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12 November 2020

UNIFIED FACILITIES CRITERIA (UFC)

DOCKSIDE UTILITIES FOR SHIP SERVICE

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UNIFIED FACILITIES CRITERIA (UFC)

DOCKSIDE UTILITIES FOR SHIP SERVICE

Indicate the preparing activity beside the Service responsible for preparing the document.

U.S. ARMY CORPS OF ENGINEERS

NAVAL FACILITIES ENGINEERING COMMAND (Preparing Activity)

AIR FORCE CIVIL ENGINEER CENTER

Record of Changes (changes are indicated by **\1** ... /**1/**)

Change No.	Date	Location

This UFC supersedes UFC 4-150-02, dated May 2003, with Change 5, 1 Sept 2012.

FOREWORD

The Unified Facilities Criteria (UFC) system is prescribed by MIL-STD 3007 and provides planning, design, construction, sustainment, restoration, and modernization criteria, and applies to the Military Departments, the Defense Agencies, and the DoD Field Activities in accordance with USD (AT&L) Memorandum dated 29 May 2002. UFC will be used for all DoD projects and work for other customers where appropriate. All construction outside of the United States is also governed by Status of Forces Agreements (SOFA), Host Nation Funded Construction Agreements (HNFA), and in some instances, Bilateral Infrastructure Agreements (BIA). Therefore, the acquisition team must ensure compliance with the most stringent of the UFC, the SOFA, the HNFA, and the BIA, as applicable.

UFC are living documents and will be periodically reviewed, updated, and made available to users as part of the Services' responsibility for providing technical criteria for military construction. Headquarters, U.S. Army Corps of Engineers (HQUSACE), Naval Facilities Engineering Command (NAVFAC), and Air Force Civil Engineer Center (AFCEC) are responsible for administration of the UFC system. Defense agencies should contact the preparing service for document interpretation and improvements. Technical content of UFC is the responsibility of the cognizant DoD working group. Recommended changes with supporting rationale may be sent to the respective DoD working group by submitting a Criteria Change Request (CCR) via the Internet site listed below.

UFC are effective upon issuance and are distributed only in electronic media from the following source:

- Whole Building Design Guide web site http://www.wbdg.org/ffc/dod.

Refer to UFC 1-200-01, *DoD Building Code*, for implementation of new issuances on projects.

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UNIFIED FACILITIES CRITERIA (UFC)
REVISION SUMMARY SHEET

Document: UFC 4-150-02, *Dockside Utilities for Ship Service*

Superseding: UFC 4-150-02, dated 13 May 2003, With Change 5, 1 September 2012

Description: This document provides a reference for the utility requirements of DoD and Coast Guard vessels and best practices for the design and maintenance of those utilities.

Reasons for Document:

- This document provides facility managers and engineers with a consolidated reference of utility requirements for active duty vessels.

- Revision includes updates to ship utility requirements.

Impact:

- There are no cost impacts.

Unification Issues:

- There are no unification issues.

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CHAPTER 1 INTRODUCTION

1-1 BACKGROUND.

This UFC 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 UFC 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 DoD shore facilities, cannot be made without prior approval of the cognizant Service.

1-2 PURPOSE AND SCOPE.

This UFC provides design criteria and guidance in the design of utility systems for piers, wharves, and dry docks. Criteria are given for Type I Piers (Fueling, Ammunition, and Supply); Type II Piers (General Purpose Piers); and Type III Piers (Repair Piers). Utilities covered include steam, compressed air, salt or non-potable water, potable water, oily waste/waste oil (OWWO) or petroleum, oil and lubricants (POL), Collection-Holding-Transfer (CHT), electric power, and telecommunications.

1-3 APPLICABILITY.

This document applies to all service elements and contractors designing dockside utilities for ship service construction, repair, and maintenance projects.

1-4 GENERAL BUILDING REQUIREMENTS.

Comply with UFC 1-200-01, *DoD Building Code*. UFC 1-200-01 provides applicability of model building codes and government unique criteria for typical design disciplines and building systems, as well as for accessibility, antiterrorism, security, high performance and sustainability requirements, and safety. Use this UFC in addition to UFC 1-200-01 and the UFCs and government criteria referenced therein.

1-5 CYBERSECURITY.

All control systems (including systems separate from an energy management control system) must be planned, designed, acquired, executed, and maintained in accordance with UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems* and as required by individual Service Implementation Policy.

1-6 GLOSSARY.

APPENDIX E contains acronyms, abbreviations, and definition of terms.

1-7 REFERENCES.

APPENDIX F contains a list of references used in this document. The publication date of the code or standard is not included in this document. Unless otherwise specified, the most recent edition of the referenced publication applies.

CHAPTER 2 GENERAL UTILITY REQUIREMENTS

2-1 SHIPS UTILITY REQUIREMENTS.

Ships utility demands and other pertinent data for individual ships utilities are available from APPENDIX A. Planners and designers must access this information in order to obtain design data regarding dockside utilities for all ship services. Data provided in APPENDIX A is the best available at the time of publication of this document. Data is incomplete, may not be completely accurate, and must be verified by planning and design team. In general, ship utility demands for active berthing are based on the ship's complement without deployed forces such as air wings or marine troops. Diversity factors are provided for use in determining demand in multiple berthing. If the designer is basing the project design on a specific ship that is not included in APPENDIX A, use data from a similar ship, or obtain the expected demand from the cognizant Service. For graving dry docks, refer to UFC 4-213-10*, Graving Dry Docks*. 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 these diversity factors, metered data from existing facilities and ships should be used for planning and design whenever such data are available.

2-2 UTILITY-CONNECTION LAYOUT.

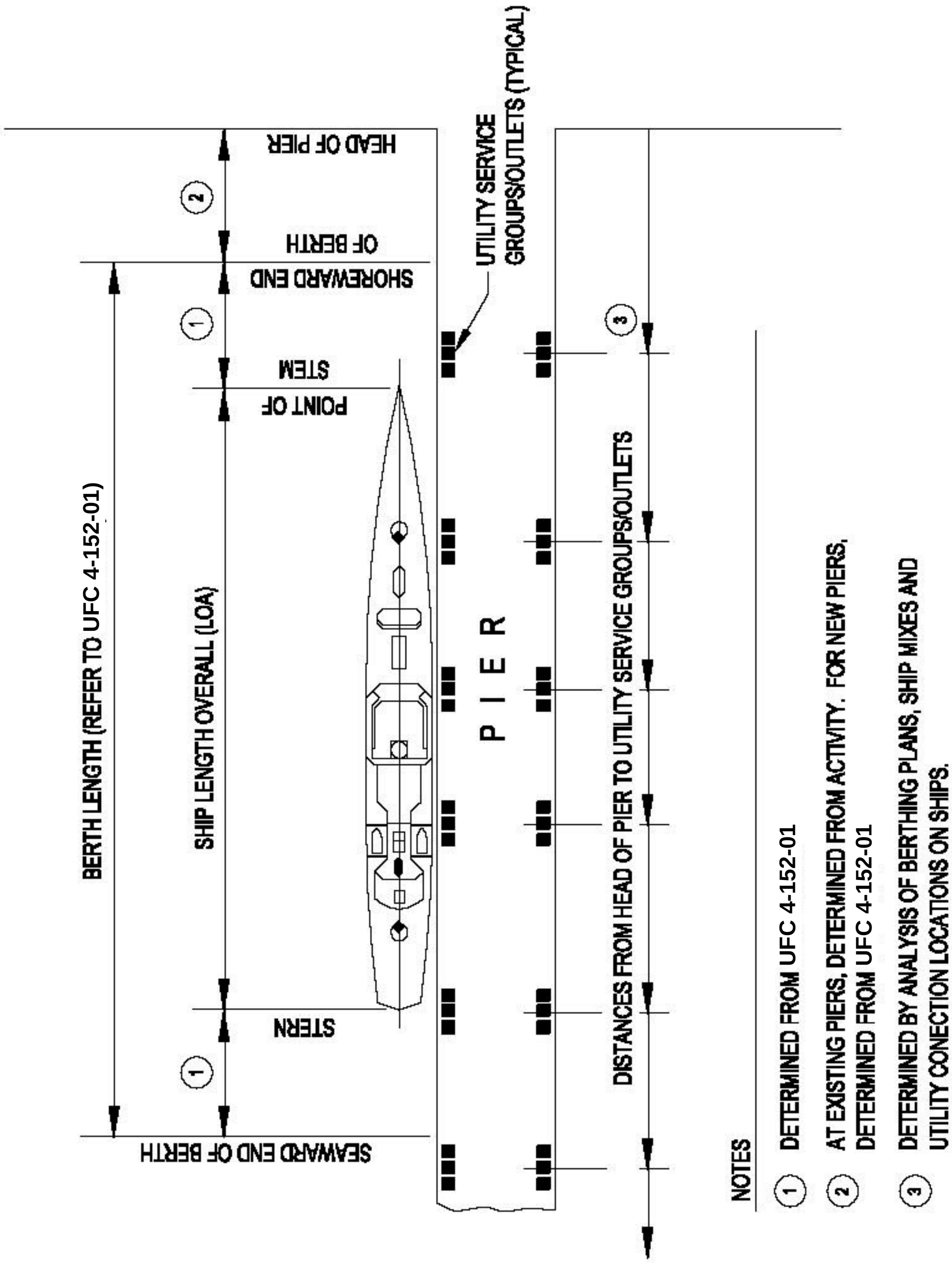
Figure 2-1 shows the dimensional relationships normally encountered in placement of shore utility connections. APPENDIX A provides size/shape data for typical ship hulls and dimensioned reference points that define the ship's utility connection locations. Ideally, the locations of shore utility connections 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. The designer must optimize the location of all utility outlet assemblies based upon the projected berthing mix.

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:

- Freshwater, saltwater (if required), steam, and compressed air;
- Electrical power and communications;
- Sewer and oily waste; and
- POL, when required.

Figure 2-1 Typical Ship-Berth-Pier-Utilities Relationships



Regardless of the variations in utility groups that may be necessary to accommodate deck fittings and pier construction, sewer and oily waste connections must always be located 10 ft (3.1 m) or more from domestic water connections. Electrical outlet assemblies must be separated from other utility outlets by at least 10 ft (3.1 m) whenever possible. Additionally, where fueling is required, separation between such connections and electrical equipment is mandatory. See UFC 3-460-01, *Design: Petroleum Fuel Facilities* and consult with the cognizant Fire Protection Engineer to ascertain the minimum separation distances. Separation distances will vary depending upon the type of fuel or fuels.

2-2.2 Hose and Cable Lengths.

Experience has shown 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 should be given preference in order to minimize required hose lengths. Preference should be given, in order of importance, to electrical power, fire protection water (if required), steam, sewage, oily waste collection, and potable water. Excessive hose and cable lengths have significant disadvantages as defined below.

2-2.2.1 Electrical Power.

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

2-2.2.2 Fire Protection Water.

Losses in the fire protection system hoses could be critical in the event of fire, particularly when ship's pumps are under repair. Coordinate with NAVSEA or cognizant Service to determine how much hose is required to ensure proper flow and pressure.

2-2.2.3 Steam.

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

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 ship's connection is broken.

2-2.3 Group Locations and Spacing.

The locating dimensions for shipboard utility connections of various ship classes are presented in APPENDIX A. These dimensions, when used with the ships configuration drawings and the parameters given in this UFC, provide guidance in spacing determinations for the shore connections. The locations of required deck equipment (capstans, bollards, cleats, ladders, and railings) and deck operations (brows, cranes, dumpsters, etc.) must always be coordinated with locations of utility connections. Pier berthing plans (graphic plots) must be made for the most likely ship mixes, and should consider local berthing practices as defined by the Activity. The berthing plans provide the basis for the design and operations of the pier's utility systems and must be included in the construction contract drawings when included under the design contract. Suitable shore connection spacing for the range of possible ships must be provided. 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 m) from corresponding ships connections when other ship types occupy their prescribed berths.

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, with deck equipment, and with deck operations. Check weights of hose lengths and cables with crane's lifting capability. Outlet groups may be placed above deck or in deck pits. They may also be placed in open galleries below the main deck where the pier has sufficient elevation to avoid submergence of the utility connections. An example is a double-deck pier system such as Pier 6 at Naval Station Norfolk as shown in Figure 2-2.

The type of connector at outlets must be compatible with hoses in use, or intended for use, at a given site. It is noted that the profile presented by utility groups above deck is dependent upon the height of the pier and the type of ship at berth. This is an important consideration in the design of dockside utilities for ship service. Required hose or cable connection types and sizes are given in individual utility descriptions in the following chapters. Provide for future expansion of utilities by the appropriate sizing of valve pits, pipe trenches, electrical vaults, and electrical duct banks. Likewise, a specific project may require the immediate design for future utility services. Lastly, always design for proper and safe access and maintenance of all utility systems.

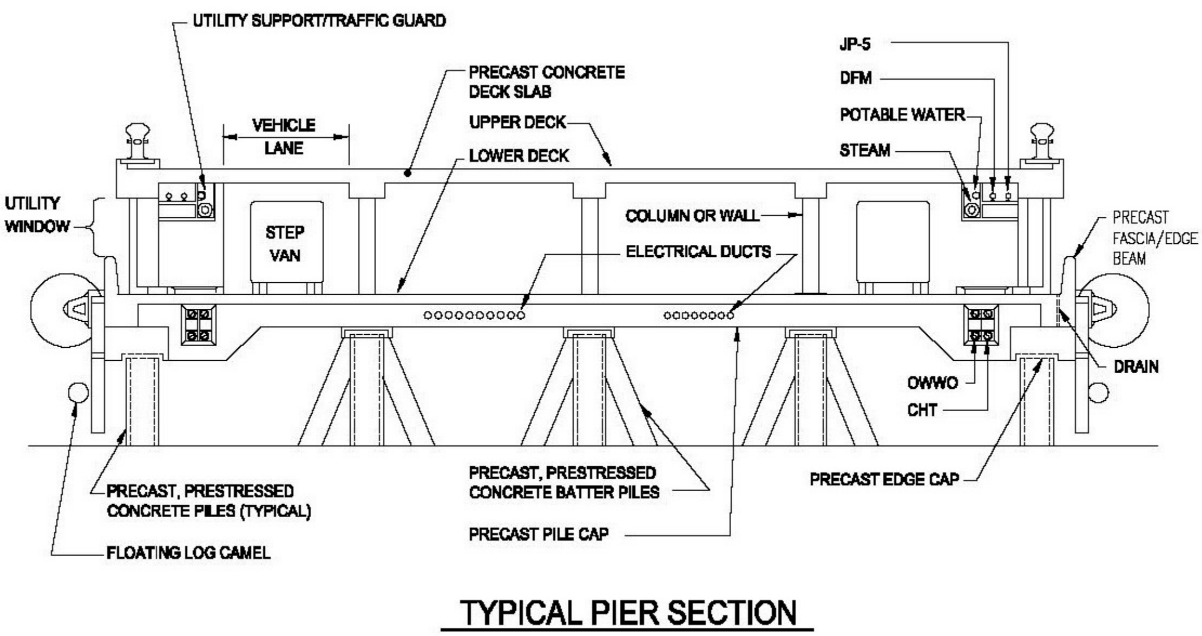
2-3.1.1 Layout.

In order to avoid hose-connection difficulties and interferences with pier traffic, outlet connections should have centerlines parallel with berths or at not more than a 30-degree angle. The distance of connections from the pier face should be as short as is consistent with structural restraints and with convenience. However, on some aircraft carrier berths such as those using narrow breasting camels, locate the utilities to clear ship elevators.

2-3.1.2 Mooring Lines.

Mooring lines for ships such as destroyers are relatively low and present a greater hazard to utility connections. Low-profile utility outlet arrangements are usually preferred. Whenever possible, mooring line patterns for the specific ships to be berthed should be observed at a similar berth before utility group design is commenced. The berthing plans are to include mooring line patterns and must uncover conflicts with utility outlets. Some typical above-deck utility connection details are shown in figures in subsequent chapters. Other arrangements are also possible and may be acceptable. A specific arrangement may be required by the cognizant Service to match existing outlet designs.

Figure 2-2 Double-Deck Pier Example



2-3.2 Design for Nesting of Ships.

Where berthing plans include the nesting of ships, provide a sufficient quantity of adequately sized services and connections. Design according to the number of ships that may simultaneously use each such berth. Unless instructed otherwise, provide internal shipboard port-to-starboard utility headers for all utilities except for potable water. For potable water, use dual connections with individual backflow devices 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 the utility corridor of a double deck pier, placed in the trenches or tunnels of a single deck pier, 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 and at least 2 ft (0.6 m) above the mean high water level.

There are cases where conduit and piping mains and laterals (except for POL systems) may be hung exposed from the bottom of pier decks in protected locations. This is not a preferred situation and is discouraged. In such cases, it is necessary to coordinate with the structural design to secure inspection ladders and deck inserts, and to facilitate installation of access platforms for maintenance purposes. New mains placed on existing piers may be placed on top of the pier deck if other construction techniques are impractical and if approved by the cognizant Service.

Corrosion protection requirements are defined in the following paragraphs. Requirements for POL systems are defined in Section 3-5 entitled “POL Systems” and refer to UFC 3-460-01, *Design: Petroleum Fuel Facilities*.

2-4.1.1 Utility Trenches.

The use of utility trenches is highly preferred. Trench covers may be concrete, steel plate, grating, or a combination of these, and as dictated by structural loading, maintenance, and cost considerations. Coordinate design with structural requirements. Note that permanently fixed covers (concrete and steel) create confined workspaces. This is a significant operational problem (regarding inspection and maintenance) that is generally undesirable and should be avoided if possible. Identifiable markings should be located on the trench entrances.

2-4.1.2 Above-deck Lines.

At most types of berthing facilities, clear deck space is at a premium, rendering above-deck mounting of utility services inappropriate, operationally difficult, and generally unacceptable. A notable exception to this general rule applies to dedicated fueling facilities. In these cases, above-deck mounting of fuel lines is often the most functional solution because it allows for the proper and safe access and maintenance of the fuel lines. See UFC 3-460-01 for additional information and criteria.

2-4.1.3 Under-deck Lines.

