surface Combatants				
Battleship	BB-61,62, 63,64	31	100	
Cruiser	CG-16,26	12	50	
	CG-47	12	50	287 C
	CGN-9	15	50	
	CGN-36	15	50	
	CGN-38	15	50	
Destroyer	DD-963	10	50	261 S
	DDG-2	10	50	
	DDG-37	10	50	
	DDG-51	10	50	
	DDG-993	10	50	
Frigate	FF-1037	8	50	
	FF-1040	8	50	
	FF-1052	8	50	240 C
	FFG-1	8	50	
	FFG-7	8	50	

Table 11
Shore Services - Telecommunications -- Continued

Ship Type	Class	Telephone Lines (pairs)		Location[2]
		(a) Active Lines[1]	(b) Cable Size at Berth	
Surface Combatants (cont'd)				
Patrol	PG-85	3	25	
	PHM-1	3	25	
Submarines	SS-580	5	25	
	SSN-594	5	25	
	SSN-637	5	25	
	SSN-688	5	25	
	SSBN-616	5	25	
	SSBN-726	5	25	
Amphibious Warfare				
Command	LCC-19	20	100	
Assault	LHA-1	25	100	
	LPH-2	20	100	
Cargo	LKA-113	10	50	
Transport	LPD-4	10	50	
Landing	LSD-36	10	50	
	LSD-41	10	50	
	LST-1179	10	50	
Mine Warfare	MSO-427	3	25	
	MCM-1	3	25	
Auxiliary				
Tenders & Repair	AD-15	20	100	
	AD-37	20	100	
	AD-41	20	100	314 P
	AR-5	5	50	

Table 11
Shore Services - Telecommunications — Continued

Ship Type	Class	Telephone Lines (pairs) (a) Active Lines[1]	Telephone Lines (pairs) (b) Cable Size at Berth	Location[2]
Auxiliary (Cont'd)				
Tenders & Repair (cont'd)	ARS-38	5	50	
	ARS-50	5	50	
	AS-31	60	100	
	AS-33	60	100	
	AS-36	6	100	
	ASR-9&21	5	50	
Cargo & Transport	AE-21	10	50	
	AE-26	10	50	
	AFS-1	15	50	
	AH-19			
	AK-280			
	AKR-7			
	AO-105	10	50	
	AO-143	10	50	
	AO-177	10	50	
	AOE-1	10	50	
	AOR-1	15	50	
	AOT-168	10	50	
	AP-110,122			
Tugs	ATF-91 ATS-1	5	25	

Table 11
Shore Services - Telecommunications -- Continued

Ship Type	Class	Telephone Lines (pairs)		Location[2]
		(a) Active Lines[1]	(b) Cable Size at Berth	
Auxiliary (Cont'd)				
Miscellaneous	AG-193			
	AGS-39	3	25	
	AGDS-2	4	25	
	AGF-11			
	AGM-20			
	AGOR-11			
	AGOS-1			
	AVM			
	Small Craft	1	6	
Embarked Staffs:				
Fleet Commander		20	None	
CARGRU Commander		8	None	
CREWDESGRU Commander		12	None	
DESRON Commander		10	None	
PHIBGRU Commander		12	None	
PHILBRON Commander		15	None	
MAB Staff		12	None	
SERVGRU Commander		8	None	
SUBRON Commander		15	None	
PHMRON Commander		12	None	

[1]Total number of active lines required for any ship is sum of column (a) for the ship class and the embarked staff requirements.

[2]Distance, in feet, of service module aft of the point of stem of the ship. Where more than one module is required, all locations are shown.

lines required by each ship type and for embarked staff in column 1. These data are provided to enable design of ships switching systems and central-office equipment. Column (b) of Table 11 lists the size of cable to be provided at berths designated for various ship types. Cable sizes given in column (b) include the ship requirement, the appropriate embarked-staff requirement, and an allowance for spare pairs. Cable sizes have been rounded up to the next larger standard telephone cable. The pier telephone-distribution cable system should be designed using the activity berthing plan to provide properly sized cable for the worst case at each berth. Berths designed for nested ships should be provided with the total number of cables indicated for all ships in the nest.

3.9.1.2 Other Demand. Consider the requirement for telephones at the head and end of the pier, and at intermediate points along the pier, to provide service to security checkpoints and watchstanding stations.

3.9.1.3 Coin-Operated Telephones. When required, provide an independent conduit to each telecommunications outlet assembly in order to provide capacity for a vendor to install telephone cables to support shipboard coin-operated telephones. Also, consider the requirement for conduit at the head of the pier to provide capacity for a vendor to install telephone cables to support coin-operated telephones ashore.

3.9.1.4 Location and Arrangement of Pier Telephone-Distribution System. As a general rule, the telephone-distribution cables should be encased in conduit embedded in the pier deck from a communications manhole or cross-connect panel beyond the head of the pier to the point of service at each berth. Each berth should be served by independent runs of conduit. The telecommunications outlet assembly may be an independent, freestanding module or it may be incorporated into the electrical outlet assembly as a separate compartment. Independent, freestanding modules shall be designed to prevent damage by ships lines and by traffic on the pier.

3.9.2 Other Telecommunications Systems. The need for the systems described below should be evaluated on a site-by-site basis. Provide these systems as directed by the activity Public Works Department and the APTS.

3.9.2.1 Dedicated Data Transmission. Furnish one 2-in. (50.8 mm) conduit from the manhole or cross-connect cabinet on shore to each telecommunications outlet assembly to provide capacity for installation of dedicated data-transmission cables. These conduits will provide the ability to satisfy extra high-speed or four wire circuit data-transmission requirements which are beyond the capability of the ships or the activity's switching equipment.

3.9.2.2 Dedicated Communication Circuits. Provide one 2-in. conduit from the manhole or cross-connect cabinet at the head of the pier to each telecommunications outlet assembly to provide capacity for communication circuits which cannot use the telephone system.

3.9.2.3 Cable Television. Provide conduit capacity from the manhole at the head of the pier to each telecommunications outlet assembly to support cable-television requirements.

3.9.2.4 Alarm and Signal Circuits. Provide two 1-1/4-in. (31.7 mm) conduits from the manhole at the head of the pier to each telecommunications outlet assembly in order to provide capacity for alarm and signal circuits which cannot use the telephone system.

3.9.2.5 Fiber Optic Transmission Systems. Consider the use of fiber-optic transmission systems between the shore activity telephone system and the telecommunications outlet assembly when the shore activity is served by a fiber-optic system. Provide interface equipment in the telecommunications outlet assembly housing to permit connection to the ship-to-shore cables. Consider providing conduit for fiber-optic transmission systems when the shore activity is using such systems for security and other similar uses.

3.10 Other Services. Although their design is not covered by this Handbook, other services will occasionally be required at active and repair berthing facilities, such as: jet fuel, chilled water, pure water, oxygen, acetylene, mapp gas and inert gases. These services may be permanent or temporary (tank truck, gas containers or similar means), depending upon required quantity, location and economic considerations.

Section 4: SUPPLY AND AMMUNITION PIERS

4.1 Steam and Compressed Air. In general, steam and compressed-air services are not required on supply and ammunition piers.

4.2 Water for Fire Protection. Provide fire-protection water as in active berthing, except for ammunition piers which are in an isolated area far removed from mobile fire apparatus. For remote ammunition piers, design a pumping station to supply between 2,500 and 3,500 gpm (9,463 and 13,248 lpm) at sufficient pressure to provide 75 psig (517 kPA) residual pressure at the most remote outlet. A pressure of 75 psig will provide 250 gpm (946 lpm) through 200 ft (61 m) of 2-1/2-in. (63.5 mm) hose with approximately 45 psig (310 kPa) at the nozzle. Provide two 2-1/2 in. valved connections at each of the outlets and space the outlets approximately 200 ft apart. Outlet connection threads shall be National Standard male hose threads or as required by the ships involved. For transit sheds, provide a sprinkler system in accordance with Section 3. For unheated sheds, in climates where freezing is possible, sprinkler systems must be dry-pipe.

4.3 Potable Water, Sewer, and Oily Waste. For supply piers, requirements are the same as those for active berthing refer to Section 3. For ammunition piers, supply only when indicated in the project directive.

4.4 Freeze Protection. Provide freeze protection in accordance with Section 6 for facilities in cold climates.

4.5 Electrical Service. Ships service, temporary lighting, and power for ships industrial services are not required for supply and ammunition piers.

4.5.1 Fire-Alarm. Provide fire alarm service in accordance with para. 3.8.

4.5.2 Pier Lighting and Incidental Power Receptacles. Methods and materials shall conform to the requirements given for active berthing in Section 3.

4.6 Telecommunication Systems. Provide the appropriate telecommunication systems as described for active and repair berths in para. 3.9, except that the outlets and telecommunications outlet assemblies shall be suitable for the intended application and shall be approved for the degree of hazard encountered, as indicated in NFPA 70, National Electrical Code, for hazardous locations.

Section 5: FUELING PIERS

5.1 Steam and Compressed Air. In general, steam and compressed air services are not required on fueling piers.

5.2 Fire Protection. Ships which are loading or unloading POL products at fueling piers will never be cold iron and will therefore not require a shore-to-ship fire protection water connection. Water requirements below are for berth and shoreside facility protection.

5.2.1 Water Supply. The shoreside freshwater system shall be used when available and when sufficient quantity is available at adequate pressure. Consider the use of booster pumps to improve pressure when appropriate. When freshwater is not available, or when the supply is inadequate, provide a salt or nonpotable water pump station designed as for active berthing to supply the requirement.

5.2.2 Fire Hydrants. Hydrants shall be provided along the pier or wharf not more than 300 ft (91.4 m) apart.

5.2.3 Foam. Where foam extinguishing systems exist for the protection of other exposures (such as storage tanks), the foam system should be extended to hydrants or monitors located adjacent to ships alongside the fuel pier.

5.2.4 Sprinkler System. Provide sprinklers, firewalls, and fire stops under decks of combustible structures and in transit sheds. Installation of automatic sprinklers shall be in accordance with NFPA 307, Construction and Fire Protection of Marine Terminals, Piers and Wharves.

5.3 Potable Water, Sewer, and Oily Waste. Supply only at locations where connections may be made to existing systems. Maximum potable water requirements are 1,000 gpm (3,785), with 40 psi (276 kPa) residual pressure at the most remote outlet. Design outlets as for active berthing and space about 200 ft (61 m) apart.

5.4 Freeze Protection. Provide freeze protection in accordance with Section 6 for facilities in cold climates.

5.5 POL Systems. Refer to NAVFAC DM-22, Petroleum Fuel Facilities, for information on piping and other appurtenances, including manifolds, hoses and shelters, connections and adapters, hose handling equipment, bilge and ballast lines, stripper pumps, environmental protection, and other equipment. For spill prevention and containment requirements, see also NAVFAC Definitive Drawing Numbers 1404371 and 1403995 through 1403999. Refer to Table 9 for locations of ships fueling connections, and locate loading arms accordingly. In general, ships use a 6-in. (152.3 mm) commercial flanged connection; verify before commencing design of shore connections.

5.6 Electrical Service. Ships service, temporary lighting, and ships industrial power are not required for fueling piers and quaywalls.

5.6.1 Fire Alarm. Provide fire-alarm service in accordance with para. 3.8.

5.6.2 Pier Lighting and Incidental Power Receptacles. Methods and materials should conform to the requirements given for active berthing in Section 3.

5.7 Telecommunication Systems. Provide the appropriate telecommunication systems as described for active and repair berths in para. 3.9, except that the telecommunications outlet assemblies and equipment shall be suitable for the intended application and shall be approved for the degree of hazard encountered, as indicated in NFPA 70, National Electrical Code, for hazardous locations. Locate the telecommunication service modules at least 25 ft from any fuel location.

Section 6: MISCELLANEOUS PROVISIONS

6.1 Freeze Protection

6.1.1 Where Required. Freeze protection for saltwater, fresh-water, sanitary-waste (sewage), and oily-waste (bilge) pipes exposed on piers and wharves and in drydocks must be considered when located in freezing climates.

6.1.2 Regional Weather Differences. For design purposes, locations within the United States can be divided into the five regions listed below (areas covered by these regions are depicted on Figure 24):

a) Region I: "Severe"—Juneau, Alaska; Portland, Maine; and Portsmouth, New Hampshire. (Also inland and Great Lakes locations.)

b) Region II: "Cold"—Kodiak, Alaska; Boston, Massachusetts; Providence, Rhode Island; Newport, Rhode Island; and New York, New York. (Although New York is on the borderline, its average winter temperature corresponds to the "cold" group.)

c) Region III: "Moderate"—Philadelphia, Pennsylvania; Baltimore, Maryland; and Washington, D.C.

d) Region IV: "Mild"—Seattle, Washington; Portland, Oregon; and Norfolk, Virginia.

e) Region V: "Very Mild"—San Francisco, California; Charleston, South Carolina; and Jacksonville, Florida.

Table 12 lists average historical weather data for the five regions. For freeze-protection systems at locations outside of the United States, match weather data (insofar as possible) to one of the regions in Table 12 and design accordingly.

Table 12
Regional Weather Data

REGION	AVERAGE JANUARY Temp. (°F)	EXTREME MINIMUM Temp. (°F)	MEDIAN ANNUAL EXTREMES (°F)	97 1/2% Temp. (°F)	AVERAGE OF 97 1/2% TEMP. AND EXTREME MINIMUM (°F)	DEGREE DAYS
I	24	-30	-11	0	-15	1,275
II	29	-14	1	10	-2	1,125
III	34.5	1	7	15	8	950
IV	34.5	3	16	24	13	750
V	50.5	17	21	32	24	450

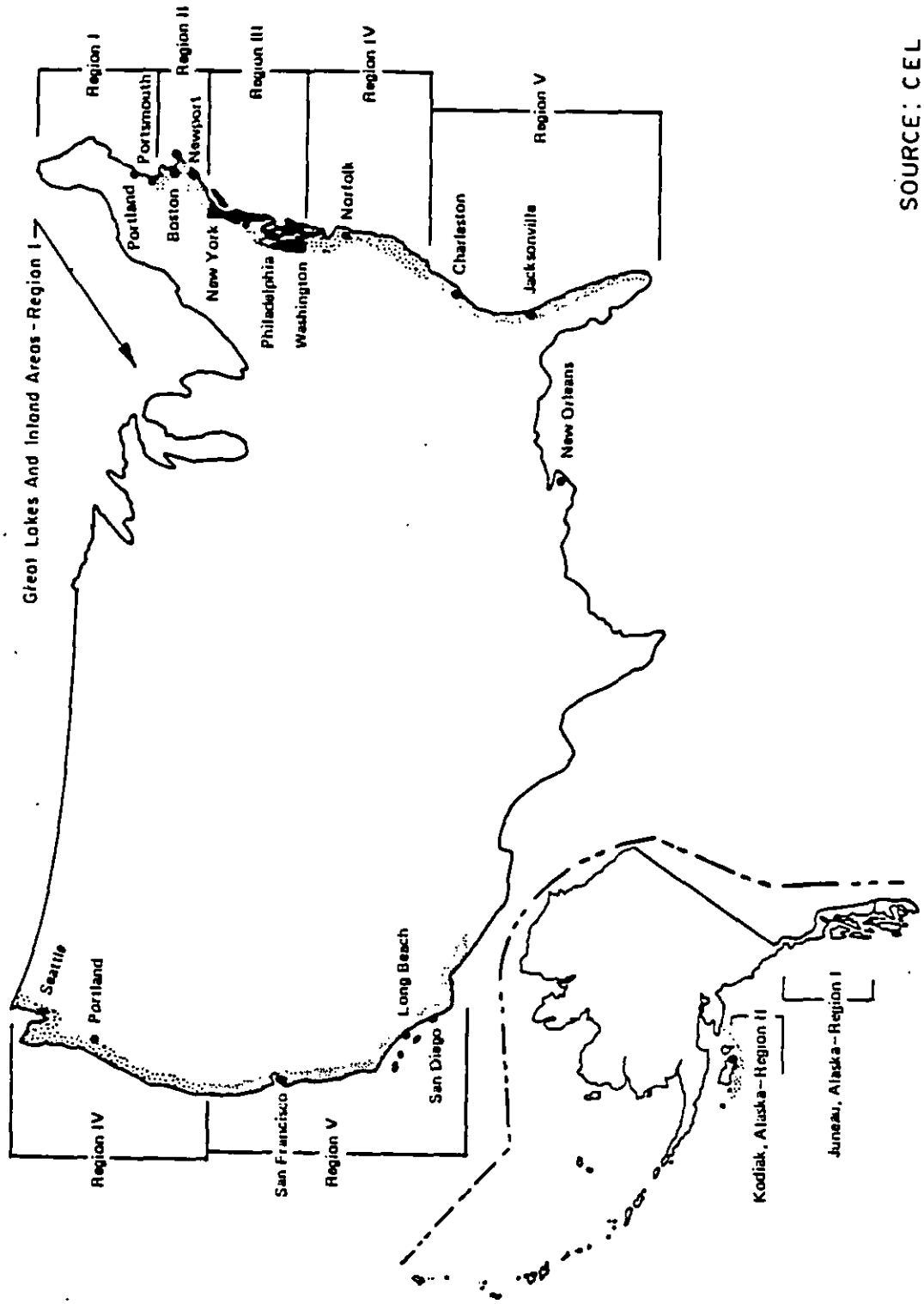


Figure 24
U.S. Winter Weather Severity by Region

6.1.3 Methods. The methods described below vary with climate and are based in part on a study made by Naval Civil Engineering Laboratory (R 593, Freeze Protection for Freshwater and Sanitary Piping Under Open Piers, September 1968). Use the methods recommended below when the relative costs of electricity and freshwater are not abnormally high. Where the cost of either electricity or water is abnormally high, or both are high, modify the freeze protection to use the method which minimizes operating cost, using life-cycle cost procedures.

6.1.4 Protection in Regions I and II

6.1.4.1 Water Lines. For water lines, provide freeze protection by using a combination of electric tape heating elements and pipe insulation. The suggested combinations of insulation thickness and heating (Watt [W] density) for various pipe sizes are shown in Table 13.

Table 13
Freeze Protection by Insulation and Heating
(Suggested Combinations for Regions I and II)

NOMINAL PIPE SIZE (In.)	REGION I		REGION II	
	INSULATION THICKNESS (In.)	HEATING (Watts/ft)	INSULATION THICKNESS (In.)	HEATING (Watts/ft)
2	1/2	6	1/2	6
3	1/2	6	1/2	6
4	1	6	1	6
6	1	6	1	6
8	1 1/2	6	1	6
10	1 1/2	6	1 1/2	6
12	1 1/2	6	1 1/2	6

Heating elements should be controlled by remote-type thermostats having sensors taped to the surface of pipes, under the insulation. Several systems with separate heating elements may be required (due to overall element-length limitations), with separate or common thermostats. Thermostats must be in a protected location above the deck, with sensors below deck as required. The heating requirement given in Table 13 (6 W/ft) is the watt density available for a typical electric-tape-type element. Any Watt density from 4 to 10 W/ft would be suitable, but insulation thicknesses must be adjusted linearly to compensate. Insulation thicknesses given in Table 13, which are for polyurethane, should be adjusted for other materials linearly with thermal conductivity. Protect backflow devices, valves, and shore-connection risers with electric tape heating elements and preformed polyurethane insulation kits.

6.1.4.2 Sewer and Oily-Waste Lines. For exposed gravity sewer piping which drains fixtures directly, for exposed oily waste piping, and for those portions of exposed CHT and oily-waste pressure lines which will not completely drain upon cessation of pumping, a combination of electric tape heating elements and pipe insulation shall be used in accordance with Table 13.

For exposed pressure and gravity sewer and oily-waste piping (or portions thereof) which receive material intermittently from ships CHT or oily-waste pumps only, and which drain well when pumping stops, design with insulation as above but omit heating elements. CHT and oily-waste connection risers and valves above pier decks or in drydock galleries need be neither insulated nor heated.

6.1.5 Protection in Regions III and IV

6.1.5.1 Fresh Water Lines. For water lines, the preferred method of freeze protection in these regions is to use a combination of insulation and flushing of water through pipes. Insulation thickness for various pipe sizes, and pipe sizes for which flushing is necessary, are given in Table 14.

Table 14
Freeze Protection by Insulation and Flushing
(Suggested Combinations for Regions III and IV)

NOMINAL PIPE SIZE (In.)	REGION I		REGION II	
	INSULATION THICKNESS (In.)	FLUSHING REQUIRED	INSULATION THICKNESS (In.)	FLUSHING REQUIRED
2	1	Yes	1	Yes
3	1	Yes	1	Yes
4	1	Yes	1	Yes
6	1	Yes	1	No
8	1	No	1	No
10	1	No	1	No
12	1	No	1	No

Insulation thicknesses are such that, for expected durations of subfreezing temperatures (refer to NCEL R 593), less than 50 percent of pipe contents will freeze where no flushing is necessary. Where flushing is indicated, use thermostatically actuated solenoid valves. Size each valve for a rate at which the entire contents of exposed piping can bleed in 8 to 12 hours. Thermostat(s) should be in protected locations, with sensors taped to the surface of pipes under insulation, and should be factory-set to open the flushing valve(s) at 30° F (-1.1° C) and close the valve(s) at approximately 35° F (2° C). Flushing valves and associated thermostats should be located at

each ships connection and at any other line extremities. Insulation thicknesses given in Table 14, which are for polyurethane, should be adjusted for other materials linearly with thermal conductivity. Insulation must be applied to backflow devices and valves as well as to mains. Special care must be taken to prevent freezeup of flushing valves and connecting piping.