Except as noted above, utility service pipelines should not be located on the operating deck. At single deck piers, utilities should be contained in trench structures, shielding the enclosed pipes from exposure to saltwater and spray. Utility trench covers are of three basic types: solid, solid with personnel access, and open gratings. Solid covers are generally used over most of the trench length. Solid covers with 30 inch (760 mm) diameter manhole covers should be located over those portions of utility trenches containing valves, expansion mechanisms, or branch connections which require easy access for inspection, maintenance, and repair. Gratings may be substituted for solid trench covers with personnel access wherever ready visibility of the respective utilities is required or where ventilation of trench is advisable (steam line drip assemblies). Unless specifically curbed against vehicular traffic, covers must be designed for the same uniform loads and wheel loads as the nominal pier deck with the exception that crane outrigger reactions need not be addressed. It is therefore necessary that utility trenches not be located within the pier cross-section where mobile cranes are likely to position their outriggers.

2-4.1.4 Hangers and Support Assemblies.

Hangers, bolts and specially fabricated supports and braces steel must be hot-dip galvanized after fabrication or stainless steel. Many Activities prefer the state-of-the-art fiberglass hangers containing ultraviolet inhibitors and polyester resin (NEC type RTRC in article 355). Consult with the Activity and the cognizant Service. Where salt spray exposure is severe, incorporate appropriate additional anticorrosion measures for hangers. This includes the application of epoxy coatings, the use of stainless steel or monel bolting. Lastly, hangers must be designed based upon the maximum potential weight of the utility system. For example, for steam piping, allow the piping to be full of water.

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. Conventional protection schemes consist of curbs, pits, concrete structures, or railings. Where pier width is sufficient, consider the use of continuous curbs located at sufficient distance from the edge of the pier. The design should exclude pier traffic from the areas containing utility connections, hoses, and cables. Where utility pits are used, sufficient pit length must be incorporated to ensure that hoses may be connected and led from pits to ships without kinking or chafing.

2-4.2.1 Outlets, Connections, and Access Hatches.

Access hatches in decks should have flush-mounted covers and must be designed to eliminate any danger of tripping. Where outlets and connections must appropriately protrude above the deck level, shield them in a manner that will ensure personnel safety and prevent mooring lines from being snagged on the piping and equipment. Certain utility connections such as sanitary sewer, fuels, oily waste, and waste oil must be contained within a curb or vault. Provide a drainage system to an appropriate collection system. Additionally, fuel hoses must be provided with a curbed lay-down area for the collection of drippings. Also, refer to UFC 4-152-01, *Piers and Wharves*, for other typical details.

2-4.3 Seismic Protection.

2-4.3.1 Performance of Utility Lines.

Provide special and detailed considerations for seismic protection. This applies to pierside utility systems and the associated landside utility systems. Specific details are required for storage structures and the interface transition between the landside systems and the pierside systems. Except POL lines, design all piping and utility lines as "essential" construction. See UFC 4-152-01. (The design requirements for POL lines are defined in the following paragraph.) In general, essential construction is expected to:

- Resist the maximum probable earthquake likely to occur one or more times during the life of the structure (50% probability of exceedance in 50 years) with minor damage, without loss of function, and the structural system to remain essentially linear.
- Resist the maximum theoretical earthquake with a low probability of being exceeded during the life of the structure (10% probability of exceedance in 100 years) without catastrophic failure and a repairable level of damage.

2-4.3.2 Performance of POL and Hazardous Utilities.

Design lifeline service associated with construction categorized as containing "hazardous materials" with the same levels of service. In general, hazardous material containment construction is expected to:

- Conform with criteria for essential construction.
- Resist pollution and release of hazardous materials for an extreme event (10% probability of exceedance in 250 years).

2-4.3.3 Liquefaction.

Design of structures should include provisions to evaluate and resist liquefaction of the foundation and account for expected potential settlements and lateral spread deformation. Refer to UFC 3-220-10N, *Soil Mechanics*. Special care must be given to buried pipelines in areas subject to liquefaction to preclude breaks resulting in release of hazardous materials. It is imperative to avoid areas of landslide and lateral spread. The presence of any potentially liquefiable materials in foundation or backfill areas should be fully analyzed and expected settlements computed.

2-4.3.4 Pipelines.

Design pipelines to resist the expected earthquake induced deformations and stresses. In general, permissible tensile strains are on the order of 1 to 2% for modern steel pipe. To accommodate differential motion between pipelines and storage tanks, it is recommended that a length of pipeline greater than 15 pipe diameters extend radially from the tank before allowing bends and anchorage and that subsequent segments be of length not less than 15 diameters. Flexible couplings should be used on long pipelines. In general, pipes should not be fastened to differentially moving components; rather, a pipe should move with the support structure without additional stress. Unbraced systems are subject to unpredictable sway whose amplitude is based on the system fundamental frequency, damping, and amplitude of excitation. For piping internal to a structure, bracing should be used for system components. Additional seismic protection considerations are as follows.

- In potentially active seismic areas, no section of pipe should be held fixed while an adjoining section is free to move, without provisions being made to relieve strains resulting from differential movement unless the pipe is shown to have sufficient stress capacity.
- Flexible connections should be used between valves and lines for valve installation on pipes 3 in (76 mm) or larger in diameter.
- Flexibility should be provided by use of flexible joints or couplings on a buried pipe passing through different soils with widely different degrees of consolidation immediately adjacent to both sides of the surface separating the different soils.
- Flexibility should be provided by use of flexible joints or couplings at all points that can be considered to act as anchors, at all points of abrupt change in direction, and at all tees.
- Piping containing hazardous materials should contain numerous shutoff valves and check valves to minimize release of materials if there is a break. Seismic shutoff valves should be used where necessary to control a system or process. A secondary containment system should be incorporated where feasible.
- When piping is connected to equipment or tanks, use of braided flexible hoses is preferable to bellow-type flexible connectors. Bellow-type flexible connectors have been noted to fail from metal fatigue. Welded joints are preferable to threaded or flanged joints. If flanged joints cannot be avoided, the use of self-energizing or spiral wound gaskets can allow a bolt to relax while continuing to provide a seal. (Reference: *Association of Bay Area Governments*, 1990.)

2-4.3.5 Supports.

Piers may contain pipelines for freshwater, saltwater, steam, compressed air, waste oil, sewer, and fuels systems; and may also contain electrical power and communication lines. Ship demands dictate the utility system configurations. In general, design of these lines follows the general provisions discussed herein. It is essential that the lines be attached to the supporting structure with sufficient rigidity that the lines are restrained against independent movement. Attachments to a pier may be analyzed as simple two-degree-of-freedom systems. Resonance amplification can occur when the natural period of the supported pipe is close to the fundamental period of the pier structure.

Flexible connections/sections should be used to bridge across expansion joints or other locations where needed.

2-4.4 Cathodic Protection Systems (CPS).

Provide special and detailed considerations for cathodic protection systems (CPS). This applies to pierside utility systems and the associated landside utility systems. Specific details are required for storage structures and the interface transition between the landside systems and the pierside systems. The services of a qualified corrosion engineer must be provided unless defined otherwise by the cognizant Service. For additional information and requirements see UFC 3-570-01, *Cathodic Protection* and guide specifications: UFGS 26 42 13.00 20, *Cathodic Protection by Galvanic Anodes*; UFGS 26 42 17.00 10, *Cathodic Protection System (Impressed Current)*; and UFGS 26 42 15.00 10, *Cathodic Protection System (Steel Water Tanks)*. Specific requirements are as follows:

- Provide CPS and protective coatings for the following buried or submerged metallic utility systems regardless of soil or water corrosivity:
  - Petroleum, Oil and Lubricant (POL) pipelines.
  - Oxygen pipelines.
  - Underground POL and gasoline storage tanks.
  - Underground hazardous substance storage tanks.
  - All water storage tanks interiors.
  - Other systems defined by the cognizant Service's Corrosion Control Coordinator.
- Provide a CPS and bonded protective coatings on other buried or submerged new steel, ductile iron, or cast-iron utility pipelines not mentioned above when the resistivity is below 30,000 Ohms at the installation depth at any point along the installation. Do not use unbonded protective coatings such as loose polyethylene wraps. Provide joint bonding on all ductile iron installations.
- When an existing CPS is being modified or extended, the new CPS must be compatible with the existing CPS system. When plastic pipe is selected to replace or extend existing metallic pipe, thermal weld an insulated No. 8 AWG copper wire to the existing pipe and run the full length of the plastic pipe for continuity and locator tracing purposes.
- The CPS must provide protective potentials according to the requirements of the National Association of Corrosion Engineer (NACE) Standard RP0169 (latest revision), *Control of External Corrosion on Underground or Submerged Metallic Piping Systems* and NACE Standard RP0285 (latest revision), *Standard Recommended Practice – Corrosion Control of Underground Storage Tank Systems by Cathodic Protection*.

- Unless instructed otherwise by the cognizant Service, provide an engineering life-cycle cost (LCC) analysis for the CPS. Coordinate with the cognizant Service's Corrosion Control Coordinator to establish design efforts and field test efforts. Obtain preliminary approval from the Corrosion Control Coordinator prior to accomplishing the LCC analysis. Define the proposed elements of the LCC analysis and a general description of the proposed CPS design.
- Unless instructed otherwise, Architect-Engineer (A/E) CPS surveys and designs must be accomplished under the supervision of one of the following individuals:
    - Registered Professional Corrosion Engineer.
    - Registered Professional Engineer who is also a NACE certified corrosion protection specialist or cathodic protection specialist or has a minimum of five years of experience in the applicable CPS.
    - NACE certified corrosion protection specialist or cathodic protection specialist with a minimum of five years of experience in the applicable CPS.
- Unless instructed otherwise by the cognizant Service, perform field tests (resistivity, pH, current requirements, etc.) at the proposed installation to evaluate, as a minimum, soil and/or water corrosivity. The tests are used to design the CPS and assumptions must be supported by the field test data. Design the CPS for overall system maintainability.
- Project Managers must contact the cognizant Service's Corrosion Control Coordinator regarding the CPS design and, upon request, will forward the design documents to the Coordinator for review. Design submittals must include, as a minimum, the following:
    - Preliminary Engineering Plan (PEP): soil and/or water corrosivity data, current requirements test data (if applicable), and all design calculations.
    - Final drawings: the CPS one-line diagrams, locations of all cathodic protection equipment (anodes, rectifiers, test stations, etc.), interference test points, installation details, insulating fittings, and bond connections.
    - Final specifications: acceptance testing procedures including static (native) potentials, initial and final system potentials, and interference tests.

2-5 METERING.

In general, all utilities should be metered unless instructed otherwise by the cognizant Service. Metering actual utility usage provides accurate data for billing and historical purposes. Install meters in accessible vaults or in above-grade enclosures ashore or on piers. Specify state-of-the-art electronic meters unless instructed otherwise. Consult with the Activity to determine if there is an existing metering program and integrate new meters into such existing programs. Where metering is not initially provided, then include provisions for the easy future addition of meters. This may include providing concrete meter vaults or access covers in pipe trenches. Consult with the cognizant Service for specific instructions.

2-6 PAINT AND FINISH REQUIREMENTS.

Evaluate the requirements for paint and finish systems. Final requirements will be based upon geographical location, the respective utility system, Station standards and preferences, and the guidance defined in UFC 3-190-06, *Protective Coatings and Paints*. The designer must confer with the Activity and the cognizant Service. Final designs must be based upon the paint manufacturers written instructions, especially with respect to surface preparation and paint/finish application.

2-7 UTILITY CONNECTIONS COLOR CODES.

To ensure safety, shore-to-ship utility service connections use the standardized federal color codes as an identification system on wharf and pierside connections and hose assemblies. The primary identifiers should be plain language tags, nameplates, or labels. Special emphasis should be applied to potable water, nonpotable water and the sewer system. The color code system is defined in CHAPTER 5.

2-8 DEPERMING PIERS AND FACILITIES.

Deperming piers and magnetic silencing facilities require special design consideration because of the magnetic operations. As a result, non-magnetic piping and conduit materials are required. This includes materials such as PVC, fiberglass and aluminum.

CHAPTER 3 ACTIVE AND REPAIR BERTHING

3-1 STEAM SYSTEMS.

Provide steam service at 150 psi (1,034 kPa) (saturated) along all piers and other waterfront structures used for active berthing and ship repair, and at the perimeter of graving dry docks. Provide 125 psi (862 kPa) only if approved by the Activity and the cognizant Service. Laundries on many vessels use the highest pressure at 100 psi (689 kPa). Provisions for returning condensate from ships will not be required except in special cases, and as directed by the cognizant Service. Newer ships do not require steam services. Contact the cognizant Service to waive the mandatory steam requirement.

3-1.1 Demands.

Steam requirements for selected ship classes are given in APPENDIX A. Generally, steam demand is considerably less in port than at sea. Loads must be selected for the appropriate local climate as indicated in Table 3-1. For ships not included in APPENDIX A, use data from a similar ship, or obtain the expected demand from the cognizant Service. For graving dry docks, refer to UFC 4-213-10.

3-1.2 Sizes of Piping.

Size the piping for single berths to meet the demands indicated. Include nested ships that are indicated on berthing plans. For multiple berthing, use diversity factors determined from Table 3-1. Branch steam lines from main to outlet locations should be sized for the full demands and should be no smaller than the outlet riser pipe. For ships that require two connection locations, assume 75% of the demand for sizing each branch. Refer to Section 3-1.5 entitled “Outlet Design” for minimum outlet and riser sizes. Determination of pipe sizes should be in accordance with UFC 3-430-09, *Exterior Mechanical Utility Distribution*.

3-1.3 Piping System Design Criteria.

For steam piping and condensate return piping design requirements, refer to UFC 3-430-09 subject to the following exceptions and additions. It is noted that steam piping on piers and wharves is often specified to be ASTM A53 steel.

3-1.3.1 Pitch.

For steam piping on or under a pier, the pitch of piping required by UFC 3-430-09 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.

Table 3-1 Diversity Factors (DF) for Steam Usage [a]

Ship Type	Outdoor Temperature Range (°F)	Diversity Factor (DF) [b] 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	0.96	0.95
	20 - 40	1	0.87	0.94	0.91
	40 - 60	1	0.80	0.90	0.86
	> 60	1	0.78	0.76	0.74
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

Note:

[a] Use of Diversity Factors (DF):
If the total number of ships in aggregate is greater than nine:
- Group the ships by types.
- Determine the maximum demand of each ship from the utility data. (See Appendix)
- Sum the individual demands within each type of ship.
- 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 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 from the utility data.
- Sum the individual demands of each ship.
- Obtain the aggregate DF from Table 3-1.
- Multiply the total demand by the "aggregate" DF in Table 3-1.

[b] Linear interpolation is permissible for actual ship quantities.

3-1.3.2 Protection.

For steam and condensate piping under a pier or wharf, or in a dry dock 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. Provide pipe hangers and associated support assemblies in accordance with Section 2-4.1.4 entitled "Hangers and Support Assemblies". Hangers should be designed based upon the maximum potential weight of the steam system; that is, the piping is full of water. Identify piping and outlets and color-code in accordance with CHAPTER 5.

3-1.4 Location and Arrangement of Piping Mains and Branches.

As a general rule, for all active berthing piers, provide a single main with cross-branch piping to outlets. For repair piers, provide a main on each side of the pier and a cross connection at the outboard end of the pier (loop configuration). 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. Coordinate piping with structural conditions and arrange mains for the best combination of versatility, security, and overall cost. For graving dry docks, refer to UFC 4-213-10. The location of ships steam connections may be found in APPENDIX A. For discussion of methods to be used to establish shore utility-station spacing on piers and wharves, refer to CHAPTER 2.

3-1.5 Outlet Design.

See Figure 3-1. Naval facilities use 2 inch (51 mm) hoses (from 1 to 10 per ship) almost exclusively for ship-to-shore steam connections. At locations where 1-1/2 inch (38 mm) and 1 inch (25 mm) hoses are used, design for 2 inch (51 mm) hoses and utilize reducing fittings at hose connections. Total numbers of shipboard steam connections are found in APPENDIX A. The number of hoses actually connected to shore per ship varies with the severity of the climate. For facilities in the coldest climates (see APPENDIX B, Figure B-1, Regions I and II), assume that all ships connections will be connected to shore. For warmer climates, obtain the demand for the appropriate design temperature; divide by 2,500 for 2 inch (51 mm) hose and by 1,250 for 1-1/2 inch (38 mm) hose. For existing facilities, the maximum number of hose connections actually made for the ships to be berthed may be obtained from the cognizant Service. Refer to CHAPTER 2 for a general description of the arrangement and spacing of utility outlets.

3-1.5.1 Steam Outlet Assemblies.

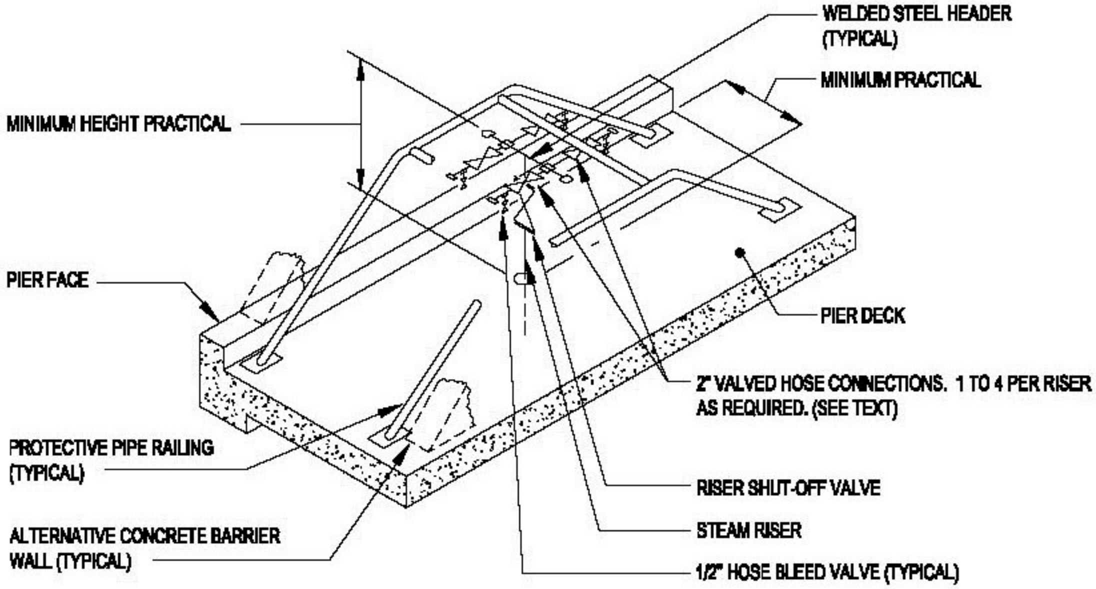
The design of steam outlet assemblies is to include the following conditions.

- Provide a shut-off valve for each riser assembly. The valve must be easily accessible.