If water is scarce, or if the wintertime temperature of water in buried mains is below approximately 45° F (7.2° C), heating elements should be used in lieu of flushing for those pipes indicated to require flushing by Table 14. In this event, use the combinations (or their equivalents) given in Table 15.

6.1.5.2 Sewer and Oily-Waste Lines. For exposed gravity sewer piping which drains fixtures directly, for exposed oily waste piping, and for those portions of exposed CHT and oily-waste pressure lines which will not drain completely upon cessation of pumping, use a combination of electric tape heating elements and pipe insulation, in accordance with Table 15.

Table 15
Freeze Protection by Insulation and Heating
(Suggested Combinations for Regions III and IV)

NOMINAL PIPE SIZE (In.)	REGION I		REGION II	
	INSULATION THICKNESS (In.)	HEATING (Watts/ft)	INSULATION THICKNESS (In.)	HEATING (Watts/ft)
2	1/2	6	1/2	6
3	1/2	6	1/2	6
4	1/2	6	1/2	6
6	1/2	6	1/2	None
8	1	None	1/2	None
10	1	None	1	None
12	1	None	1	None

For exposed pressure and gravity sewer and oily waste piping (or portions thereof) which receive material intermittently from ships CHT and oily-waste pumps only, and which drain well when pumping stops, neither insulation nor heating is required.

6.1.6 Protection in Region V. In portions of region V in which the temperature can drop below 25° F (-4° C), use a properly sized flushing valve, atmospheric thermostat, and timer to bleed approximately 35 gallons (132.5 l) per inch of pipe diameter for each 100 ft (30.5 m) of freshwater pipe, over an 8- to 12-hour period, on each day that the ambient temperature drops below 25° F. Pipes need not be insulated, but flushing valve(s) and connections must be located at system extremities, and must be protected from freezeup.

6.1.7 Modification of Requirements for Saltwater. Because seawater freezes at a temperature approximately 4.5° F (-15.3° C) lower than that at which freshwater freezes, make the following regional adjustments when designing freeze protection for exposed saltwater mains:

a) In regions I and II, design as for regions I and II (that is, treat as freshwater).
b) In region III, design as for region IV.
c) In region IV, design as for region V.
d) In region V, no freeze protection is necessary for saltwater at any location.

6.1.8 Materials

6.1.8.1 Pipe. Where heating elements are necessary to prevent freezing, piping materials must be metallic in order to assure proper heat transfer through the pipe wall. Where a flushing system is utilized, any approved material may be used for piping.

6.1.8.2 Heating Elements. Flat tape electric elements, which lend themselves to easy attachment to pipes, are recommended. Elements should be easy to splice and repair and should be waterproof. A low Watt density (4 to 10 Watts per lineal foot of pipe) is recommended, and the ability to lap at least once without damage to the element should be required. When heating elements are used with the insulation thicknesses listed in Tables 13 and 15, they will be cycled on approximately 30 to 60 percent of the time on the coldest days.

6.1.8.3 Insulation and Covering. Closed-cell foam-type insulations, such as cellular glass, having low moisture-absorption qualities should be used for regions I and II due to the destructive effect of freezing on wet insulations. Use closed-cell foam-type insulation for regions III and IV as well if wave action and/or immersion will get insulation or covering wet. Cover all insulation with a watertight metallic or plastic system.

6.1.8.4 Valves and Thermostats. Select single-seated solenoid valves having flow constants suitable for bleeding proper quantities of water in the prescribed interval. Temperature sensors should be atmospheric or surface-type, as required. Thermostats may be bimetallic, thermistor, or resistance (RTD) type, having differentials of 2° F (-16.6° C) to 5° F (-15° C).

6.2 Piping Identification

6.2.1 Primary Identification. Each valve on a pier, wharf, or drydock must be identified by a plain-language brass tag, labeled, for example, as "potable water" or "sewer." Additionally, at each shore-to-ship utility connection, name plates or stenciled letters near the connection must identify the utility in plain language.

6.2.2 Color Coding. Two sources of design requirements govern color coding for pier, wharf, and drydock piping (refer to paras. 6.2.2.1 and 6.2.2.2).

6.2.2.1 Distribution Piping On or Under Deck and Ashore. Such piping, exclusive of shore-to-ship utility connections, should be color coded in accordance with MIL-STD-101, Color Code for Pipelines and Compressed Gas Cylinders, and applicable requirements should be specified in design projects.

6.2.2.2 Shore-to-Ship Utility Connections. Such piping, including valves, operating levers, ends of hose assemblies, risers, and adjacent piping, must be specified to be color coded in accordance with Table 16 (refer to NAVFACINST 11300.34 CH-1, 18 July 1983). Such colors may also extend, where practical, to adjacent curbs and protective rails, posts, and walls.

Table 16
Color Code for Shore-to-Ship Utility Connections[2]

SHORE SERVICE[1]	COLOR	FED. STD. 595(A) NO./ FED. SPEC. TT-E-489 NO.
Potable Water, 40-81 psi	Blue, Dark	15044
Nonpotable Water, 100-175 psi Fire/Flushing/Cooling	Red	11105
Chilled Water	Striped Blue/White	15044/17886
Oily Waste Discharge	Striped Yellow/Black	13538/17038
Sewer	Gold	17043
Steam, 150 psig	White	17886
Compressed Air, 100-125 psi	Tan	10324
High Pressure Air, 3000 psi	Striped Yellow/Gray	13538/16081
Fuel	Yellow	13538

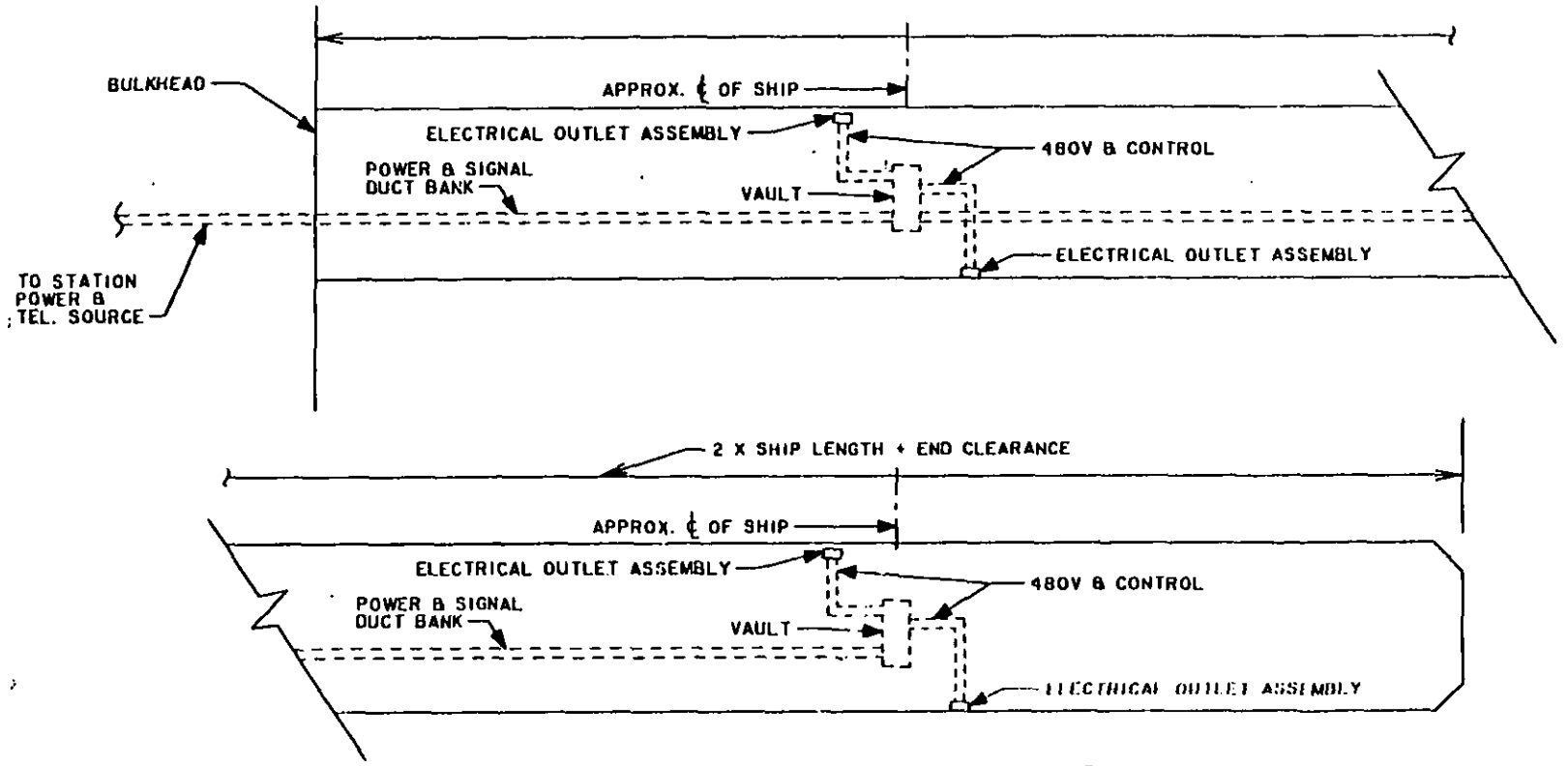
[1]Pressures shown are nominal pressures and represent average conditions.

[2]If additional information is needed on color coding systems, contact NAVFACENGCOMHQ Code 04T1, A/V 221-0374, commercial (202) 325-0374, or Code 04Bd, A/V 221-0308, commercial (202) 325-0308.

6.3 Nuclear Fueling. Replacement of spent reactor cores usually requires the services of a specially equipped shipyard. Specific criteria are under development, and the designer shall refer to NAVFACENGCOM HQ for interim instructions.

Appendix A

FACILITY PLATES



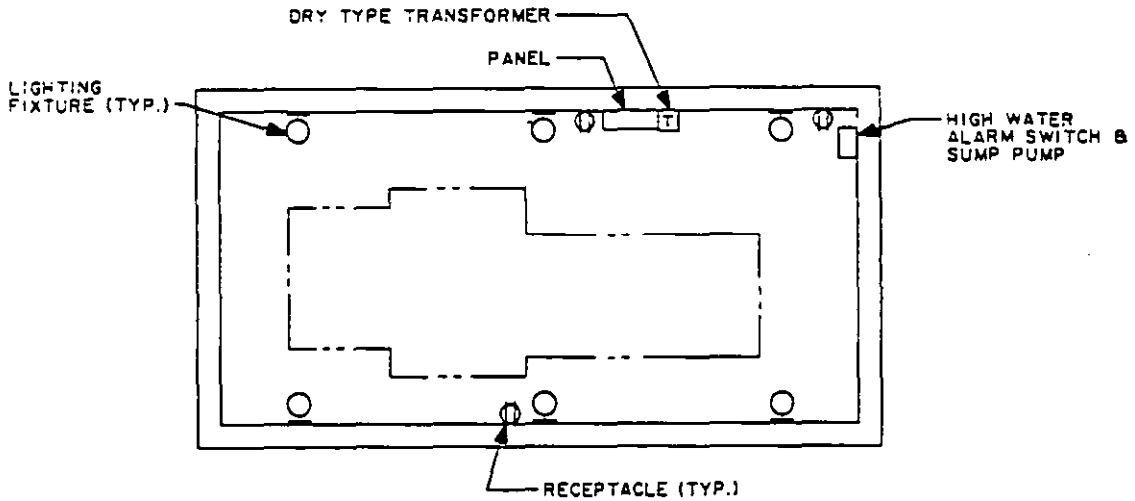
PLAN - TYPICAL PIER

NO SCALE

NOTES

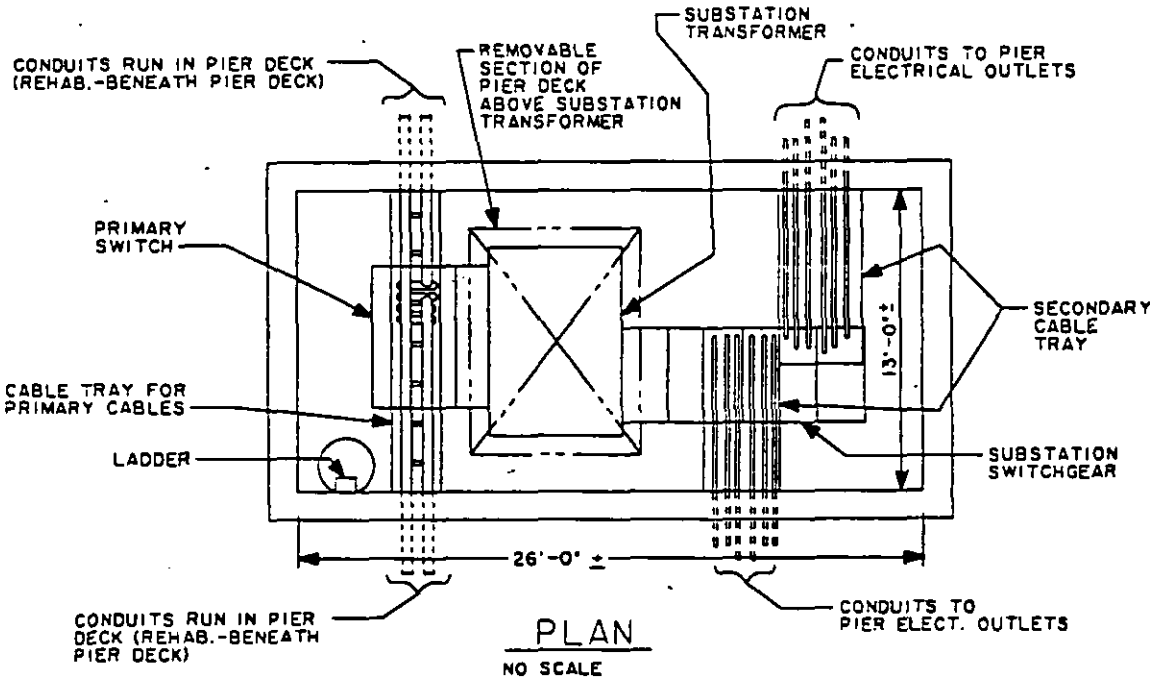
1. THIS DRAWING IS FOR REFERENCE, PLANNING AND ESTIMATING PURPOSES ONLY.
2. IN NEW CONSTRUCTION, PROVIDE CONDUITS IN PIER DECK. IN REHABILITATION PROJECTS, PROVIDE CONDUITS BENEATH PIER DECK.
3. VAULTS HAVE HIGH WATER ALARMS AND HIGH TEMPERATURE TRANSFORMER ALARMS.
4. SET SUBSTATION INCLUDING SWITCHGEAR ON 6" HIGH CONCRETE PAD.
5. THIS PLATE IS BASED ON A 3750 KVA SUBSTATION WITH 15 KV CLASS INCOMING PRIMARY AND SERVING 16-400 AMPERE RATED 480 VOLT SHORE TO SHIP CIRCUITS.

Figure 25A
Pier Electrical Distribution-New/Rehabilitated Pier



LIGHTING AND SMALL POWER PLAN

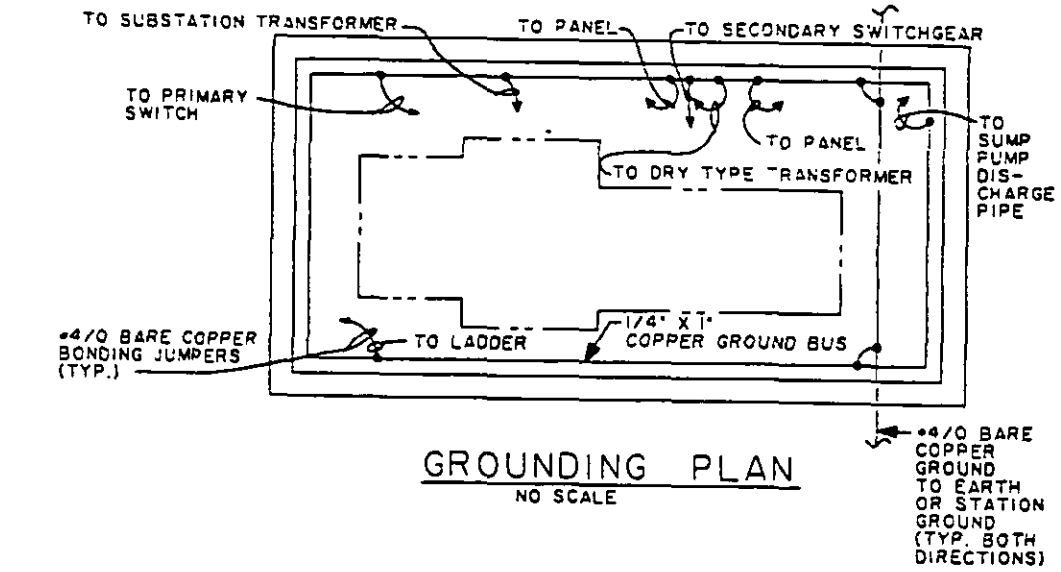
NO SCALE



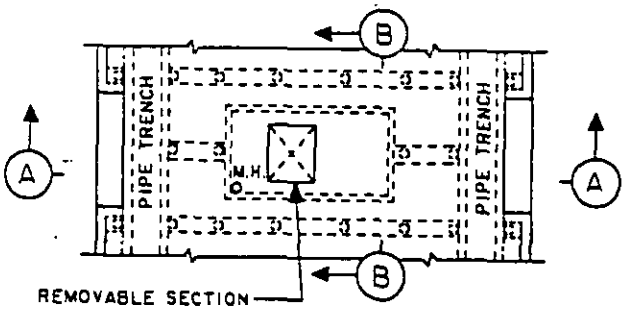
PLAN

NO SCALE

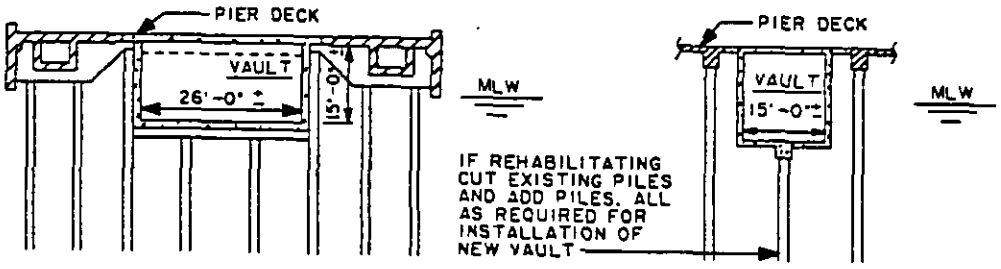
Figure 25B
Pier Electrical Distribution-New/Rehabilitated Pier