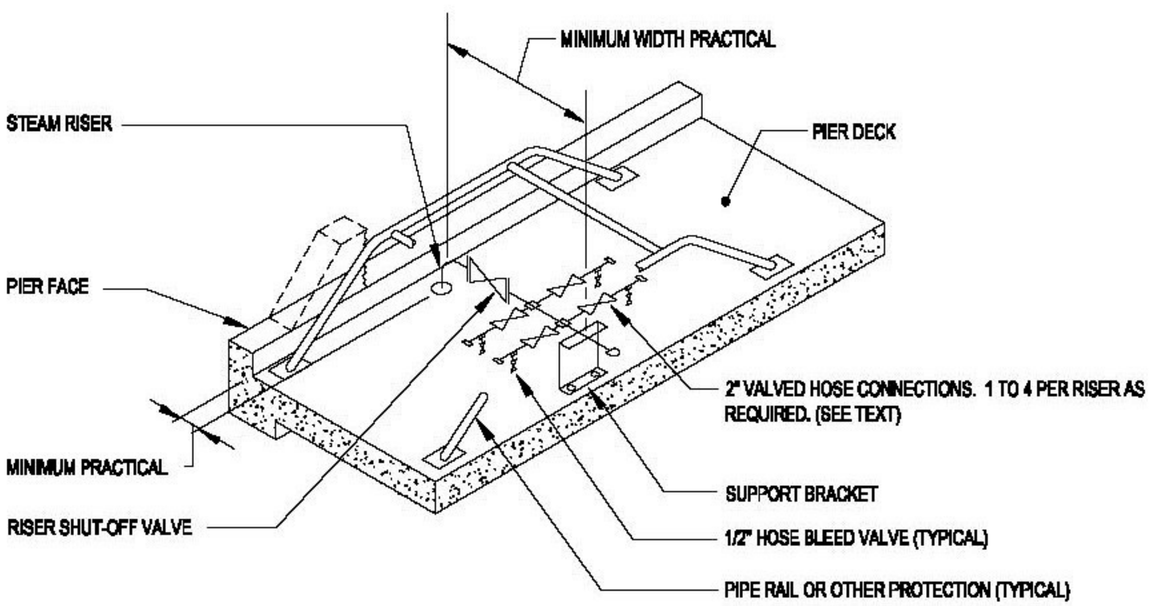
- Provide a welded steel header after the riser shut-off valve. The header must serve the hose connections.
- The designer is responsible for determining the number of hose connections required at each outlet assembly.
- Hose connections must be 2 inch (51 mm) unless instructed otherwise.
- Each hose connection must include a shut-off valve, a 1/2 inch (13 mm) hose bleeder valve, and a hose connector. Threaded connections are to be avoided in order to prevent loosening of joints due to hose tension.
- Minimum pipe size of each rise assembly must be as follows:

Number of Hoses Connected to Riser	Riser Size inch (mm)
1	2-1/2 (64)
2	3 (76)
3 or 4	4 (102)

Figure 3-1 Typical Steam Outlet Assembly



NORMAL CONFIGURATION



LOW PROFILE CONFIGURATION

3-1.6 Specific Ship Requirements.

3-1.6.1 CVN Ship Requirements (All Classes).

These ships are normally berthed starboard side-to. Steam is provided to CVNs certified pure at 150 psi (1,034 kPa). Galley and hot water requirements should be increased by 50% where it is reasonable to assume that the ship's air wing 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. The proper selection is dependent upon local weather conditions. Evaluate each location on an individual basis. The cognizant Service will approve.

3-1.6.3 Troop Carrier Special Requirements (LHA, LHD, LPD, and LSD).

Provide steam service at 150 psi (1,034 kPa) certified pure. For LHA, LHD, LPD, and LSD increase galley and hot water requirements by 100% if it is probable that troops will be aboard while at active berths.

3-1.6.4 Nested Ships.

Maximum nested ships demand at shore connections is 17,950 lb/h (8142 kg/h) based on the requirements of nested CG 47s.

3-1.7 Shore-to-Ship Steam and Feedwater Requirements.

3-1.7.1 Quality.

Naval Sea Systems Command (NAVSEA) shore-to-ship steam and feedwater quality standards are provided in NAVSEA S9086-AB-ROM-010, *Naval Ship's Technical Manual (NSTM)*, Chapter 220, *Boiler Water/Feedwater - Test and Treatment*, paragraphs entitled: “Shore Steam and Condensed Shore Steam Used as Feedwater”; “Navy and Commercial Facility Shore Steam Certification Requirements”; “Shore Processed Feedwater (Demineralizers, Reverse Osmosis)”; “Shore Source Feedwater Requirements”; and “Makeup Feedwater Demineralizer System”. These standards are given in Table 3-2 and Table 3-3.

Table 3-2 Shore Steam and Condensed Shore Steam Quality Requirements [a]

Constituent or Property	Requirement
pH	8.0 to 9.5
Conductivity	15 µ S/cm maximum [b]
Dissolved Silica	0.2 ppm maximum
Hardness	0.10 ppm max or 5 ppm as $CaCO_3$ total hardness
Total Suspended Solids	0.10 ppm maximum

Note:

[a] Steam must be generated from feedwater which is either treated with a chemical oxygen scavenger or mechanically deaerated 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.

[b] µS/cm = micro-Siemens/centimeter = micro-mho/centimeter. The lowest reading on the shipboard conductivity meter is 40.

Table 3-3 Bulk Shore Feedwater Quality Requirements [a]

Constituent or Property	Requirement
pH	5.4 to 8.2 (process effluent)
Conductivity	2.5 µS/cm maximum (at point of delivery) [b]
Silica	0.2 ppm maximum

Note:

[a] Produced by method other than condensed steam.
[b] µS/cm = micro-Siemens/centimeter = micro-mho/centimeter.

3-1.7.2 Use of Steam Separators.

Provide steam separators as required to meet the NAVSEA criteria 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 dry docks. (See S9086-AB-ROM-010 NSTM Chapter 220). 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 dry docks if adequate condensate removal is provided at the boiler plant and in shore mains. Steam separators should be used only when necessary and as based upon a case-by-case evaluation of local conditions. If a steam separator should be necessary, then Figure 3-2 provides a typical installation detail that should be used in conjunction with the guidelines of NFESC Test Report No. TN 1586, *Steam Separator Test and Evaluation*.

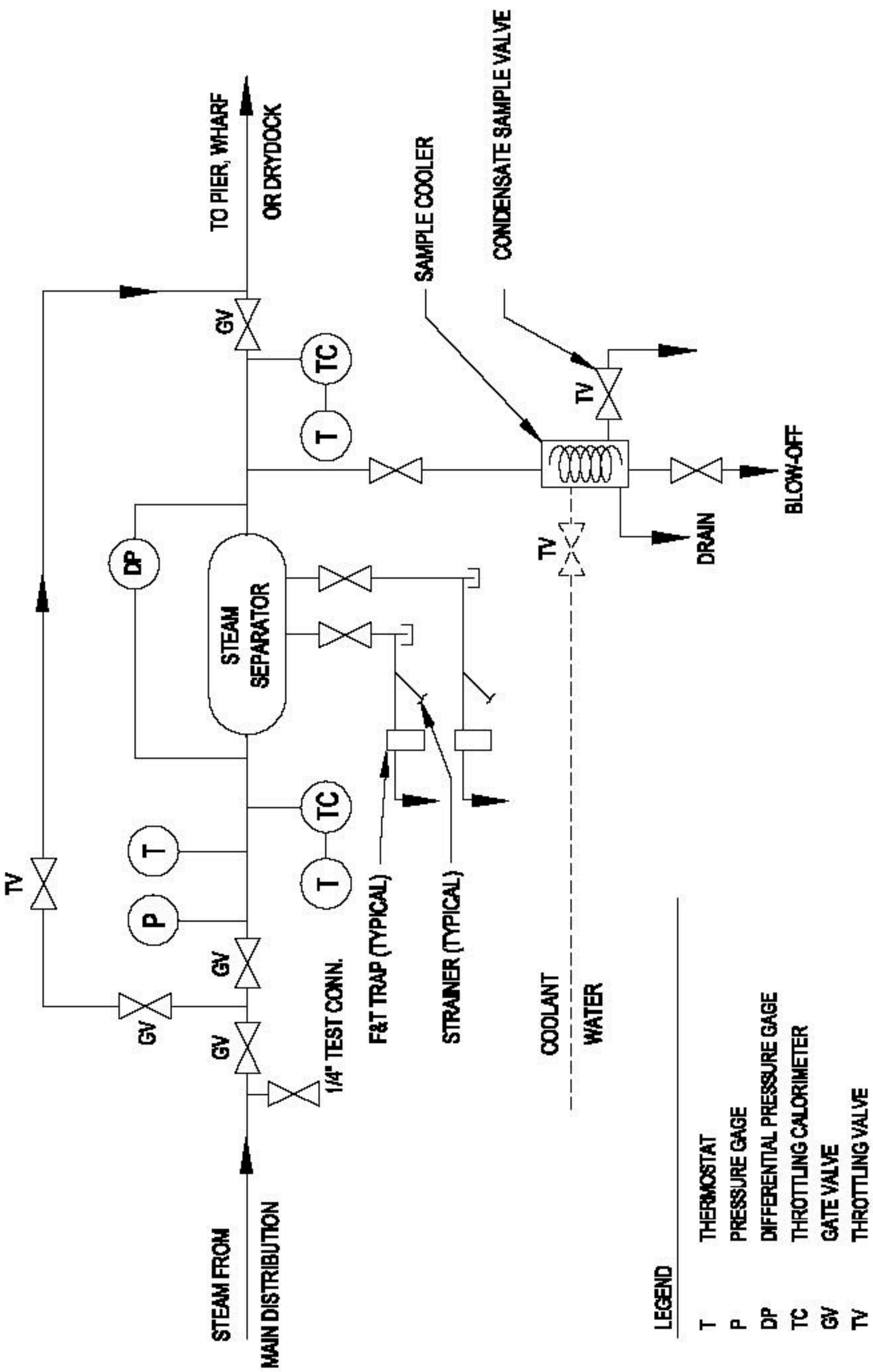
3-1.7.3 Sampling.

Due to the harsh marine environment, conductivity and pH meters should not be installed permanently on piers or wharves. Condensate sampling stations should be provided at piers and at steam plants. Figure 3-2 also 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 dry docks. Install meters in accessible vaults or in above grade enclosures ashore or on piers. At individual piers or dry docks, use pressure and/or temperature compensated electronic microprocessor type flow meters for good mass flow accuracy and range. Consult with the cognizant Service to determine if a steam meter installation and maintenance program exists at the Activity. Consult the Activity steam meter program coordinator to integrate the flow meter type selection into any existing meter program. Where metering is not initially required, make provision for ease of future installation by means of concrete vaults or pier access covers.

Figure 3-2 Schematic Steam Separator and Sampling Station



3-2 COMPRESSED AIR SYSTEMS.

In general, a compressed air system (low pressure) is required at all active and repair berths. However, final needs and requirements vary on a pier-by-pier basis. Consult with the Activity for actual requirements, existing construction standards, and preferences. Requirements for graving dry docks are given in UFC 4-213-10. See Section 3-2.7 for high pressure compressed air requirements.

3-2.1 Demands.

Compressed air requirements for selected ship classes are defined in APPENDIX A. For ships not included in APPENDIX A, use data from a similar ship, or obtain the expected demand from the cognizant Service.

3-2.2 Piping System Design Criteria.

Design compressed air piping to conform to commercially available standard practices. Also, the designer may consult UFC 3-430-09, *Exterior Mechanical Utility Distribution*. In addition, provide corrosion protection of steel pipes. 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. Provide pipe hangers and associated support assemblies in accordance with the Section 2-4.1.4 entitled “Hangers and Support Assemblies”. Identify piping and outlets and color-code in accordance with CHAPTER 5.

3-2.3 Quality.

Compressed air should normally be "commercial" quality. Where breathing quality air and/or an oil-free system is necessary use an oil-free source and/or purification systems. Compressed breathing air compressors must meet the requirements of 29 CFR 1910.134 and the requirements for Grade D breathing air described in ANSI/CGA G-7.1, *Commodity Specification for Air*. Locate compressors used to supply breathing air so as to prevent entry of contaminated air into the air supply system and breathing air couplings are incompatible with outlets for nonrespirable worksite air or other gas systems.

3-2.4 Size of Piping.

For single berths, size the mains in accordance with air quantity per ship data given in APPENDIX A. 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. The designer should consult with the cognizant Service. For multiple berthing at a single pier or wharf, including nested ships, use the following diversity factors:

Number of Ships	Diversity Factor
1	1.0
2	0.8
3	0.7
4	0.6
5 or more	0.5

3-2.4.1 Branches.

Branch-pipe sizes should be in accordance with the ships' usage data defined in APPENDIX A. Where a variable mixture of ships is probable at a given pier, all branch lines should be 3 inch (76 mm) minimum. However, where carriers may be berthed, branch lines should be 4 inch (102 mm) minimum.

3-2.4.2 Sizing Method.

Determination of pipe size should be in accordance with available friction loss tables. Size mains for a pressure drop of not greater than 5 psi (34.5 kPa) total friction loss from pier or wharf entrance to farthest outlet, and as based upon the designed flow rates. 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% of the quantity defined in APPENDIX A, and then adjusted for its full-diversified demand.

3-2.5 Location and Arrangement of Piping Mains and Branches.

As a general rule, for all active berthing piers, provide a single compressed air main with cross branch piping to outlets. For repair and submarine piers, provide a piping main on both sides of the pier and provide a cross connection at the outboard end of the pier (loop configuration), unless not feasible or practical on a submarine pier. 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. Coordinate piping with structural conditions and arrange mains for the best combination of versatility, security, and overall cost. The number of shore compressed air outlets and risers for various ship types is defined in APPENDIX A. Specific ships connection locations (one or two per ship) are also defined. However, compressed air may be required at many locations both on and alongside a ship during maintenance or repair operations. The number of outlets and risers per berth should therefore be integrated within utility groups designed and spaced as discussed in CHAPTER 2.

3-2.6 Outlet Design.

See Figure 3-3. The size of outlet risers should be the same as that of branch piping. Provide a full-sized accessible shut-off valve in each branch near the outlet riser. Hose couplers for maintenance and repair connections should be quick coupler type and must match those used 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 following table. Shore couplings for 2-1/2 inch (64 mm) ship-to-shore connections should be male cam-locking connector with cap which complies with Commercial Item Description (CID) A-A-59326, *Coupling Halves, Quick-Disconnect, Cam-Locking Type* (with supplements). Shore couplings for 4 inch (102 mm) ship-to-shore connections should be 150-pound flanges with blind flange covers. Refer to CHAPTER 2 for general description of the arrangement and spacing of utility outlets. Provide a header at the outlet riser, with hose connections (valved outlets and hose couplers) sized as follows:

Size of Riser inch (mm)	Maintenance and Repair Connections Number, inch (mm)	Ship-to-Shore Connection inch (mm)
2 (50.8)	Four 3/4 (19.1)	None
3 (76.2)	Two 3/4 (19.1) & Two 1-3/4 (44.5)	4 (102)
4 (102)	Two 3/4 (19.1) & Two 1-1/4 (31.8)	4 (102)

3-2.7 Requirements for High Pressure Compressed Air.

Submarines and aircraft carriers (CVN 68 class and higher) (ref NSTM Chapter 9490) require a high pressure compressed air (HPA) supply in addition to the customary low pressure compressed air (LPA) requirements. This service may be provided by tapping an available 3,000 psi (21 MPa) or 4,500 psi (31 MPa) source, or by utilizing portable compressors. Required ships service size is normally 1/2 inch (13 mm) or 3/4 inch (19 mm). The ship's compressors will be used for top off under emergency conditions. Air quality should be in accordance with NAVSEA S9086-AB-ROM-010, *Naval Ship's Technical Manual (NSTM)*, Chapter 551, *Compressed Air Plants and Systems*. This chapter requires air to be oil free and dehumidified by a desiccant type dehydrator to a dew point (at atmospheric pressure) of -60 °F (-51 °C). High pressure compressed air service is normally portable and provided by the Activity, but the need must be determined on an individual site basis.

3-2.8 Submarine Pier Requirements.

Submarine and UUV piers/berths require both LPA and HPA. Provide permanently installed LPA and HPA systems at submarine and UUV piers/berths. However, this must be determined on a case-by-case basis.

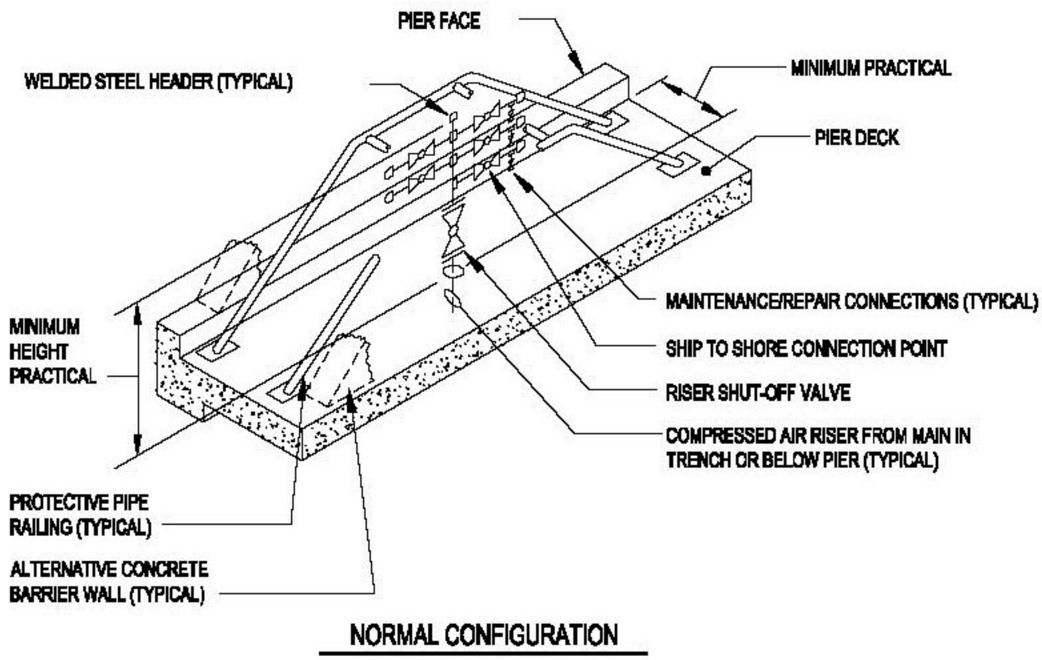
Where not feasible or practical to provide a permanently installed utility systems, a suitable solution that limits operational impacts must be developed and fully vetted through the various stakeholders to meet this utility requirement. Project team must document the variation in providing the utility, alternatives, mitigation measures, and resolution.

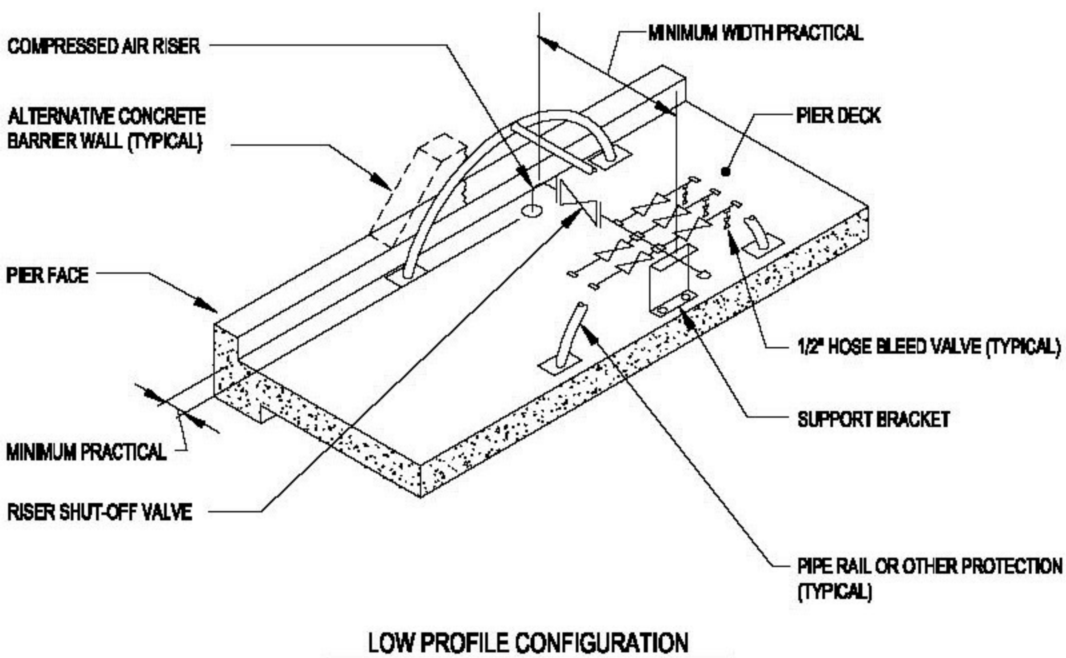
Permanently installed systems are preferred. But, require adequate pier width, deck space, shoreside space, and/or a remote facility for supply. Permanently installed piping with connections for temporary/portable equipment is an option, but is not preferred. This requires a location for portable equipment that limits impacts to operational areas. It is less desirable to provide portable compressors with hoses since they will impact pier deck space and interfere with operations.

3-2.9 Metering.

Provide metering of LPA and HPA supply to piers or groups of piers unless instructed otherwise. See Section 2-5 entitled "Metering" in CHAPTER 2.

Figure 3-3 Typical Compressed Air Outlet Assembly





3-3 SALTWATER OR NONPOTABLE WATER SYSTEMS.

Do not provide shore-supplied saltwater or nonpotable water to active berthing piers and wharves unless instructed by the cognizant Service. Refer to the paragraphs below for guidance regarding justification for the use of permanent salt or nonpotable water systems. For dry docks, refer to UFC 4-213-10. For pier and wharf fire protection requirements, refer to UFC 3-600-01, *Fire Protection Engineering for Facilities*, as well as the criteria in this UFC. Also, refer to NAVSEA 8010, *Industrial Ship Safety Manual for Fire Prevention and Response* for requirements for any industrial work being performed pierside on in a dry dock. Consult with the cognizant fire protection engineer, both at the local level and at the cognizant Service level.

3-3.1 Justification.

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

3-3.1.1 Repair Piers and Dry Docks.

At facilities used for major ship repair in which the repaired ships do not have use of their own pumping capabilities, permanent shore salt or nonpotable water systems are normally utilized. These types of installations do not require prior approval. Design such systems in accordance with applicable requirements defined herein and beginning with Section 3-3.2 entitled “Demands and Pressure Requirements”.

3-3.1.2 Active Berthing.

Permanent salt or nonpotable water systems must not be provided at active berthing facilities unless instructed otherwise. It is the Navy's intent that ships at active berth will normally rely upon their own pumping capabilities to supply saltwater for flushing/cooling and firefighting. 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 capability.

Generally, fixed fire protection systems are not required for active berthing piers when the level of the pier is low enough to the waterline such that the responding fire crews can perform drafting operations from the pier. However, with the development of the double-decker type piers, normal fire department operations are restricted due to the elevation of the pier above the water level. Provide dry standpipe systems for piers where construction features restrict fire department vehicle access and/or prevent the fire department from performing drafting evolutions from the pier. The system consists of multiple inlet, or pumper, connections and multiple outlet (standpipe) connections located on both levels of the pier.

3-3.1.2.1 Connections.

Locate inlet connections on both sides of the access ramp and size to support flows of 3,000 gpm (190 L/s). Pumper connection type should be as preferred by the base fire department, but typically will consist of both 5 inch (127 mm) Storz and 2-1/2 inch (64 mm) connections. This configuration will permit the fire department to obtain water from adjacent fire hydrants, drafting operations from the relieving platform, or a combination of both.

Outlet connections consist of the following:

- Upper level connections consist of a single 5 inch (127 mm) Storz outlet and valve or four (4) 2-1/2 inch (64 mm) hose valves. Locate connections at each stair access point to the lower level and at the top of the pier access ramp.
- Lower level standpipe or hose stations consist of two (2) 2-1/2 inch (64 mm) hose valves. Locate hose stations along both sides of the pier, spaced so that all portions of the lower level are within 150 ft (45 m) of a hose connection. Measure distances along a path of travel originating at the hose connection.

3-3.1.2.2 Identification.

Identify locations of the lower level connections on the upper level by color coordinated reflective markers located on the curb along the pier edge. Provide reflective markers to identify all fire protection and ship service connections. Identify locations of lower level connections on the lower level by painting the adjacent pier structural column (bent) red in color.

3-3.1.2.3 Piping.

Main distribution piping on the pier must be a minimum 8 inch (203 mm) diameter, Schedule 40-Galvanized. Loop piping to supply hose stations along both sides. Piping must not infringe on vehicle lanes with respect to clear height requirements.

3-3.1.3 Justification Requirements.

At locations where special conditions or hazards exist, permanent salt or nonpotable water systems will be allowed for active berthing and inactive berthing facilities on a case-by-case basis provided: (1) it is adequately justified by the Activity; and (2) it is approved in advance by the cognizant Service Chief Fire Protection Engineer. 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 should submit the following when requesting approval for these systems.

- Identify the type of facility and activities, and describe the special condition(s) or hazard(s) peculiar to this facility upon which this request is based.
- Establish the required pier or facility demand and pressure parameters based on the methods given in Section 3-3.2 entitled "Demands and Pressure Requirements".
- 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 items (1) and (2). All existing Navy assets must be included in the analysis including any existing permanent systems.
- Provide a life cycle cost analysis for all viable options on a site-specific basis. Perform the analysis in accordance with the cognizant Service P-442, *Economic Analysis Handbook*. The analysis must take into consideration the costs of owning and operating all pertinent plants, both on ships and ashore.
- Make recommendations for the best system to meet the required demand as based on consideration of the special conditions(s) or hazards(s) and on the life cycle cost analysis.
- The demands and pressure parameters of an approved permanent salt or nonpotable water system should be designed as described in Section 3-3.2 entitled "Demands and Pressure Requirements" and all subparagraphs.

3-3.2 Demands and Pressure Requirements.

Berthing facilities should conform to the requirements specified below. Note that the requirements differ for overhaul and dry dock berthing versus those for active berthing.

3-3.2.1 Dry Dock, Repair and Inactive Berthing.

Nonpotable or saltwater supply should be furnished at dry docks, piers, and wharves as described below. Requirements for selected ship classes are defined in APPENDIX A. For ships not included in APPENDIX A, use data from a similar ship, or obtain the expected demand from the cognizant Service. The following criteria should also apply.

- <u>Dry dock:</u> Provide sufficient saltwater to meet the requirement of the ship with the highest saltwater demand anticipated to be docked at the dry dock. Use the "Total Demand" quantity listed in APPENDIX A. Refer to UFC 4-213-10 and NAVSEA 8010 for additional requirements at dry docks.
- <u>Repair Berthing:</u> Provide sufficient saltwater to meet the "Total Demand" requirement defined in APPENDIX A for the largest ship to be berthed at the pier plus the aggregate cooling/flushing demand of all remaining ships

at the pier, and then multiplied by the diversity factors given below. In general, allow 1,000 gpm (63 L/s) minimum for piers serving frigate ships and larger and 500 gpm (32 L/s) minimum for piers serving ships smaller than frigates. Also, do not include nested ships.

Number of Ships	Diversity Factor
1	1.0
2	0.9
3	0.8
4	0.7
Over 4	0.6

- Total System Demand: Where a system serves more than one pier, assume only one ship fire will occur for the group of repair piers. The multiple pier supply system should be designed to meet the requirement of the pier with the highest demand plus the aggregate cooling/flushing demand from ships at all remaining piers, and then adjusted by the same diversity factors defined above. To obtain an overall demand that includes dry docks, add the sum of all dry dock demands to the multiple pier demand as described herein.
- Pressure Requirement: The saltwater pressure should be 150 psi (1,034 kPa) residual pressure (for all ships except submarines) at the most remote outlet. Submarines require only 40 psi (276 kPa). These pressure requirements should be available within 3 minutes of system activation.

3-3.2.2 Active Berthing (Single or Multiple Berths).

As stated previously in Section 3-3 entitled “Saltwater or Nonpotable Water Systems”, shore supplied saltwater or nonpotable water should not be provided to active berthing piers or wharves. However, there are instances where this occurs. 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.)

- Base fire demand on a fire occurring aboard the ship with the largest fire protection demand plus the cooling/flushing ratings of all other ships connected to the fire protection water systems, and then adjusted for diversity.
- Base cooling/flushing demand on the aggregate of connected ships and then adjusted for diversity.

Requirements for selected ship classes are defined in APPENDIX A. For ships not included in APPENDIX A, use data from a similar ship, or obtain the expected demand from the cognizant Service. For aircraft carriers (CVN 68 class and higher) include saltwater for firefighting and cooling/flushing when potential exists for ship to be in cold iron status. Total demand equals firefighting plus cooling/flushing flow.

3-3.3 Pumping Equipment.

Pumps may be permanent, portable or mobile as justified and approved under the requirements defined in Section 3-3.1 entitled “Justification”. 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 when upgrading an existing system as defined in Section 3-3.5.2 entitled “Upgrading”. Refer to UFC 3-600-01 for requirements of fire pumps and associated equipment. Centrifugal fire pumps should comply with NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*.

3-3.3.1 Drives.

As defined by NFPA 20, fire pumps may be driven entirely by electric motors if either a single reliable power source is available, or if two independent power sources are available. Single reliable power sources need not include dual substations or starting equipment. If the above conditions for use of "electric drive only" cannot be met, design the system such that a minimum of 50% 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. It is imperative 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 provision 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 cognizant Service. Variable speed drive equipment should be selected from types that have been proven by successful use. Adjustable frequency type variable speed systems are preferred because of their higher efficiency. See UFC 3-520-01, *Interior Electrical Systems*, for additional requirements regarding variable speed systems.

3-3.3.4 Location.

Permanent pumping equipment for individual piers, wharves, or dry docks should be located ashore and as near as possible to the pier, wharf or dry dock. It is highly preferred to provide vertical pumps with wet sump/intake configuration. Where this is impractical, then the pumps may be placed in an enclosure on or alongside a pier or wharf. The pump columns must be adequately protected from wave action and floating debris. Portable or mobile pumping equipment may also be placed on pier decks or on floating platforms moored to the pier.

3-3.3.5 Materials.

Care must be taken when specifying pump materials for nonpotable water service. Where salt or brackish waters are present, the potential for galvanic and crevice corrosion is severe. Steel and cast iron, ordinary brass and bronze, and most stainless steels are not suitable for these corrosive water sources. Specially coated steel and cast iron as well as 400 series stainless steel have proven to be ineffective. Material selection should be based on a thorough investigation of the site and operational conditions. The construction specifications should be explicit as to materials required for each major part, indicating appropriate ASTM designation and Unified Numbering System (UNS) number per ASTM E527, Numbering Metals and Alloys in the Unified Numbering System (UNS). Since it is impractical to list all parts, a sentence such as the following should be included:

"Minor parts not listed should be of comparable materials with equivalent corrosion resistance to the materials listed."

Submittals for Government approval, including material lists, should be required for pumps. Materials generally considered appropriate for salt and brackish waters are as follows:

Application	Material	ASTM	UNS
All wetted parts	316 SS, or	A276	S31600
	316L SS	A276	S31603
Shafts/Couplings	Nickel-Copper	B164 [a] and	N04400
	(Monel)	B165 [a]	N04499
All wetted parts,	Alum Bronze, or	B148 [a]	C95200
except shafts/couplings	Ni-Alum Bronze	B148 [a]	C95500

Note:

[a] Full titles for ASTM Standards can be found in APPENDIX F.

In salt water it is important to avoid dissimilarity of parts. Pumps constructed of type 316L stainless steel or nickel aluminum bronze with monel shafts are preferred. In brackish water, cost savings can be realized by allowing acceptably small dissimilarities. Aluminum bronze pumps with type 316 stainless steel shafts are a reasonable alternative. The presence of sand/grit must also be considered. Pumps constructed of stainless steels handle sand/grit better than pumps constructed of bronze and other copper alloys. However, saline waters corrosion concerns are still paramount.

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 the rated design flows to the berths farthest from the pumping location. Where a common shore pumping and distribution system feeds several piers or dry docks, the shore distribution system must be sized to deliver the design firefighting flow to any one of the piers or dry docks while cooling/flushing flows continue to all other locations.

3-3.4.2 Location and Arrangement of Mains.

As a general rule, provide a permanent main on both sides of a pier with a cross connection at the outboard end of the pier (loop configuration). When permanent mains are placed on piers 50 ft (15 m) or less in width or in unique situations, provide a single main with branch lateral pipes for outlets on both sides of the pier. 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. Coordinate piping with structural conditions and arrange mains for the best combination of versatility, security, and overall cost. Segregation valve should be placed in the fire main loop so that the maximum distance between any two adjoining valves does not exceed 200 ft (61 m).

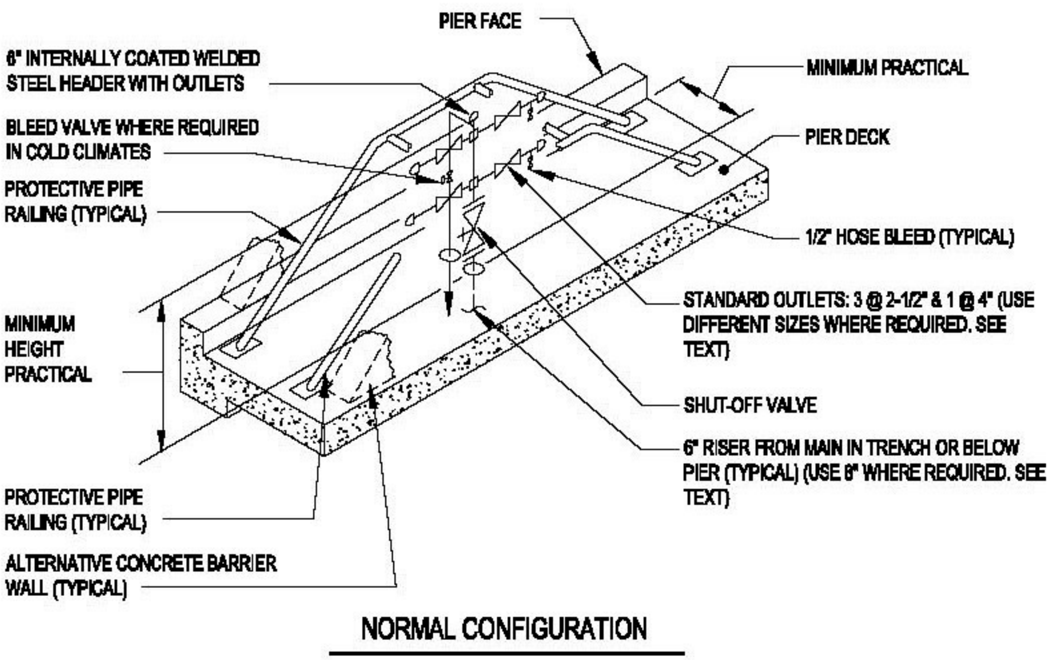
3-3.4.3 Location and Spacing of Outlets.

The pier location of ships' saltwater connections are defined in APPENDIX A. Refer to CHAPTER 2 for a description of the methods to be used in establishing shore utility-station spacing on piers and wharves. Hose valve manifolds should be provided in sufficient numbers such that all parts of the ship can be reached by at least two 100 ft (31 m) hoses. For spacing in dry docks, refer to UFC 4-213-10.

3-3.4.4 Outlet Design.

See Figure 3-4. The typical outlet should consist of a 6 inch (152 mm) branch main and riser feeding a manifold arrangement of three 2-1/2 inch (64 mm) and one 4 inch (102 mm) valved hose connections. 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 should be modified as defined in Section 3-1.6.1 entitled “CVN, LHA, and LHD Requirements (All Classes)”. Provide four 4 inch (102 mm) valved hose connections in a manifold arrangement at the outboard end of large piers. These outlets are to serve fireboat 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 (39 L/s), properly spaced 4 inch (102 mm) risers having two to three 2-1/2 inch (64 mm) connections may be used in lieu of the above. All connections should be protected by a corrosion resistant chained cap, sized to properly support the weight of the cap on the chain for extended periods of time. At each designated pier in each naval station where oceangoing U.S. merchant and foreign ships are expected, provide two international shore connections. See Figure 3-5.