GROUNDING PLAN
NO SCALE



PLAN

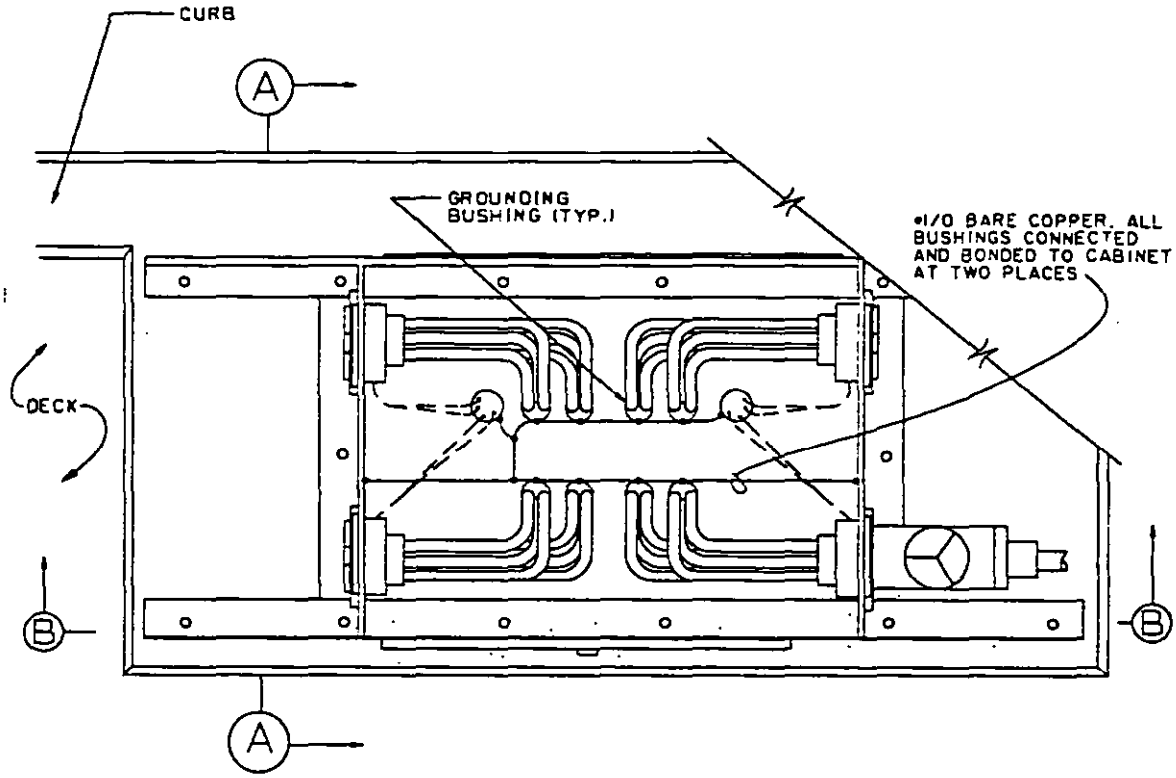


SECTION A

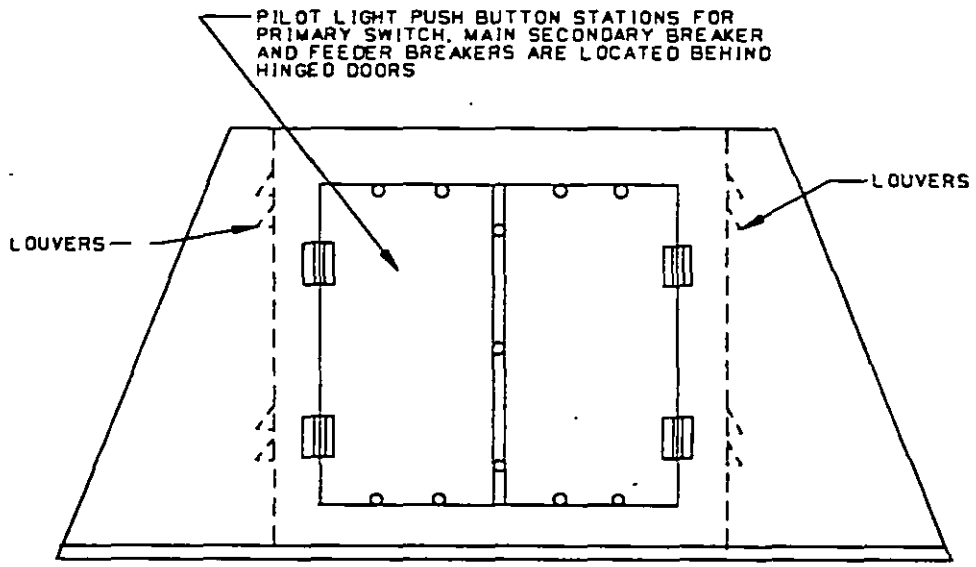
SECTION B

STRUCTURAL MODIFICATIONS/ NEW
NO SCALE

Figure 25C
Pier Electrical Distribution-New/Rehabilitated Pier



PLAN



3/8" PLATE, WELDED CONSTRUCTION

FRONT ELEVATION (REAR SIMILAR)

PIER ELECTRICAL OUTLET ASSEMBLY

NO SCALE

Figure 26A
Pier Electrical Distribution-Miscellaneous Electrical Details

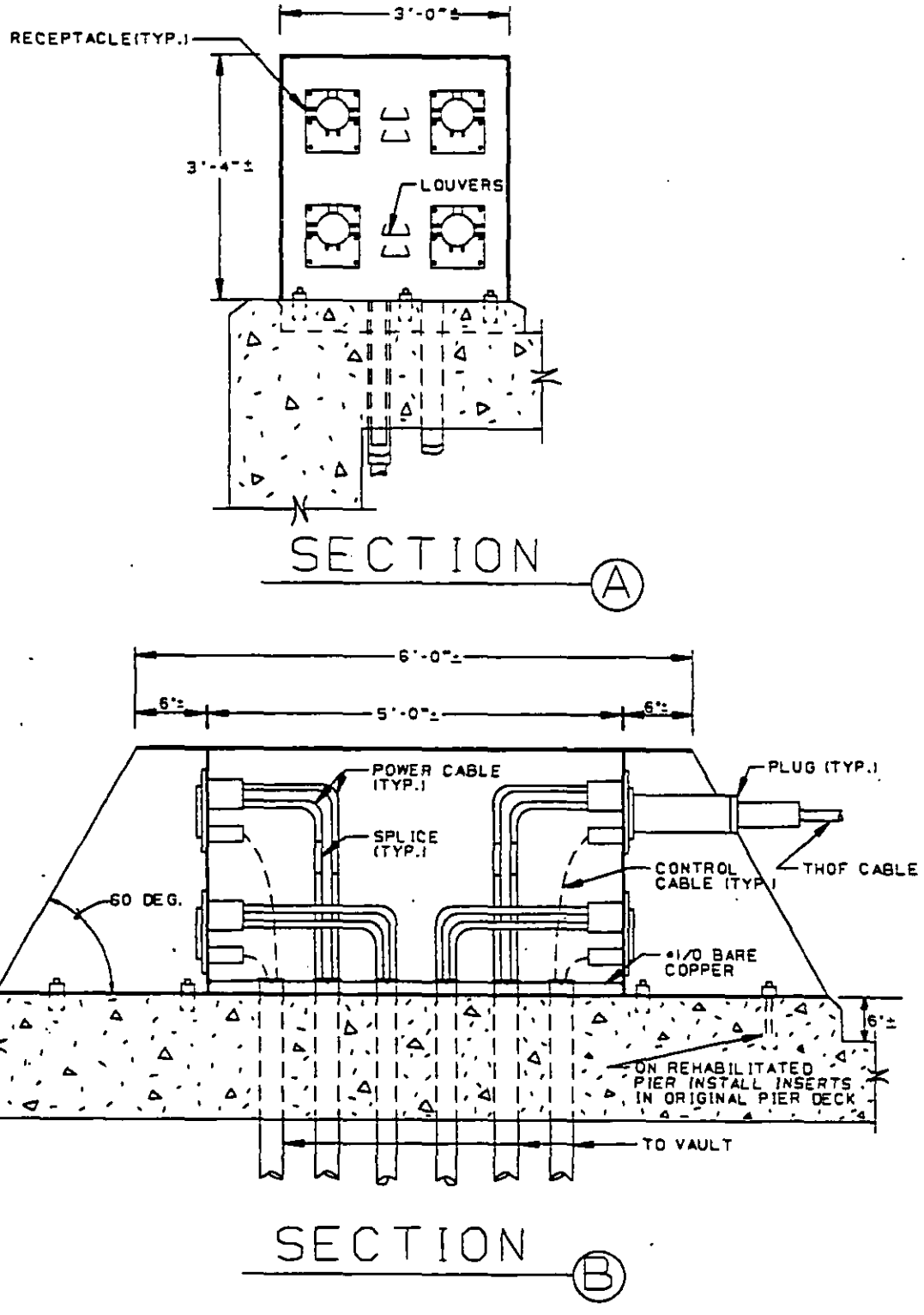
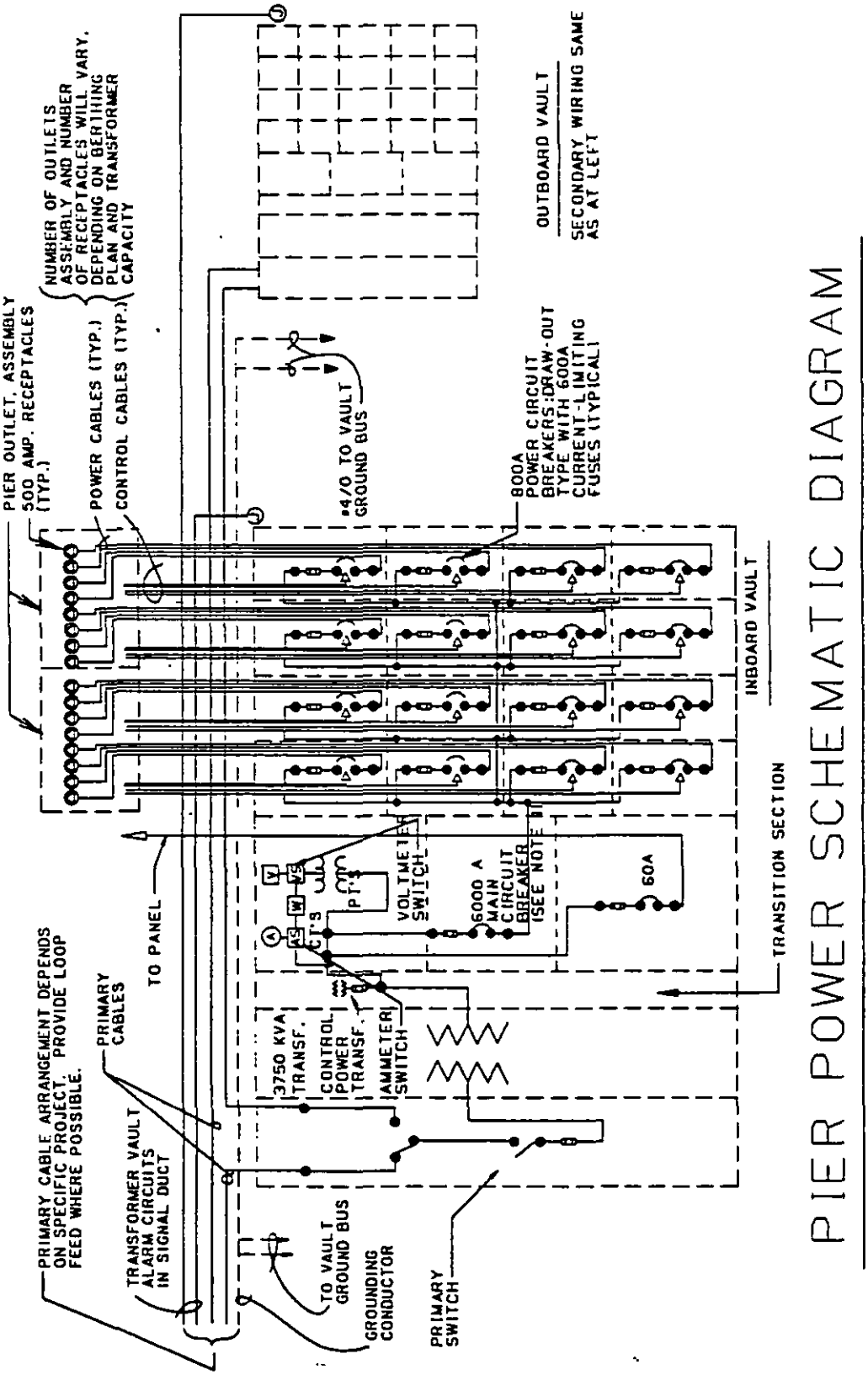