Figure 3-4 Typical Salt or Nonpotable Water Outlet Assembly



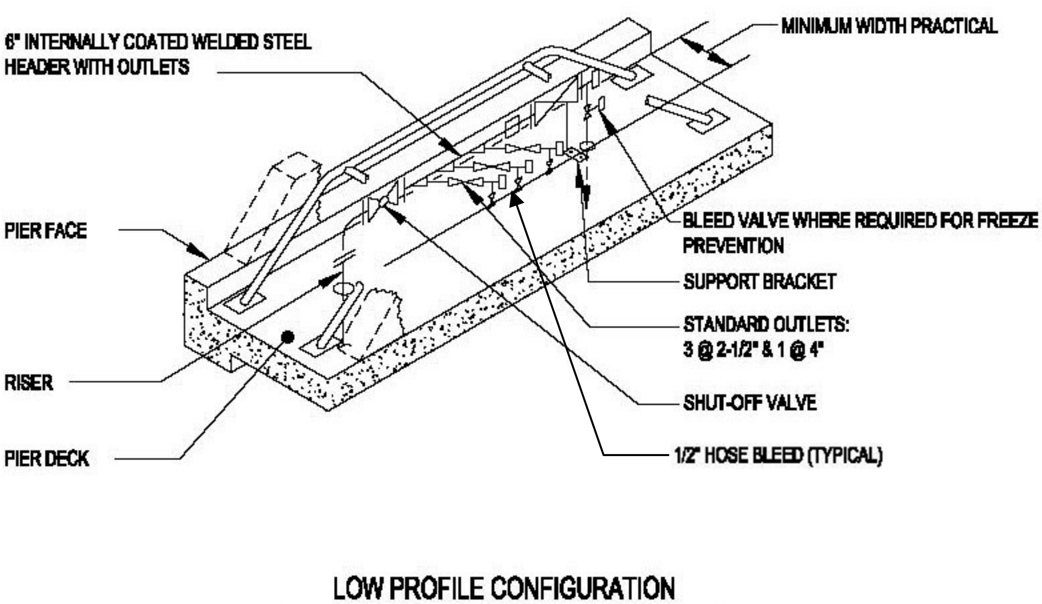
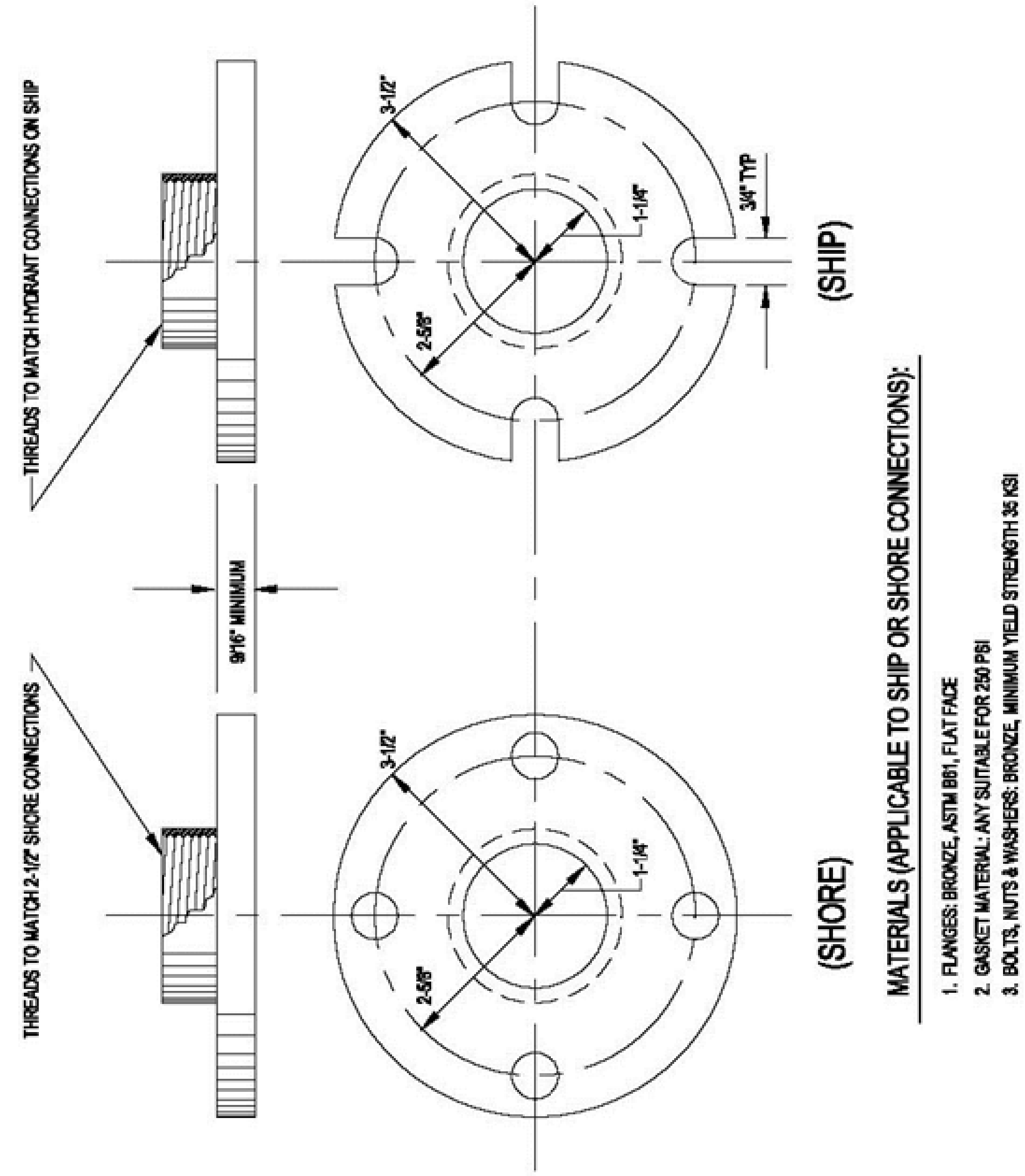


Figure 3-5 International Shore Connection for Ship Fire Mains



3-3.4.5 Materials and Installation Criteria.

Pipe and fittings should conform to UFC 3-230-01, *Water Storage and Distribution*, as applicable to piers and wharves. Use pipe, fittings and valves pressure-rated at 250 psi (1,724 kPa) minimum. Hose threads should be National Standard hose-coupling threads, 7-1/2 threads/inch, or as approved by the cognizant Fire Protection Engineer. Materials for valves should conform to requirements for pumps as defined in Section 3-3.3.5 entitled “Materials”. For piping on a pier or wharf, evaluate the relative advantages of cement-lined ductile iron versus cement-lined steel pipe with an extruded polyethylene or polypropylene exterior coating. An ultra violet inhibitor must be used in polyethylene coatings that will be exposed to sunlight. For coated pipe, use polyethylene heat-shrinkable sleeves and/or tape wrapping at joints and fittings. Provide pipe hangers and associated support assemblies in accordance with Section 2-4.1.4 entitled “Hangers and Support Assemblies”. Provide means of pipe movement due to thermal expansion, preferably by the 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 CHAPTER 5.

3-3.5 CVN, LHA, and LHD Requirements (All Classes).

At existing installations where insufficient saltwater pressure exists, the pressure should be increased to provide 150 psi (1034 kPa) residual pressure at the pier outlets. Pump-discharge pressure must be sufficient to provide the required residual at the rated design flow. The following special requirements apply to these large class ships:

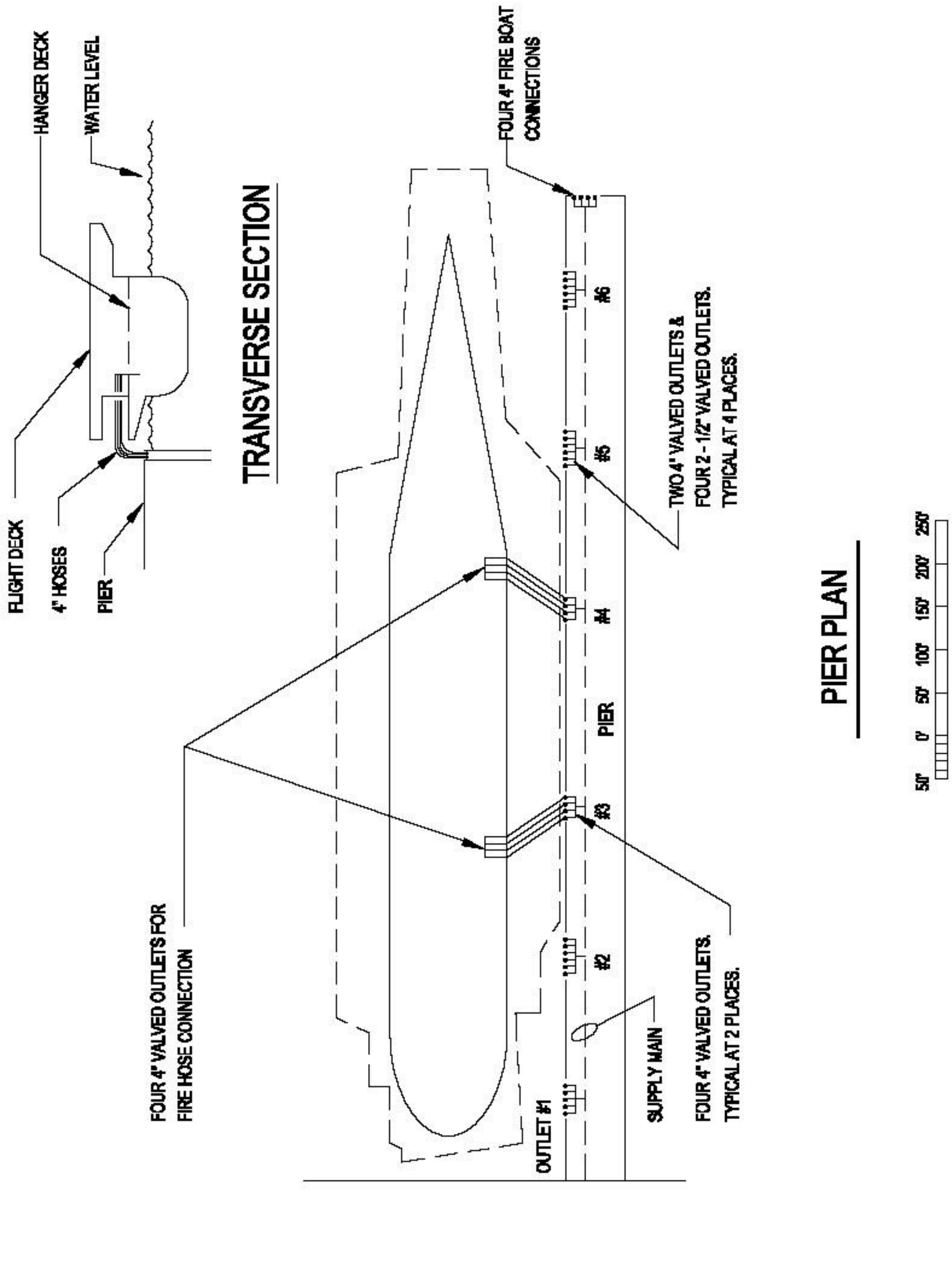
3-3.5.1 Special Outlets.

In lieu of the typical outlet assembly, provide four 4 inch (102 mm) gate valve hose connections in an 8 inch (203 mm) manifold arrangement with an 8 inch (203 mm) riser at each of two locations. Approximate locations of outlets for aircraft carriers are indicated on Figure 3-6. For LHA and LHD ships, determine locations from NAVSEA or from the Activity. Except for the riser size, outlet design and configuration should be similar to outlets at other locations and which serve the smaller ships.

3-3.5.2 Upgrading.

Permanent changes to existing pier systems for upgrading of the fire protection system (where permanent system has been justified) should be a separate high-pressure system. Provide pipes, 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.

Figure 3-6 Salt or Nonpotable Water for CVN Classes at Pier



3-3.5.3 Portable or Mobile Pumps.

Supplemental large-volume portable or mobile pumps may be utilized to augment the salt-water supply from a permanent system. Existing systems that can supply a portion of the requirement at 150 psi (1,034 kPa) residual pressure may remain unchanged. However, when portable or mobile systems are used at dry docks or repair facilities, the capacity of the permanent system should be no less than 5,000 gpm (18,925 L/min).

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.

3-4 POTABLE WATER SYSTEMS.

Provide potable water via a permanently installed fixed piping system to all berthing spaces. For graving dry docks, refer to UFC 4-213-10. Supplemental utility data as well as specialized technical data and specific ship requirements are provided at the end of this chapter. See Section 3-4.6.3 entitled “Additional Requirements for Nuclear-Powered Ships” for pure water requirements.

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 (63 L/s) for all berth lengths up to 2,000 ft (610 m). Design for a minimum residual pressure of 40 psi (276 kPa) downstream of an RP2 backflow preventer located 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 (63 L/s) for the first 2,000 ft (610 m) of berth, plus 500 gpm (32 L/s) for each additional 2,000 ft (610 m), up to a maximum of 2,000 gpm (126 L/s), and with a minimum pressure of 40 psi (276 kPa) downstream of an RP2 backflow preventer located at the most remote outlet. Potable water requirements for selected ship classes are defined in APPENDIX A. For ships not included in APPENDIX A use data from a similar ship or obtain the expected data from the cognizant Service.

3-4.1.2 Repair Berthing.

The potable water requirements are defined in APPENDIX A. Add the quantities indicated for each ship (including nested ships) and that total available on the pier. Base the peak rate of flow for sizing the main on providing the entire daily flow requirements defined in APPENDIX A, applied to 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 (276 kPa) minimum at the furthest shore connections. It is noted that this data is based on 30 gpd/person (114 L/d/person).

3-4.1.3 Multiple Piers.

Determine total usage for multiple piers by summing daily flows for all ships at all piers or wharves assuming 30 gpd/person (114 L/d/person). Determine the peak-flow rate for multiple piers by summing peak-flow rates for all piers or wharves as determined by the method described above and then multiplied by a diversity factor of 0.75.

3-4.2 Piping System Design Criteria.

For piping materials and installation requirements, refer to UFC 3-230-01. Ductile iron is typically used for the main lines while PVC or copper is used for branch lines. For piping under a pier or wharf, evaluate the relative advantages of cement-lined ductile iron versus cement- lined steel pipe with an extruded polyethylene or polypropylene exterior coating. Provide an ultra violet inhibitor in polyethylene or polypropylene coatings exposed to sunlight. For coated pipe, use polyethylene, heat-shrinkable sleeves and/or tape wrapping at joints and fittings. Type of joint requires particular consideration. Provide pipe hangers and associated support assemblies in accordance with Section 2-4.1.4 entitled “Hangers and Support Assemblies”. 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. Consider effects of transients from water hammer.

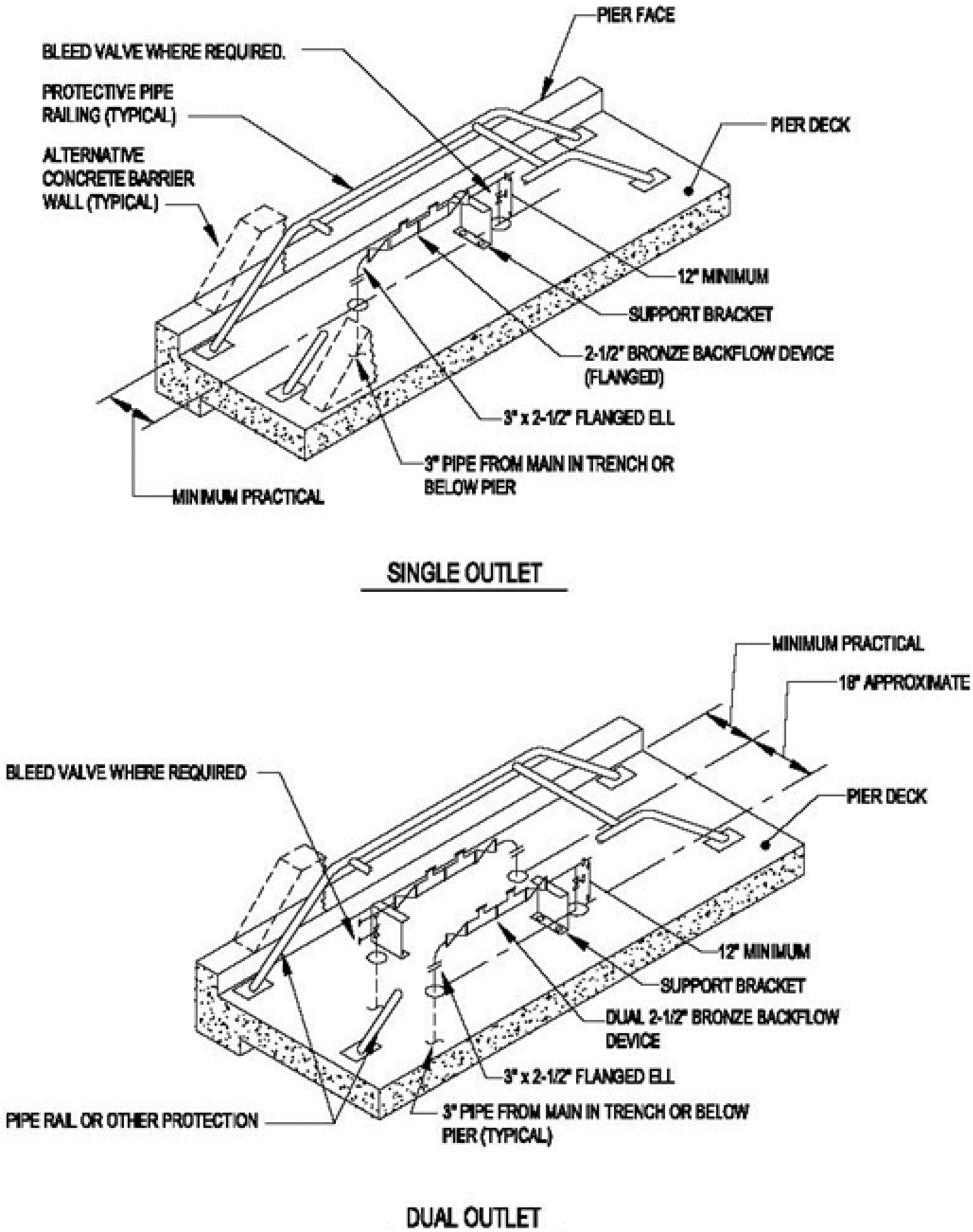
3-4.3 Location and Arrangement of Piping Mains.

As a general rule, provide a single water main with cross-branch piping to outlets for active berthing piers. For repair and submarine piers, provide piping mains on both sides of the pier with a cross connection at the outboard end of the pier (loop configuration), unless not feasible or practical on a submarine pier. Normally, it is more desirable to provide a looped main rather than an equivalent single main. Provide isolation valves at appropriate locations for reliability of service during emergency repairs. Coordinate piping with structural conditions and arrange mains for the best combination of versatility, security, and overall cost.

3-4.4 Piping and Outlets.

See Figure 3-7. Provide at least one 2-1/2 inch (64 mm) connection at each service outlet except as specified in Section 3-4.6 entitled “Specific Ship Requirements” for large ship requirements or where nesting is anticipated. Branch piping from mains to outlet risers should be not less than 2-1/2 inches (64 mm), and not less than 4 inches (102 mm) where dual 2-1/2 inch (64 mm) connections are fed by a common branch. Terminate shore connections with a 2-1/2 inch (64 mm) gate valve with hose threads (national hose threads) and a chained cap. Provide a reduced-pressure type backflow prevention device in accordance with UFC 3-230-01. Identify and color-code potable water outlets on piers and wharves in accordance with CHAPTER 5. If static pressure in supply mains is greater than 80 psi (552 kPa) for any portion of the day, then provide regulators set at 80 psi (552 kPa) maximum. All connections should be protected by a corrosion resistant chained cap, sized to properly support the weight of the cap on the chain for extended periods of time.

Figure 3-7 Typical Potable Water Outlet Assembly



3-4.5 Location and Spacing of Outlets.

The pier locations of ships potable water connections may be determined by the data defined in APPENDIX A. Refer to CHAPTER 2 for a description of methods to be used in establishing shore-utility station spacing on piers and wharves.

3-4.6 Specific Ship Requirements.

3-4.6.1 CVN Ship Requirements (All Classes).

Design systems as specified above except provide a 4 inch (102 mm) branch line, a 4 inches (102 mm) reduced pressure backflow prevention device, and an outlet assembly at outlet locations 3 and 4 of Figure 3-6. Provide a 4 inch to 2-1/2 inch (102 mm to 64 mm) reducer for each location to allow the use of these outlets by ships other than carriers.

3-4.6.2 LHA and LHD.

Design systems as specified for CVN class ships except provide dual outlets at each utility connection group, one 4 inch (102 mm) reduced-pressure backflow prevention device, and an outlet assembly near the center of the berth. Provide a 4 to 2-1/2 inch (102 to 64 mm) reducer to allow use of the 4 inch (102 mm) outlet with other ships.

3-4.6.3 Additional Requirement for Nuclear Powered Ships.

A "pure" water supply as defined by NAVSEA is required for all nuclear-powered ships. Quantities for CVNs and submarines are 20,000 gpd (75,708 Lpd) and 10,000 gpd (37,854 Lpd) respectively. Applicable reference documents include MIL-STD-767, *Control of Hardware Cleanliness (NOFORN)* and MIL-STD-2041, *Control of Detrimental Materials (NOFORN)*. A project team will be established for pure water delivery systems for new projects. The project team (consisting of at least the cognizant Service project manager and a Shipyard pure water engineering representative) will agree on the pure water delivery system for new projects with NAVSEA 08 concurrence. Viable options include:

- At locations where there is an existing remote demineralized water plant of sufficient capacity, pure water can be produced from the demineralized water plant and processed through a polishing unit for either direct delivery to the ship via permanent piping system or delivered via pure water tanker delivery trailer.*
- At locations where there is neither an existing demineralized water plant nor one of sufficient capacity, pure water can be produced from a portable demineralizer unit processed through a portable polishing trailer for either direct delivery to the ship or delivered via pure water tanker delivery trailer.*

- At locations where usage quantities or berth arrangements dictate, design and construction of a pure water production plant and/or permanent piping delivery system may be considered.*

* NOTE: Final connections to the ship from either the trailers or the permanent piping system are made with hoses.

3-4.6.4 Submarine Pier Requirements.

Submarine piers/berths require both potable water and pure water. Provide permanently installed potable water system and pure water system at submarine piers/berths. See Section 3-4.6.3 entitled “Additional Requirement for Nuclear Powered Ships” for pure water requirements.

Where not feasible or practical to provide a permanently installed “pure” water system, a suitable solution that limits operational impacts must be developed and fully vetted through the various stakeholders to meet this utility requirement. Project team must document the variation in providing the utility, alternatives, mitigation measures, and resolution.

Preferred option is a permanently installed pure water system with an on-site pure water plant. But, this requires space for the production plant shoreside or remotely. Water quality and O&M are a concerns with this option. A less preferred option is permanently installed piping with connections for temporary pure water supply. But, this will require portable equipment or tanker truck. The least preferred option is to provide pure water directly to ship via pure water tanker. But, tanks and hoses take up deck space and interfere with operations.

3-4.7 Quality.

Refer to UFC 3-230-01. The quality of water must meet or exceed the requirements of 40 CFR, Part 141, *U.S. Environmental Protection Agency's National Primary Drinking Water Regulations*.

3-4.8 Metering.

Provide metering of potable water supply to piers or groups of piers unless instructed otherwise. See Section 2-5 entitled “Metering” in CHAPTER 2. Use compound-disc or magnetic-flow meters to achieve a high range of registration.

3-5 POL SYSTEMS.

Refer to UFC 3-460-01, *Design: Petroleum Fuel Facilities*. Fuel and lube oil connection locations on various ships are defined in APPENDIX A. Pier fueling connections and hoses must be kept a minimum of 25 ft (8 m) away from any possible ignition sources, such as pier power outlets, telephone terminal panels, and fire alarm equipment. Required POL connection sizes must be obtained from specific ship data available from NAVSEA. General requirements for pipe hangers and support assemblies (see Section

2-4.1.4 entitled “Hangers and Support Assemblies”) and for metering (Section 2-5) are applicable. Identify POL outlets on piers and wharves and color-code in accordance with CHAPTER 5. POL piping systems also require special consideration for protective coatings and cathodic protection systems. See Section 2-4.4 entitled “Cathodic Protection Systems (CPS)”. Refer to military specifications MIL-C-52404, *Connection Hose, Fire and Water* and MIL-S-12165, *Strainer Suction, Fire Hose, and Strainers, Suction, Hose* for POL connection types. Consult with the cognizant fire protection engineer, both at the local level and at the cognizant Service level.

3-6 OILY WASTE SYSTEMS.

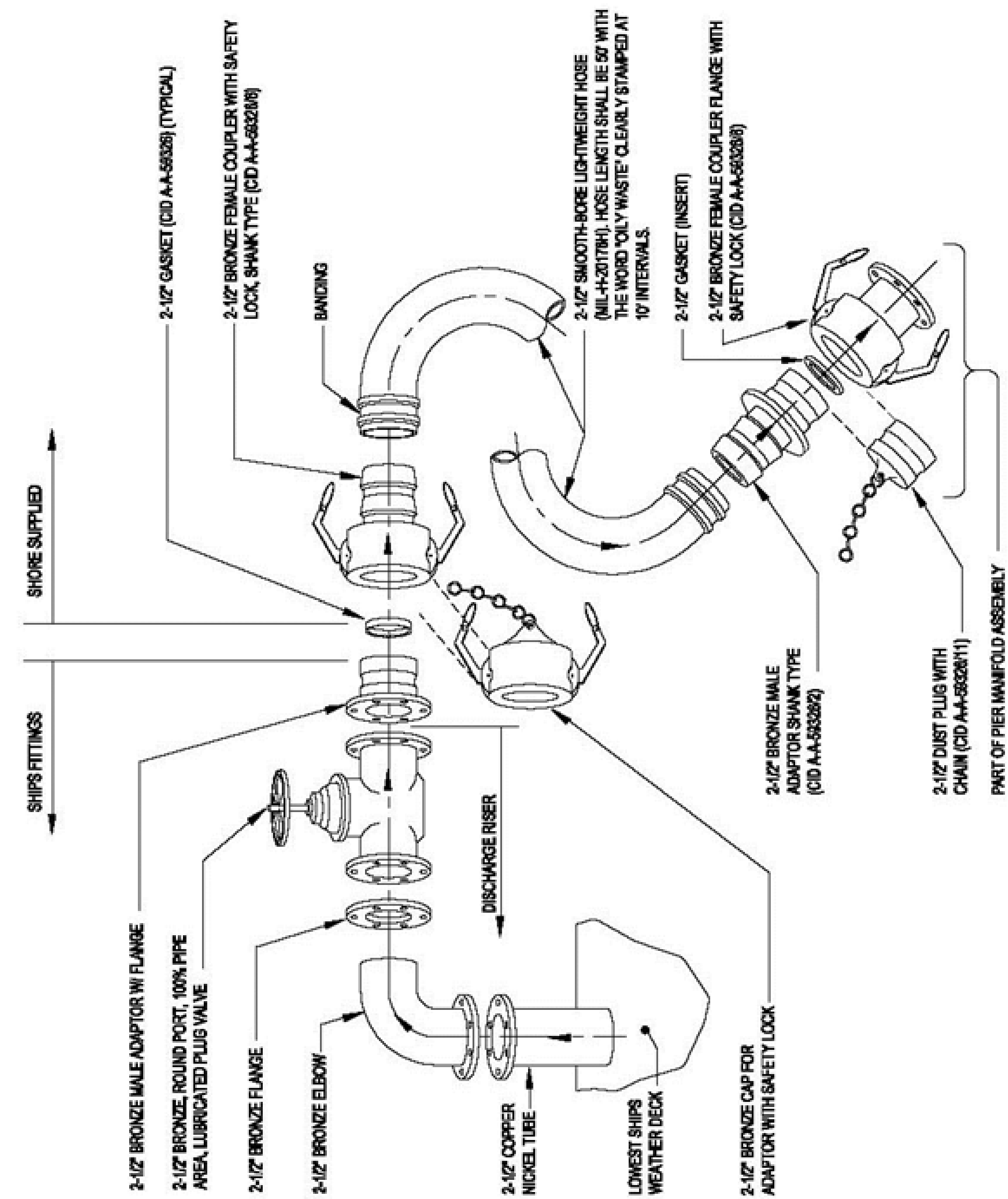
For typical ship-to-shore connection requirements, see Figure 3-8. Oily waste collection must be provided at all berths for 100 gpm (6.3 L/s). Oily waste system requirements for selected ship classes are defined in APPENDIX A. For ships not included in APPENDIX A, use data from a similar ship or obtain the expected demand from the cognizant Service.

The system is usually a fixed piping system. However, tanker truck or barges may be used for transient berths if allowed by the Activity. Ship waste oily barges (SWOB) should not be used at submarine berths due to potential hull damage. Provide a permanently installed oily waste collection system at submarine piers, see Section 3-6.6. Design ships oily waste (bilge water) systems in accordance with UFC 4-832-01N, *Industrial and Oily Wastewater Control*. Also, refer to *40 CFR, Part 1700, Uniform National Discharge Standards for Vessels of the Armed Forces*, and to *NAVSEA S9593-BF-DDT-010, Oil Pollution Abatement System* for ship design. Connection locations for ships oily waste are defined in APPENDIX A. Refer to CHAPTER 2 for a description of utility spacing requirements. In climates subject to freezing temperatures, oily waste lines must be properly protected. Refer to CHAPTER 5.

3-6.1 Pierside and Barge Collection of Shipboard Oily Waste.

Shipboard oily waste must not be directly discharged to public waters. In many cases it is unsuitable for discharge to a publicly owned treatment works (POTW). Requirements are: (1) provide full treatment to direct discharge standards; or (2) provide pretreatment to reduce pollutants to acceptable levels for municipal sewer discharge. Bilge wastes are normally the primary influent (both in volume and contaminant concentration) to an oily waste treatment system. Occasionally, compensating ballast water is discharged from ships and barges directly overboard. As of this writing, Puget Sound, Washington, activities are required by the local regulatory agencies to collect compensating ballast water during ship's refueling operations. This waste contains lower contaminant levels than bilge wastes but usually requires treatment before disposal. Lastly, the designer should refer to the Naval Facilities Engineering Service Center’s (NFESC), *Bilge and Oily Wastewater Treatment System* as an alternative system for pollution prevention. Every project must be evaluated on a project-by-project basis. The designer must consult with the cognizant Service, the Activity, and the responsible Environmental Engineers, both at the local level and at the cognizant Service level.

Figure 3-8 Ship-to-Shore Oily Waste Hose Connection



3-6.2 Ship Oily Waste Generation.

Collection may take the form of transfer systems to trucks or barges, or a facility pipeline system. Coordinate with environmental requirements to provide an environmentally acceptable collection system with the most economical life cycle cost.

3-6.2.1 Oil Content.

Primary sources of ship-generated oily wastewater are bilges, oily waste holding tanks for collecting lubricating oils and water contaminated fuel, condensate lines, and tank cleaning water. Sonar dome pumping water is not normally collected as part of the oily waste collection system. The oil content in the bilge water normally varies from 100 ppm (0.01%) to 10,000 ppm (1.0%). The rest is mostly saltwater of unknown chloride content. The oil content of ship discharges overboard is limited to 20 ppm or less within 12 nautical miles of the nearest land. In ports that restrict the direct discharge of ballast water, the ballast water can be discharged from most ships (other than tankers) through a large diameter piping system to a ship waste oily barge (SWOB) or a YON Fuel Oil Barge. Compensating ballast water can also be discharged directly to a pier collection system provided the liquid can discharged by gravity flow (from ship to pier connection) and the back pressure can be kept to a minimum. The Navy policy on classification of oily wastewater is that the oily waste and waste oil (OWWO) become a waste only upon removal from the ship. In general, bilge water should be treated like any other waste.

3-6.3 Pumping Equipment.

Provide basket or bar type screens on a pump inlet that can be easily removed and cleaned from an easily accessible and safe location.

Determine pump capacity and operating cycle. In order to reduce mechanical formation of emulsion at oily waste treatment plants, use positive displacement pumps (in lieu of centrifugal pumps) with pressure relief valves. Pumps should pass solids having a diameter 0.125 inch (3 mm).

Provide controls suitable for Class I, Division 1, Group D hazardous classification. Use float or sonic type level controllers for pump control and alarm. Air bubbler type controllers must not be used. Provide a discharge pump control valve to minimize surge effects on equalization basins located at oily waste treatment plants. (This requirement is not applicable for positive displacement pumps.) Provide an alarm system for overflow or power failure. Provide manual override of automatic pump controllers. Low-level alarm conditions must lock out all pumps and must require manual resetting.

3-6.4 Piping Systems.

Piping requirements are similar to requirements for sewage systems. See Section 3-7 entitled “Sewage Systems” and the associated subparagraphs. Piping material is typically galvanized steel. However, some local environmental regulations require double-wall piping systems. Consult with the Activity and the cognizant Service.

Provide pipe hangers and associated support assemblies in accordance with Section 2-4.1.4 entitled “Hangers and Support Assemblies”. Identify oily waste outlets on piers and wharves and color-code in accordance with Chapter 6.

3-6.5 Metering.

Unless instructed otherwise, specify the following to monitor the system: (1) accumulating flow meter; (2) elapsed time meter for pumps and ventilator; and (3) pump suction and discharge pressure gages. Provide gages with oil-filled diaphragm and cutoff valves. Consult with the cognizant Service for any additional requirements. See Section 2-5 entitled “Metering” in CHAPTER 2 for additional metering requirements.

3-6.6 Submarine Pier Requirements.

Submarine piers/berths require an OWWO collection system. Provide a permanently installed OWWO system at submarine piers/berths.

Where not feasible or practical to provide a permanently installed OWWO utility system, a suitable solution that limits operational impacts must be developed and fully vetted through the various stakeholders to meet this utility requirement. Project team must document the variation in providing the utility, alternatives, mitigation measures, and resolution.

Preferred option is a permanently installed system connected to an on-base collection system. But, this requires a base treatment or collection and transfer facility. A less preferred option is permanently installed piping with connections for tanker truck transfer. But, this may infringe on deck and shoreside space. The least preferred option is to provide OWWO collection directly from pier to a tanker truck, but tanker truck and hoses will take up deck space and interfere with operations.

3-7 SEWAGE SYSTEMS.

3-7.1 Introduction.

Design information on wastewater collection and transmission systems is extensively covered in Water Environment Federation (WEF) MOP FD-5, *Gravity Sanitary Sewer Design and Construction*. This section addresses two wastewater collection and transmission topics that are not addressed in WEF MOP FD-5: (1) pier and wharf facilities; and (2) dry dock facilities.

3-7.2 Specialized Shipboard Sewage Characteristics and Parameters.

Designing sewage collection systems for shipboard wastewater requires special and unique conditions that the designer must take into account. All of these special issues must be addressed and resolved.

3-7.2.1 Characteristics of Ship Holding Tank Discharges.

Ship holding tank discharges can be a major source of wastewater. These wastewaters have the following general characteristics.

- A ship's wastewater is primarily domestic wastewater but may also contain industrial wastewater depending on the ship operations.
- A ship's wastewater is more concentrated than typical domestic wastewater, a result of specific design features of the ship's wastewater collection systems.
- A ship's wastewater may contain high concentrations of dissolved solids, chloride, sulfates, and sodium if seawater flushing or ballast systems are used.

3-7.2.2 Ship Discharge Values.

APPENDIX A defines the maximum sewage discharge values of a ship's complement, daily flow, maximum discharge, number of pumping stations, total number of pumps, and number and location of discharge connections. Where destroyers or submarines are nested next to a tender berthed at a pier, the nested ships will discharge into the tender. The tender will then discharge to the pier's sewage collection system at the rate listed for the tender. For nested ships, it is suggested to provide a pressure manifold to reduce peak demand flow.

3-7.2.3 Flow Rate Variations.

Domestic wastewater flows at piers, wharves, and dry docks can be expected to exhibit seasonal and other weather-influenced flow variations. In addition, the effect of industrial and ship discharge flows as well as the variable nature of military operations may significantly affect flow variations. To minimize flow variations, flow equalization should be considered. Equalization can be applied to specific flows (such as industrial flows or other specialized flow types) that exhibit wide variations to the entire wastewater flow. When calculating flows, consider the following.

- Industrial flows, such as vehicle and aircraft wash facilities. If these flows coincide with peak domestic flows, then they should be added to the peak flows.
- Ship holding tank discharge flows. Flow rates will depend on the total volume of flow and the time required to convey the wastewater to the treatment facility. Design equalization systems to equalize the flows in order to minimize their effects on peak flows. Consider conveying the ship wastewaters to the treatment facility at night when domestic flows are low.
- Intermittent flows due to military functions. Periods of increased sewage flows will occur because of training activities or other personnel mobilization exercises common to military installations. Training activities

or other mobilization exercises will create short-term increases in domestic wastewater and possibly industrial flows. These intermittent activities may create the peak wastewater flow rate. Design the sewage collection system to handle routine variations in flow resulting from training and other routine military exercises. The design must ensure acceptable performance with reasonable operational costs. (For example, an equalization system may provide flow and load dampening to accommodate these significant variations.) However, do not design facilities to accommodate peak surges resulting from emergency military mobilizations.