Figure 26B
Pier Electrical Distribution-Miscellaneous Electrical Details



NOTE

1. AT THE OPTION OF THE DESIGNER, TWO 3000A. MAIN CIRCUIT BREAKERS MAYBE USED IN LIEU OF ONE 6000A. CIRCUIT BREAKER

Figure 26C
Pier Electrical Distribution-Miscellaneous Electrical Details

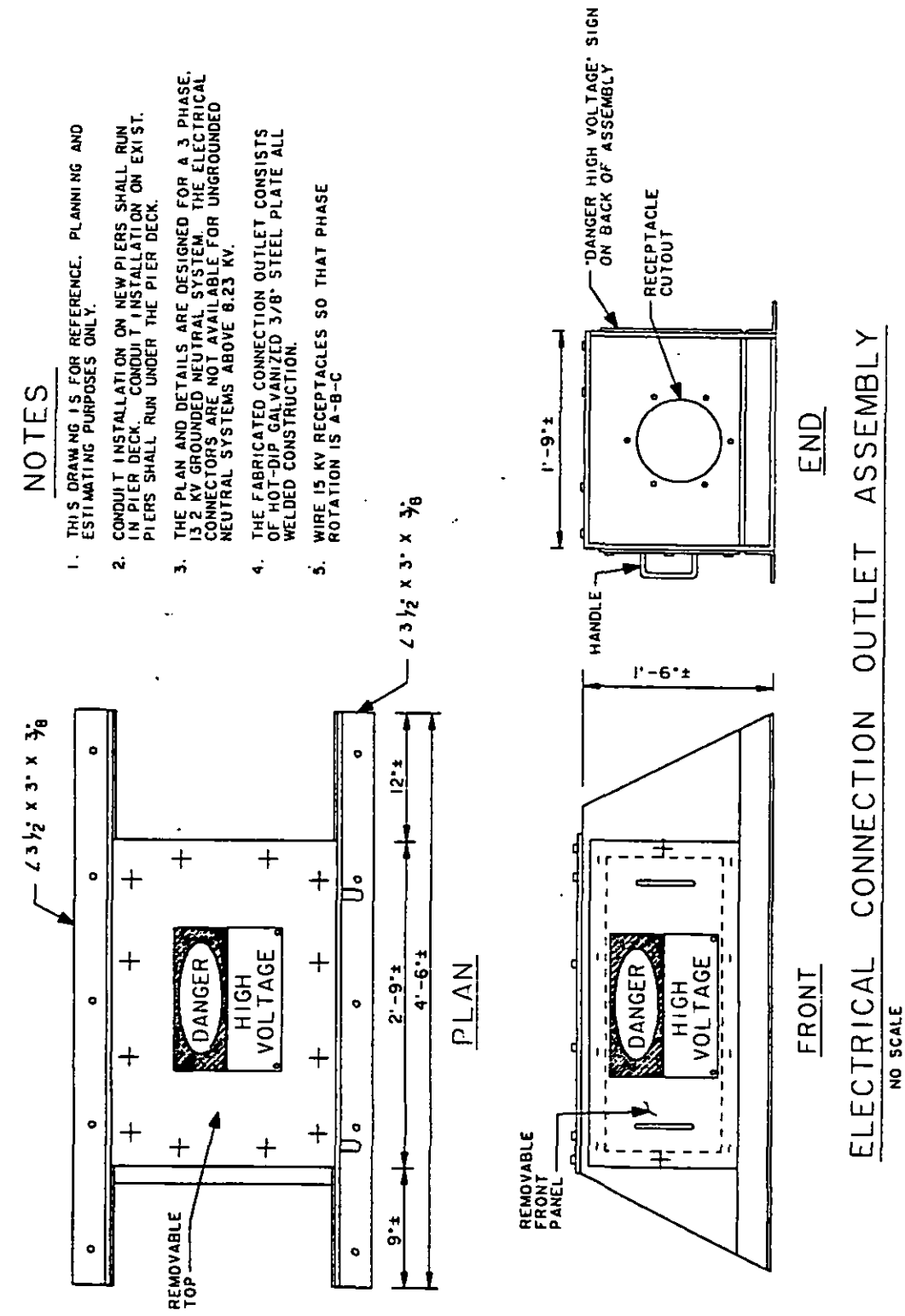
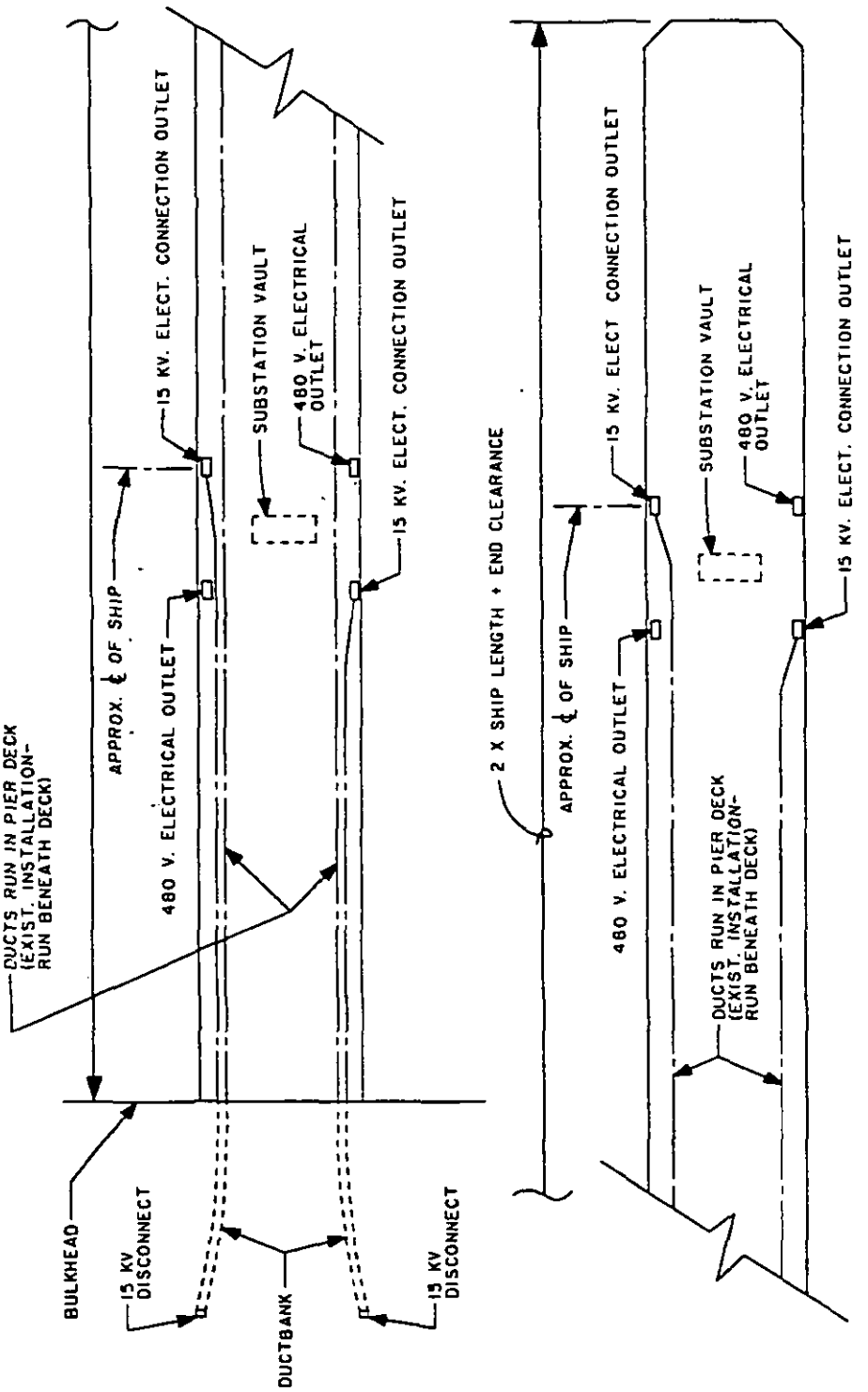


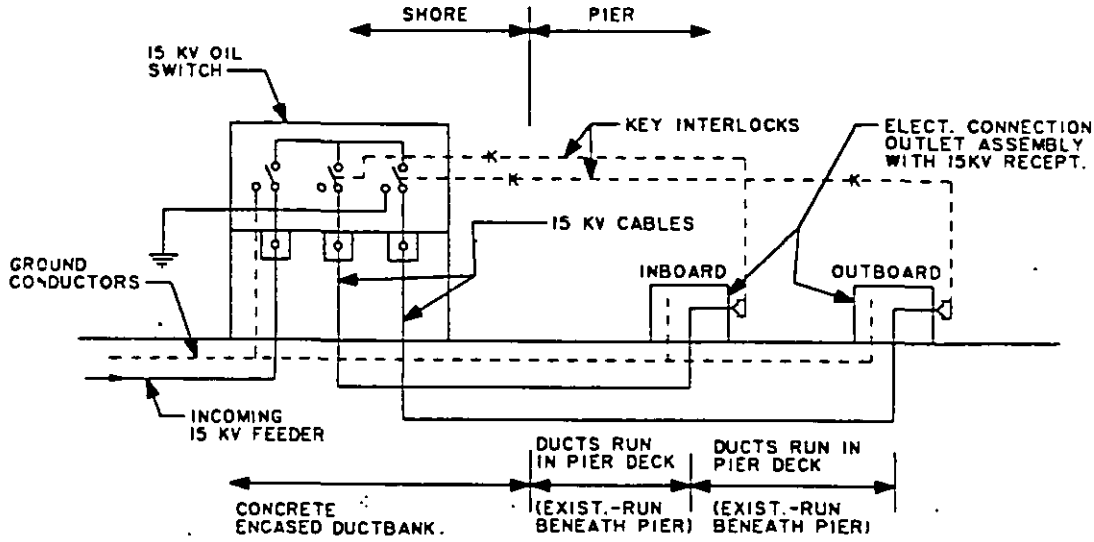
Figure 27A
High Voltage Installation on New/Existing Pier For Shore-to-Ship Electrical Service