- Intermittent periods of reduced use. Low flows can also be a problem. Therefore, design the wastewater facility to operate efficiently over a range of flows. (For example, provide parallel trains that can be taken out of service.)
- Changes in requirements or military mission. Designs should include provisions for the system's expansion and contraction as well as system modifications due to more stringent effluent requirements or military mission changes. In general, maximize operational flexibility.

3-7.2.4 Wastewater Loadings.

Wastewater loadings are typically calculated based on the projected flows and wastewater pollutant concentrations and are expressed in pounds per day (lb/d) (kilograms per day (kg/d)). Where possible, determine loadings by analyzing the wastewater to be treated. Consult with the Activity and the cognizant Service to obtain collected data and specific instructions.

3-7.2.5 Ship Sewage.

Ship sewage settles well and is amenable to biological treatment, but it may be septic. Table 3-4, "Typical Ship Sewage Concentrations", define typical concentration values. Wastes from shipboard industrial activities are not included. High dissolved solids, chloride, sulfates, and sodium concentrations apply when seawater flushing or ballast systems are used. For more information on ship sewage, refer to *NAVSEA S9086-AB-ROM-010, Naval Ship's Technical Manual (NSTM), Chapter 593, Pollution Control*.

3-7.2.6 Effect of Wastewaters with High Seawater Content.

- <u>Performance:</u> High concentrations of seawater tend to inhibit biological treatment. Process inhibition is related to the chloride concentration of the wastewater.
    - o For new designs: Currently, there is an absence of pilot plant data or treatment data from similar wastewaters. Consequently, compensate for high seawater content according to the data presented in Table 3-4.

- o In analyzing the capacity of existing treatment facilities to receive ship's wastewater, use figures defined in Table 3-5. If these indicate overloading solely because of chloride inhibition, conduct pilot plant tests before planning any expansion. Consult with the Activity and the cognizant Service for instructions.
- o Sudden changes in chloride concentration may upset biological processes. Consider equalization storage to limit chloride variation at the wastewater facility. For chloride concentrations in excess of 5,000 mg/L, provide design limitations of 200 mg/L/h.

- Maintenance: High seawater content in wastewater will aggravate incrustation problems. Avoid fine bubble air diffusion systems and design orifices to facilitate periodic cleaning of mineral deposits. This is especially applicable to orifices in trickling filter flow distributors or in aeration devices. Use care in selecting construction and equipment materials.

Table 3-4 Typical Ship Sewage Concentrations

Characteristic	Concentration (mg/L)
Total suspended solids	600
Total dissolved solids	20,000
Chlorides	11,000
Sulfates	1,500
Sodium	6,200
Other dissolved solids	1,300
Biochemical oxygen demand (BOD)	400

Table 3-5 Chloride Inhibition of Biological Nitrification

Process	Maximum Chloride Concentration for No Inhibition (mg/L)	Concentration for Chlorides in Excess of Maximum Level [a]
Trickling filters and rotating biological contactors	5,000	Referring to appropriate design loading curve, decrease loading an amount corresponding to one percentage point of removal efficiency per 1,000 mg/L of chlorides in excess of 5,000 mg/L
Activated sludge	5,000	Decrease loading by 2% per 1,000 mg/L chlorides in excess of 5,000 mg/L
Aerobic and facultative lagoons	8,000	Increase detention time by 2% per 1,000 mg/L chlorides in excess of 8,000 mg/L

Note:

[a] Highest average chloride concentration expected over 24 hours.

3-7.3 Pier and Wharf Systems.

Provide a permanently installed sewage collection system at all active berths. Design the ship sewage collection system for the peak flow from the maximum planned berthing with sewer flowing full. Base the design on maximum discharge of ship pumps. Provide a gravity flow system unless approved otherwise.

3-7.3.1 Layout/Location.

See Figure 3-9. Provide a single (1) 4 inch (102 mm) pressure rated manifold assembly at each berth. Each manifold assembly should have four (4) single (1) 4 inch (102 mm) diameter pressure sewer connectors. This layout has the following advantages:

- It provides large reduction in peak flows by combining multiple discharges from a ship (or nested ships) into a single stream, thereby increasing the head on the ship's pumps.
- By reducing peak flow, it allows berthing of other ship types included in the berthing plan.
- It is self-regulating and self-cleaning plus avoids failure or maintenance problems inherent in regulating valves or other similar devices.

3-7.3.2 Additional Requirements.

See Figure 3-10 for typical collection sewer layouts on different pier types. Properly isolate each berthing space in order to prevent pumping from one berth into another and to allow ships with lower head pumps to discharge into the pier sewer.

Isolate the berths by providing one separate manifold assembly at each berth and then connect the manifold assembly directly to the pier's gravity sewer system. Where the berthing space is less than 600 ft (183 m), the number of manifold assemblies should be reduced to fit the space available. In such cases, it may be necessary to reduce the 150 ft (46 m) spacing between the assemblies. For carrier berths, two (2) standard manifold assemblies each with four (4) 4 inch (102 mm) outlet connectors should be provided.

Figure 3-9 Pressure Manifold Schematic for Pier and Wharf Systems

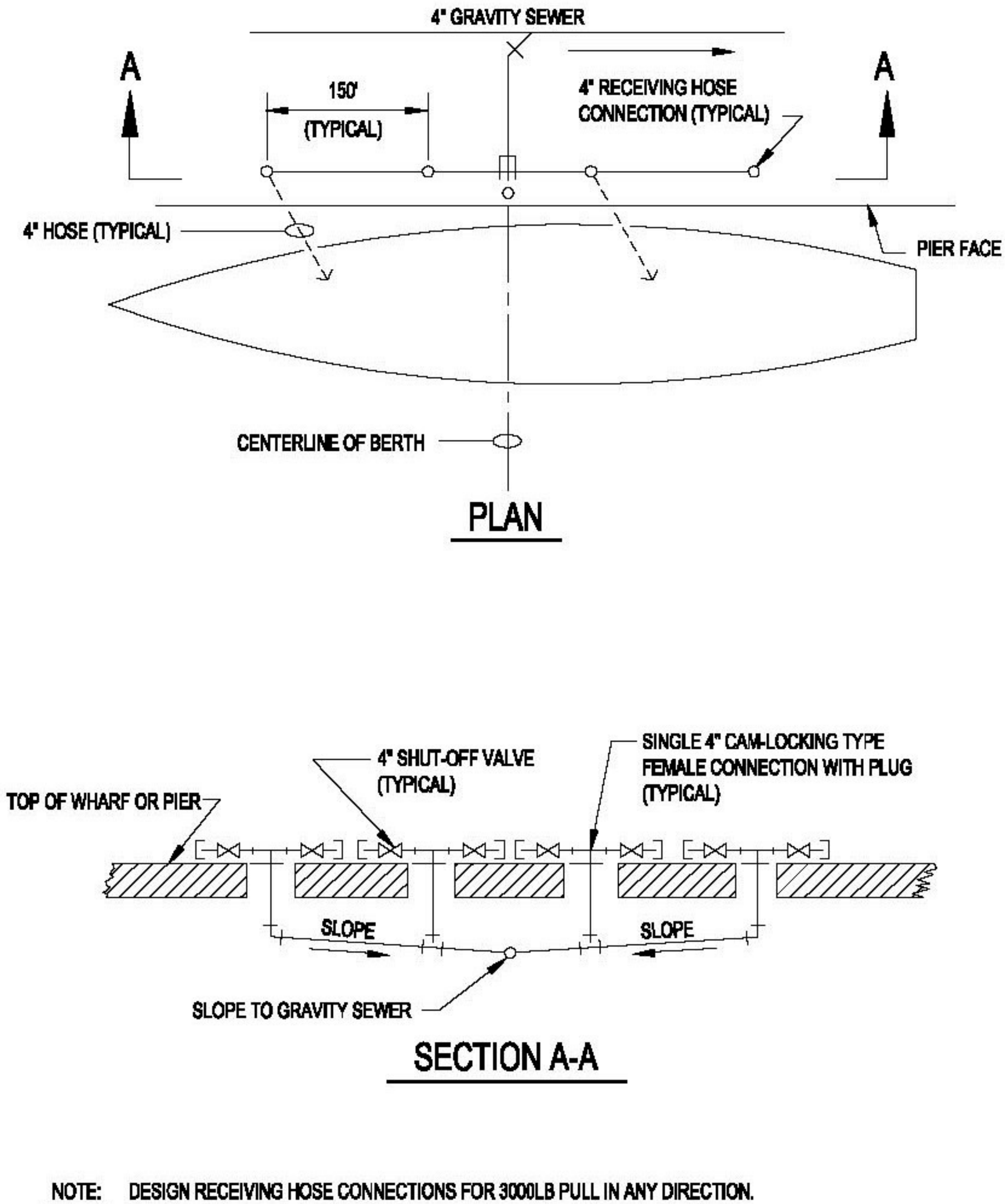


Figure 3-10 (a) Sewer Layout for Alternative Pier Types (1 of 2)

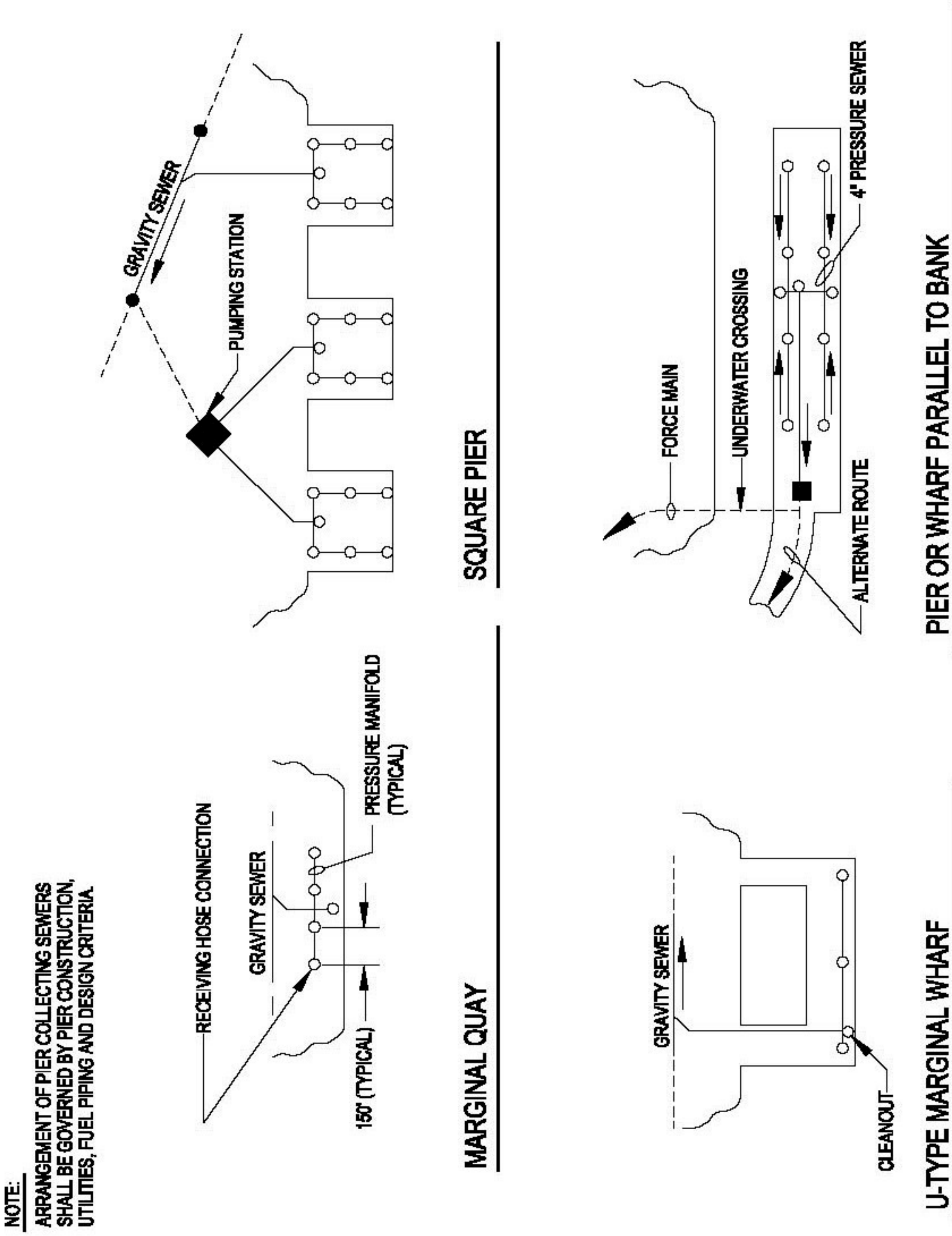
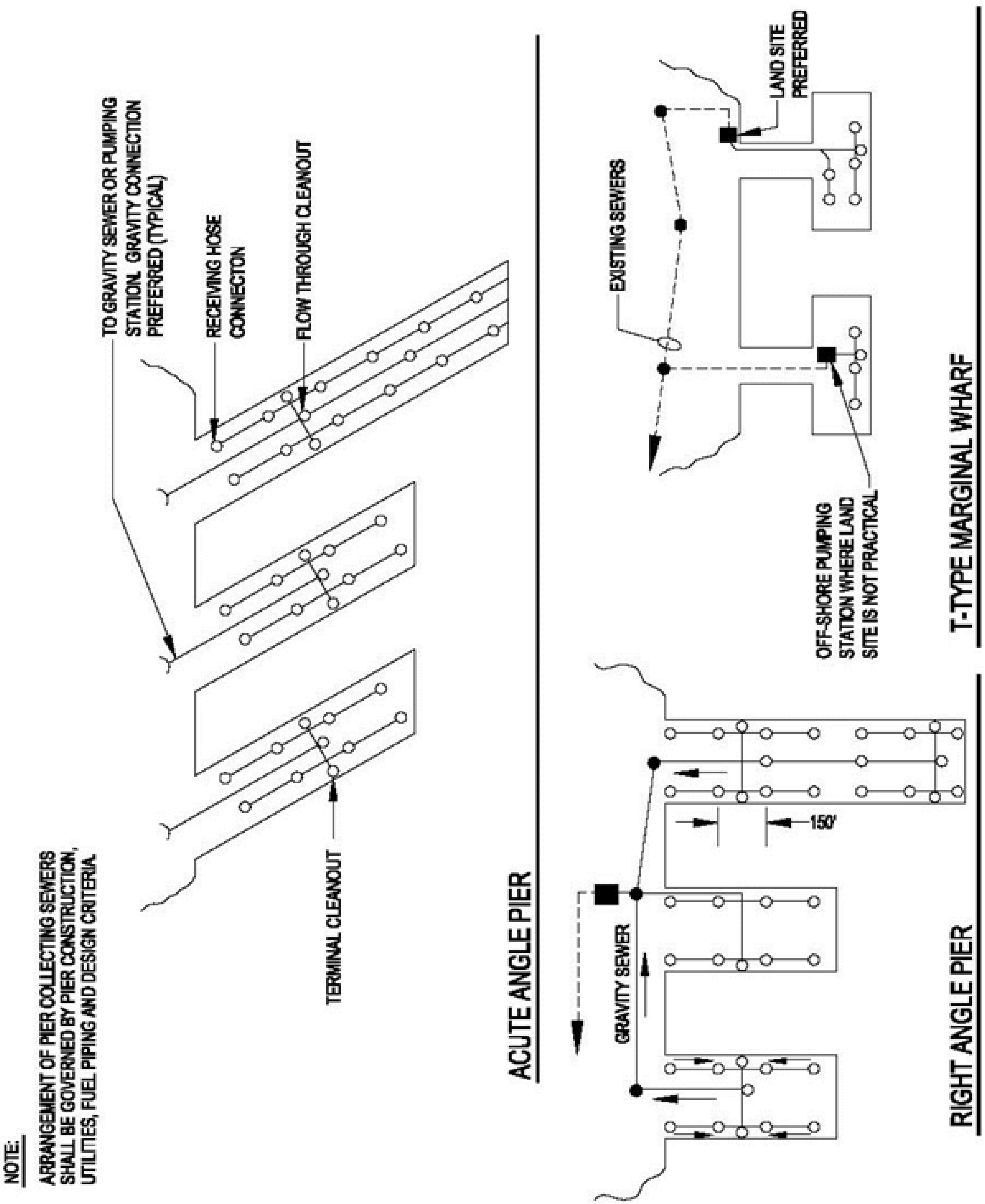


Figure 3-10 (b) Sewer Layout for Alternative Pier Types (2 of 2)



3-7.3.3 Location Details.

See Figure 3-11 and Figure 3-12 for typical installation on piers and quay walls. Locate all collecting sewers behind the permanent wharf or pier construction and away from the fender systems. Locate pump stations off the pier and behind the bulkhead lines. If location along the pier deck is required, then do not restrict working area on the pier. Lines behind wharves should always be buried. For design of new piers and quay walls, consider locating sewers in utility tunnels. This arrangement will reduce external corrosion and improved maintainability of the sewer lines, and thus may offset higher construction costs.

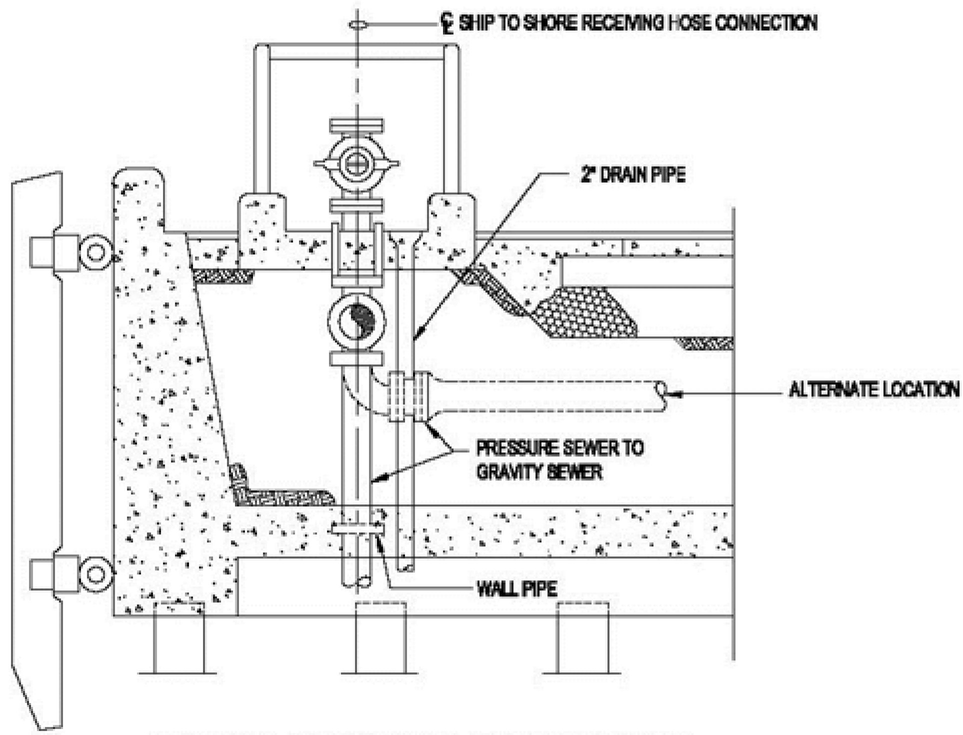
3-7.3.4 Environmental Considerations (Corrosion and Freeze Protection).