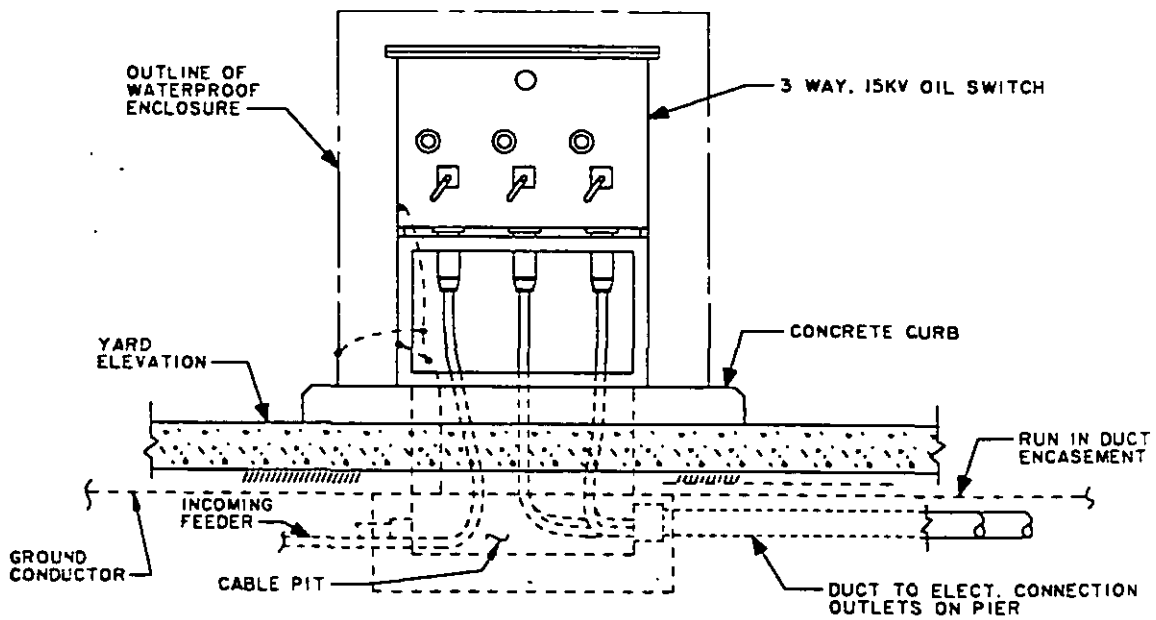
PLAN - TYPICAL PIER

NO SCALE

Figure 27B
High Voltage Installation on New/Existing Pier For Shore-to-Ship Electrical Service



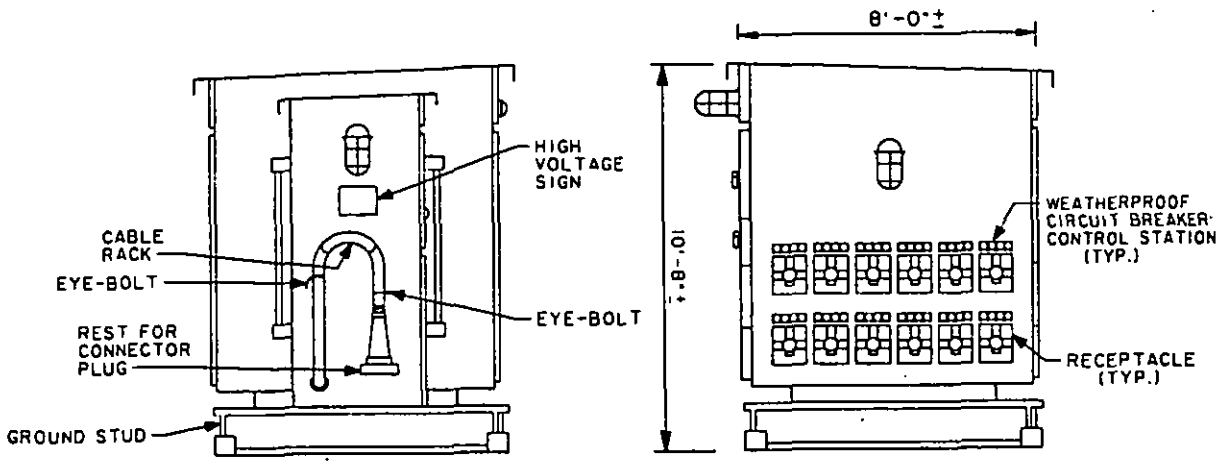
ONE LINE DIAGRAM



SHORE INSTALLATION OF 15KV. DISCONNECTS

NO SCALE

Figure 27C
High Voltage Installation on New/Existing Pier For Shore-to-Ship Electrical Service



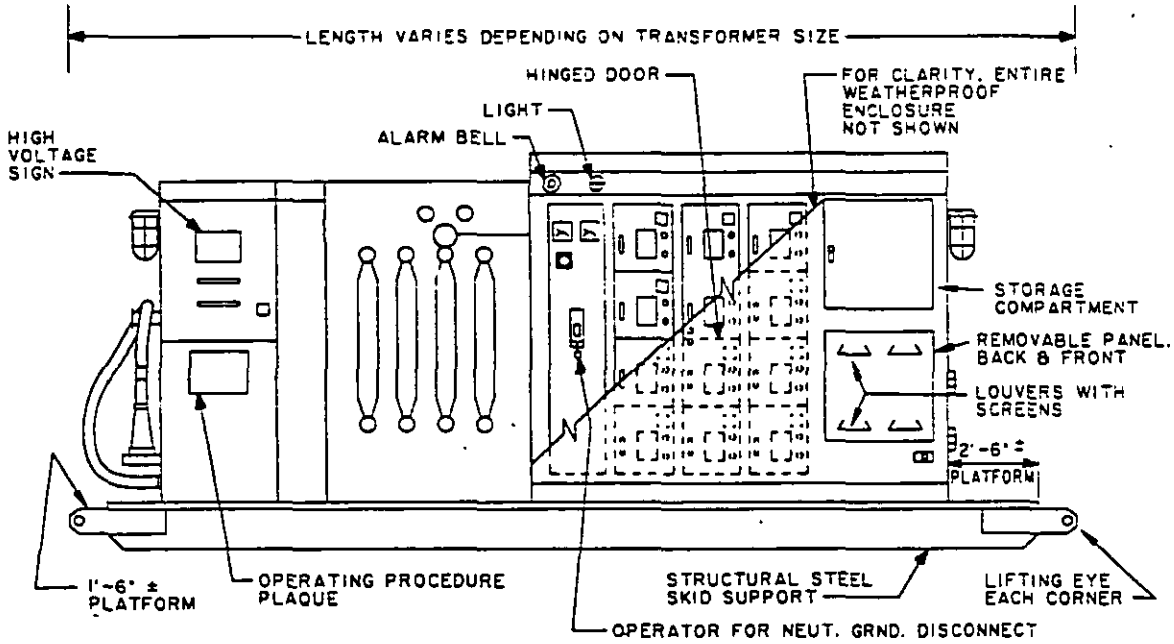
PORTABLE SUBSTATION ASSEMBLY

NO SCALE

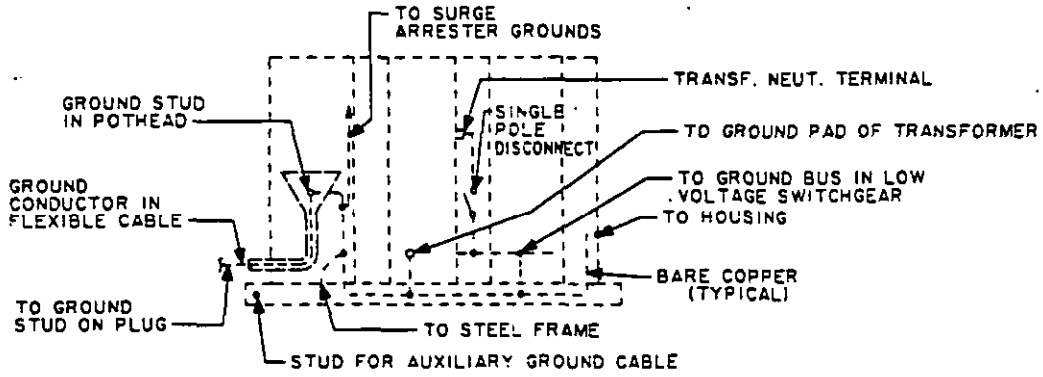
NOTES

1. DRAWING IS FOR REFERENCE, PLANNING AND ESTIMATING PURPOSES ONLY.
2. DRAWING IS DESIGNED FOR A 3 PHASE, 13.2K.V., GROUNDED NEUTRAL SYSTEM. THE CONNECTORS ARE NOT AVAILABLE FOR UNGROUNDED NEUTRAL SYSTEMS ABOVE 8.32K.V.
3. THE NUMBER OF CIRCUIT BREAKERS AND RECEPTACLES AND THE LENGTH AND WEIGHT OF THE SUBSTATION WILL VARY DEPENDING ON THE TRANSFORMER KVA SIZE. THE TRANSFORMER SIZE WILL NORMALLY VARY FROM 1000 KVA TO 2500 KVA, THE NUMBER OF CIRCUIT BREAKERS AND RECEPTACLES FROM 6 TO 12, THE SUBSTATION LENGTH FROM 22' ± TO 26' ±, AND THE SUBSTATION WEIGHT FROM APPROX. 22,500 LBS TO 33,500 LBS.

Figure 28A
Portable Substation for Temporary Shore-to-Ship Electrical Service



SIDE



SCHEMATIC

GROUNDING PLAN

NO SCALE

Figure 28B
Portable Substation for Temporary Shore-to-Ship Electrical Service

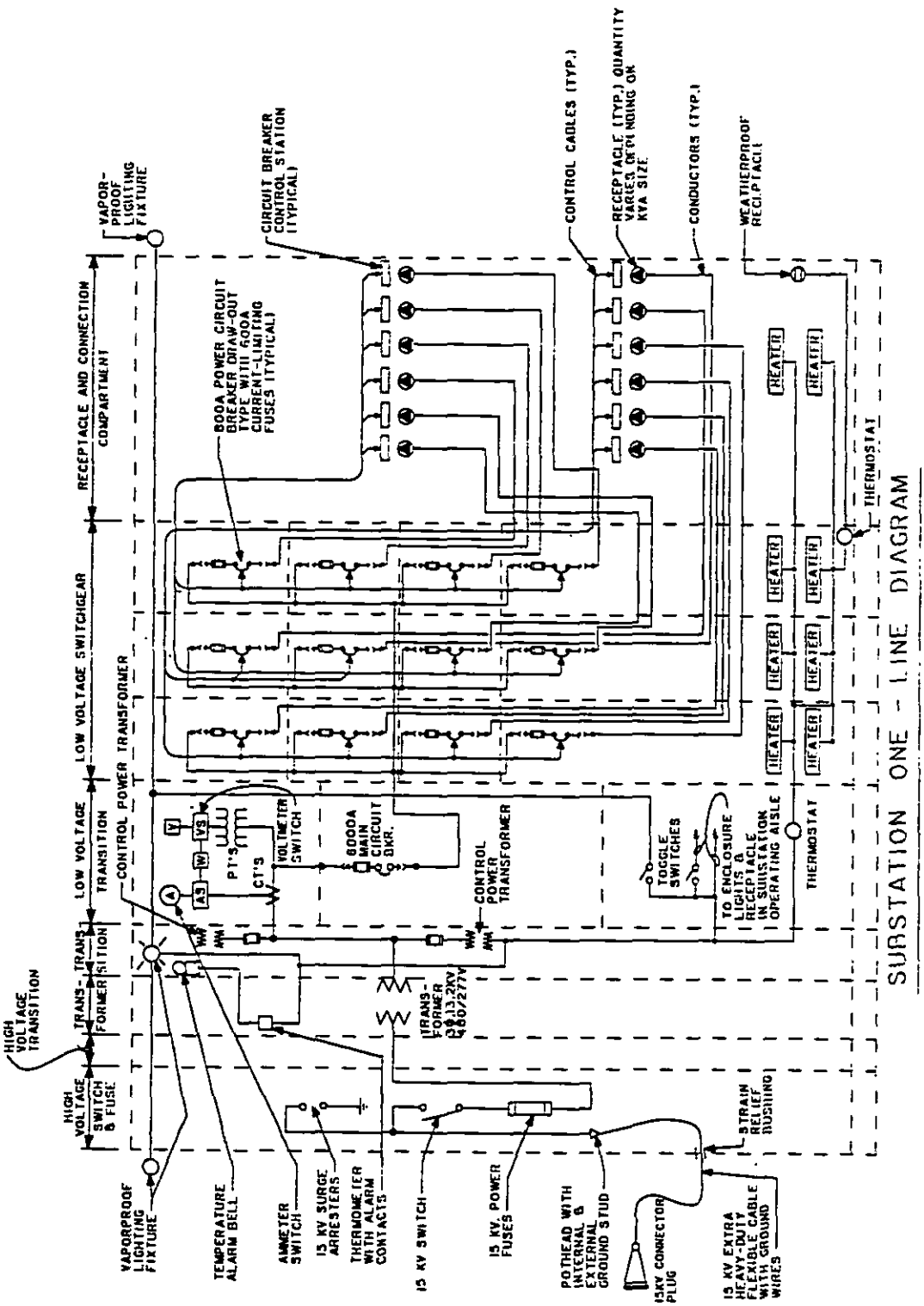


Figure 28C
Portable Substation for Temporary Shore-to-Ship
Electrical Service

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S-66-524	Cross-Linked-Thermosetting Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy (2nd Edition, 1982).

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NFPA 20-87	Centrifugal Fire Pumps.
NFPA 70-87	National Electrical Code.
NFPA 78-86	Lightning Protection Code.
NFPA 307-85	Construction and Fire Protection of Marine Terminals, Piers and Wharves.

Naval Facilities Engineering Command, (NAVFAC), 200 Stovall Street, Alexandria, VA 22332.

NAVFACINST 11300.34 and CH-1 (18 July 83), Color Code for Shore-to-Ship Utility Connections.

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DM-3.03	Heating, Ventilating, Air Conditioning, and Dehumidifying Systems.
DM-3.5	Compressed Air and Vacuum Systems.
DM-4.1	Preliminary Design Considerations.
DM-4.05	Four-Hundred Hertz Generation and Distribution Systems.
DM-4.6	Lightning (and Cathodic) Protection Systems.
DM-4.07	Wire Communication and Signal Systems.
DM-5.02	Hydrology.
DM-5.03	Drainage Systems.
DM-5.7	Water Supply Systems.
DM-5.8	Pollution Control Systems.
DM-5.9	Metering, Instrumentation and Control, and Chemical Feeding.
DM-5.10	Solid Waste Disposal.
DM-22	Petroleum Fuel Facilities.
DM-25.5	Ferry Terminals and Small Craft Berthing Facilities.
DM-25.6	General Criteria for Waterfront Construction.

DM-26.1	Harbors.
DM-29.1	Graving Drydocks.
DM-38.01	Weight-handling Equipment.
MIL-HDBK-1003/8	Exterior Distribution of Utility Steam, HTW, CHW, Fuel Gas, and Compressed Air.
MIL-HDBK-1004/3	Switchgear and Relaying.
MIL-HDBK-1004/4	Electrical Utilization Systems.
MIL-HDBK-1008	Fire Protection for Facilities Engineering, Design, and Construction.
MIL-HDBK-1025/1	Piers and Wharves.
MIL-HDBK-1025/3	Cargo Handling Facilities.
P-89	Engineering Weather Data.
P-272	Definitive Designs for Naval Shore Facilities.
P-442	Economic Analysis Handbook.

Department of Defense activities may obtain copies of Design Manuals, Military Handbooks, and P-Publications from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120. NAVFAC P-442 may also be obtained from Naval Facilities Engineering Command, Code 203, 200 Stovall Street, Alexandria, VA 22332-2300. Department of Defense activities must use the Military Standard Requisitioning and Issue Procedure (MILSTRIP), using the stock control number obtained from NAVSUP Publication 2002.

Other Government agencies and commercial organizations may procure Design Manuals, Military Handbook and P-Publications from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

NAVFACENGCOM Guide Specifications, available from the Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120. Telephone: Autovon (DOD only): 422-3321; Commercial: (215) 697-3321.

NFGS-16304	Pier Electrical Distribution for Naval Stations.
NFGS-16740	Telecommunications Systems.

NAVFACENGCOM Definitive Drawings

1403995	Non-Polluting Fuel Pier--Pier Piping Plans and Section.

1403996	Non-Polluting Fuel Pier--Fueling Pier Partial Plan, Sections and Details.
1403997	Non-Polluting Fuel Pier--Loading Arm Plan, Detail and Miscellaneous Sections and Details.
1403998	Non-Polluting Fuel Pier--Pier Drainage Plan and Details.
1403999	Non-Polluting Fuel Pier--Pier Electrical Plans, Details, Legend and Notes.
1404371	Oil Spill Containment for Berthing Facilities.

Commercial firms desiring copies of these standard drawings should submit application for copies to the Project Manager's office at the sponsoring Engineering Field Division.

U.S. Military Specifications and Standards: available to all parties, free of charge, from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120. Telephone: Autovon (DOD only): 422-3321; Commercial: (215) 697-3321.

MIL-C-915/6F	Cable and Cord Electrical, for Shipboard Use.
MIL-F-19488	Fitting, Hose Water, and Steam (other than Flexible, Metalic)
MIL-C-24368/1A	Connector Assemblies, Plug Assembly, Power Transfer, Shore-to-Ship and Ship-to-Ship.
MIL-C-27487E	Coupling Halves, Quick-Disconnect, Cam-Locking Type.
MIL-C-28840/12	Connectors, Electrical, Circular, Screw Threads, High Density, High Shock, Shipboard, Crimp Contacts, Receptacle, Mounting Box, Classes D and DS.
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59300-AW-EDG-010/EPISM, Electric Plant Installation Standard Methods, (EPISM).

Requests for the above EPISM should be made to: Commanding Officer, Naval Ship Weapons Systems Engineering Station, Code 5700, Port Hueneme, CA 93043. This publication is in book form; standard drawings contained therein are available in microfilm aperture cards or microfiche.

GLOSSARY

Active Berthing. A pier or wharf with berths used for homeport or light repair purposes, usually with a full or partial crew aboard, and always with ships in active status.

Berth. A specific, marked-off length, along a pier or wharf, containing ships services appropriate for the ship classes which may be assigned to it.

Berthing Pier. A general term for a pier with berths and ships services.

Berthing Plan. A plan devised by each facility showing all berthing areas with ships assignments. May be permanent or temporary, depending upon the type of facility.

Bollard. A single-post fitting to which mooring lines from vessels are attached.

Capstan. A motorized, vertical-drum device used to tension lines for positioning ships, usually in drydock.

Cleat. A mooring fitting having two diverging horizontal arms to which mooring lines from vessels are attached.

Cold Iron. Used to describe the condition of a ship when all shipboard boilers, engines, and generators are inoperative during repairs and can furnish none of the required ships services.

Cooling/Flushing Water. Water (usually nonpotable or salt) supplied to ships for condenser-cooling, fixture-flushing and other miscellaneous uses.

Dedicated Berth. A berth having required services for, and dedicated to use by, a specific ship for an extended period of time.

Graving Drydock. A permanent concrete drydocking structure requiring the use of caisson and dewatering pumps.

Hotel Services. Dockside utilities provided for a ship at berth (also called ships services, utility services, and cold iron services).

Inactive Berthing. Permanent or semipermanent berthing areas for ships out of service, with crew normally not aboard.

Nested Ships. Two or more ships berthed side by side, with utility services supplied from berthside to the outer ships via ships header systems or hoses and cables strung across decks.

Oily Waste. Water (usually salt) from ships bilge which has been contaminated with petroleum products (fuel or lube oils) and which cannot discharge either to surface waters or to sanitary sewer.

Overhaul Facility. Generally used interchangeably with Repair Facility.

Pier. A dock, built from the shore out into the harbor, which is used for berthing and mooring vessels.

POL. Petroleum, oil and lubricants. An acronym used to describe petroleum products, and the facilities used in their storage and handling. As used herein, applies to marine fuels, jet fuels and lubricants.

Quaywall. A heavy gravity or platform structure fronting on navigable water, behind which earth fill is placed to a level grade along its length.

Repair Facility. Locations where ship repair activities take place, such as at a shipyard or ship-repair facility. Facilities may utilize repair piers, drydocks, or both. (Also, Overhaul Facility.)

Telecommunications. Systems of communicating speech or impulses via wire or cable over distances, such as telephone, data transmission, coded transmission, cable TV and signal or alarm circuits.

Wharf. A dock, oriented approximately parallel to shore, with more than one access connection with the shore; a wharf is used for berthing or mooring vessels. May also be as above except with continuous connection to shore.

CUSTODIAN:
NAVY-YD

PREPARING ACTIVITY
NAVY-YD

PROJECT NO.
FACR-0228

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-HDBK-1025/2	DOCKSIDE UTILITIES FOR SHIP SERVICE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR ☐ EFD/PWO ☐ AE ☐ USER ☐ CONTRACTOR ☐ MANUFACTURER ☐ OICC/ROICC ☐ OTHER *(Specify)*: _____
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5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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