- Evaluate paint and finish requirements. See Section 2-6 entitled “Paint and Finish Requirements”. For ship to shore sewer connections (including ductile iron sewer pipe and all exposed metal such as steel support members, gratings, angles, pipe support hangers, fastening devices, and other appurtenances) it is generally recommended to provide a two coat, coal tar epoxy coating, conforming to Steel Structures Painting Council (SSPC) Paint No. 16. Specify a total dry film thickness of 16 mils (0.4 mm) minimum.
- Evaluate freeze protection requirements. See Figure 3-13. Pipes installed under piers or wharves in any geographic location must be protected from wave action and floating objects. Provide protective jacketing of the insulation using aluminum, stainless steel, or coal tar epoxy coated steel where freeze protection is required. Provide structural protection for the entire length of pipe run in addition to jacketing. Use steel cage of fabricated shapes or consider the use of a catwalk system that would provide both access and piping protection. Specialized freeze protection features are defined in CHAPTER 5.

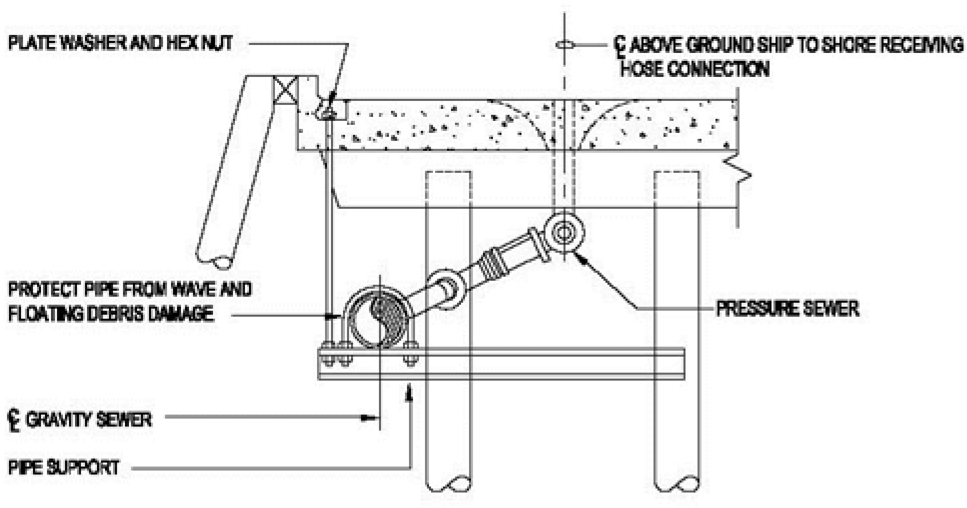
3-7.3.5 Odor/Septicity Control.

Slope sewer pipes as much as possible to minimize detention time. Provide aeration in accordance with sound engineering practices. Holding tanks must be aerated unless detention time is less than 3 hours at average 24-hour flow. Keep force mains as short as possible and avoid sulfide generation. Control sulfide generation by using an injection of oxidizing chemicals such as chlorine, permanganate, or hydrogen peroxide. Consult suppliers of chemicals feed equipment regarding costs and expected performance. Refer to WEF MOP FD 5, Gravity Sanitary Sewer Design and Construction, for rational methods to predict sulfide generation rates and methods of control. Maintain minimum flow velocity of 3 ft/s (0.9 m/s). Provide cleanouts and air relief valves at strategic and accessible locations. Provide check valves at pump stations.

Figure 3-11 (a) Typical Sewage Collection Facilities (1 of 2)

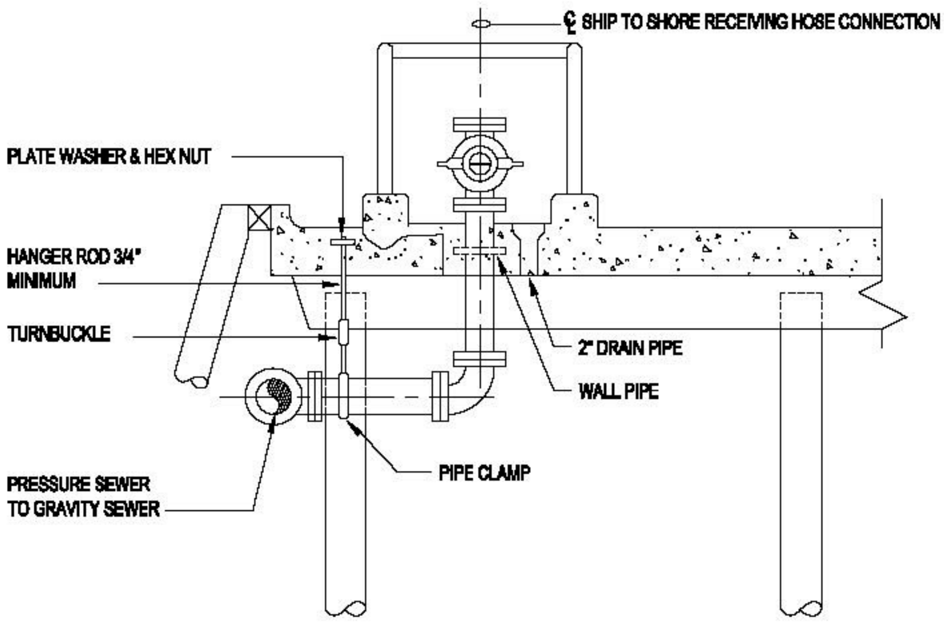


TYPICAL QUAY WALL INSTALLATION

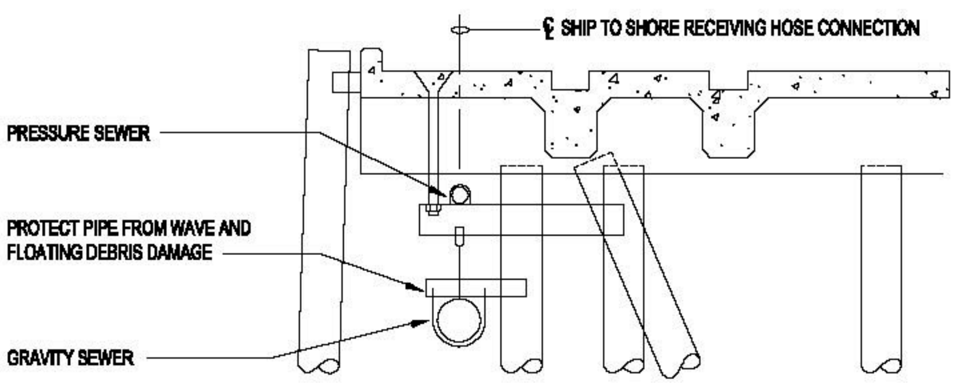


TYPICAL PIER SEWER ASSEMBLIES

Figure 3-11 (b) Typical Sewage Collection Facilities (2 of 2)

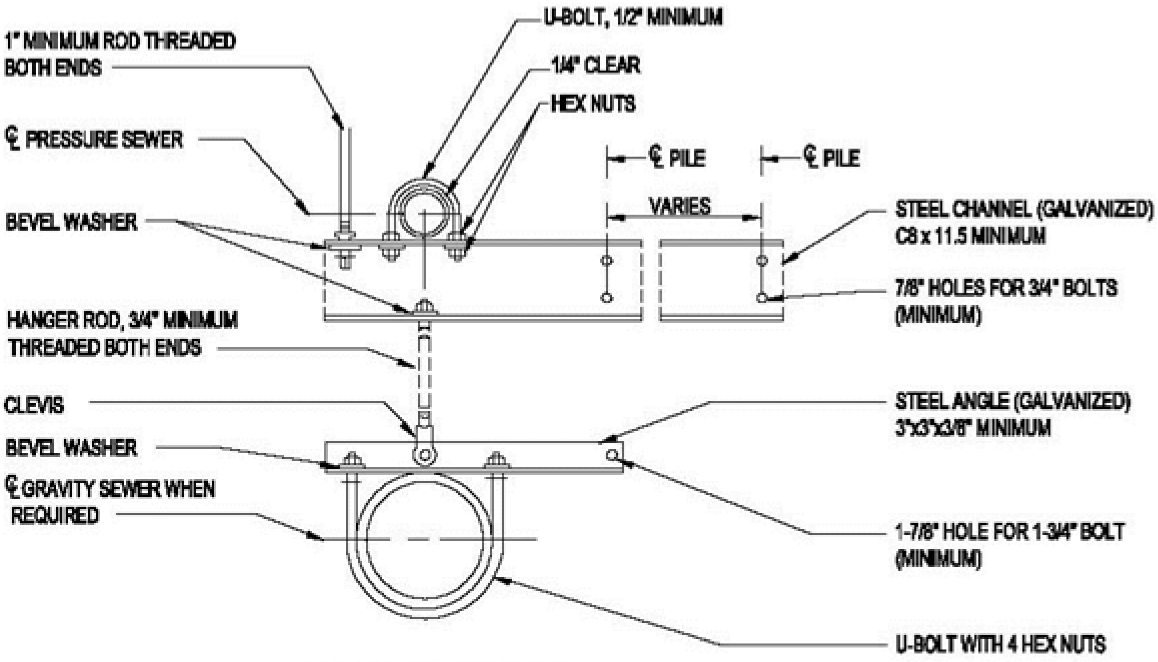


ALTERNATE PIER SEWER ASSEMBLY

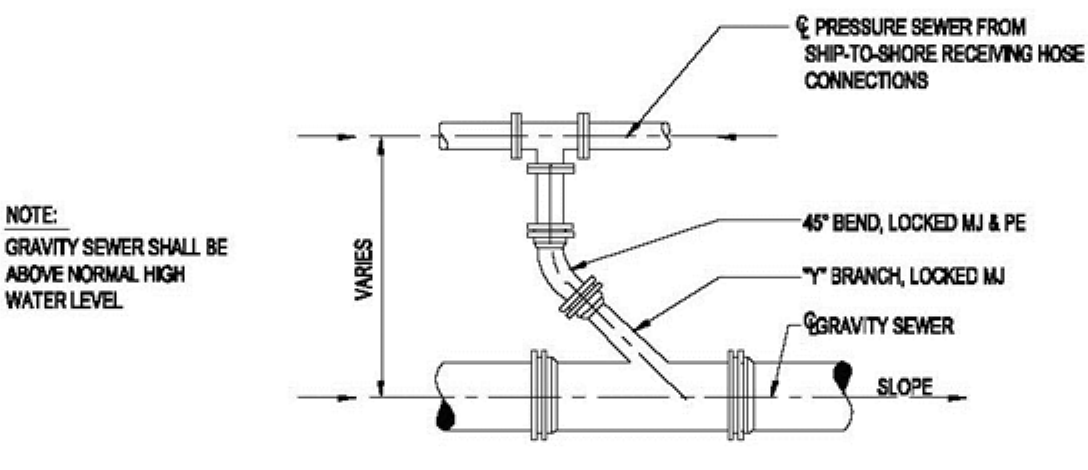


TYPE (2) PIER

Figure 3-12 (a) Details for Sewage Collection Facilities (1 of 2)

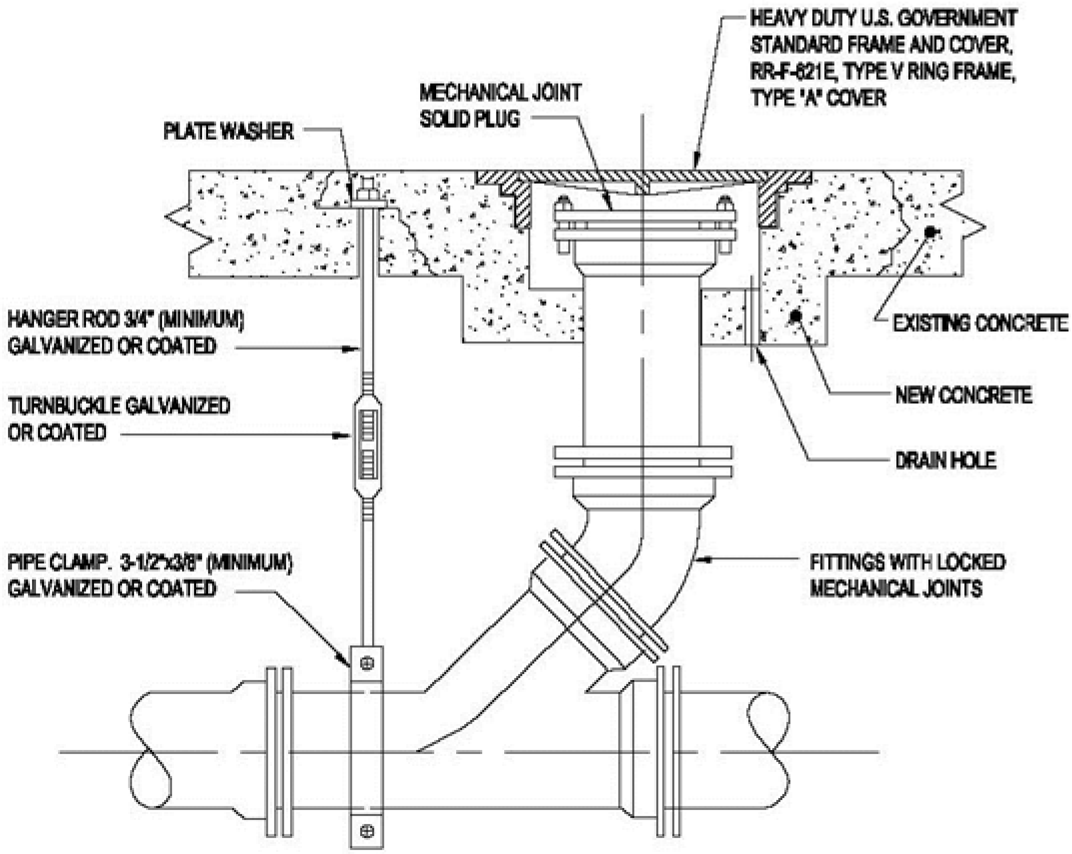


PIPE SUPPORT DETAIL



JOINT DETAIL

Figure 3-12 (b) Details of Sewage Collection Facilities (2 of 2)



FLOW THROUGH CLEANOUT DETAIL

CONCRETE DECK INSTALLATION

CLEANOUT SPACING

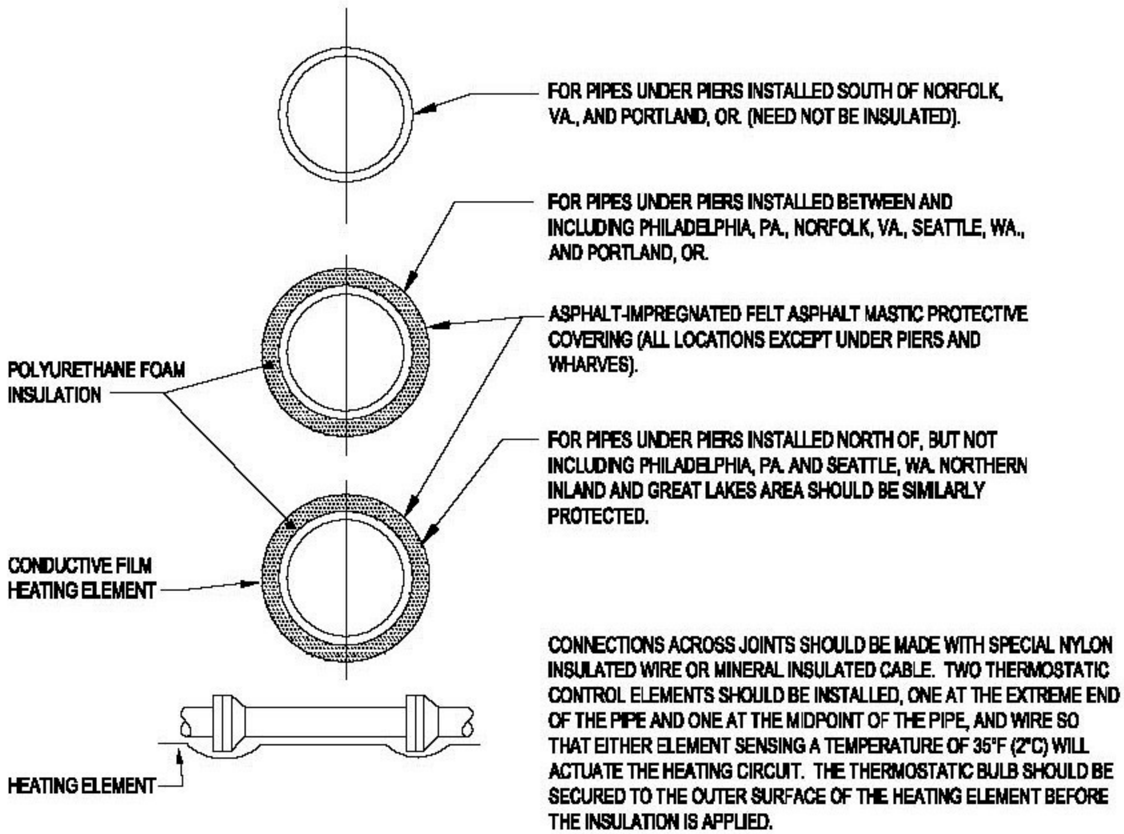
400' MAXIMUM FOR PIPES 15" & SMALLER

500' MAXIMUM FOR PIPES 18" & LARGER

NOTE:

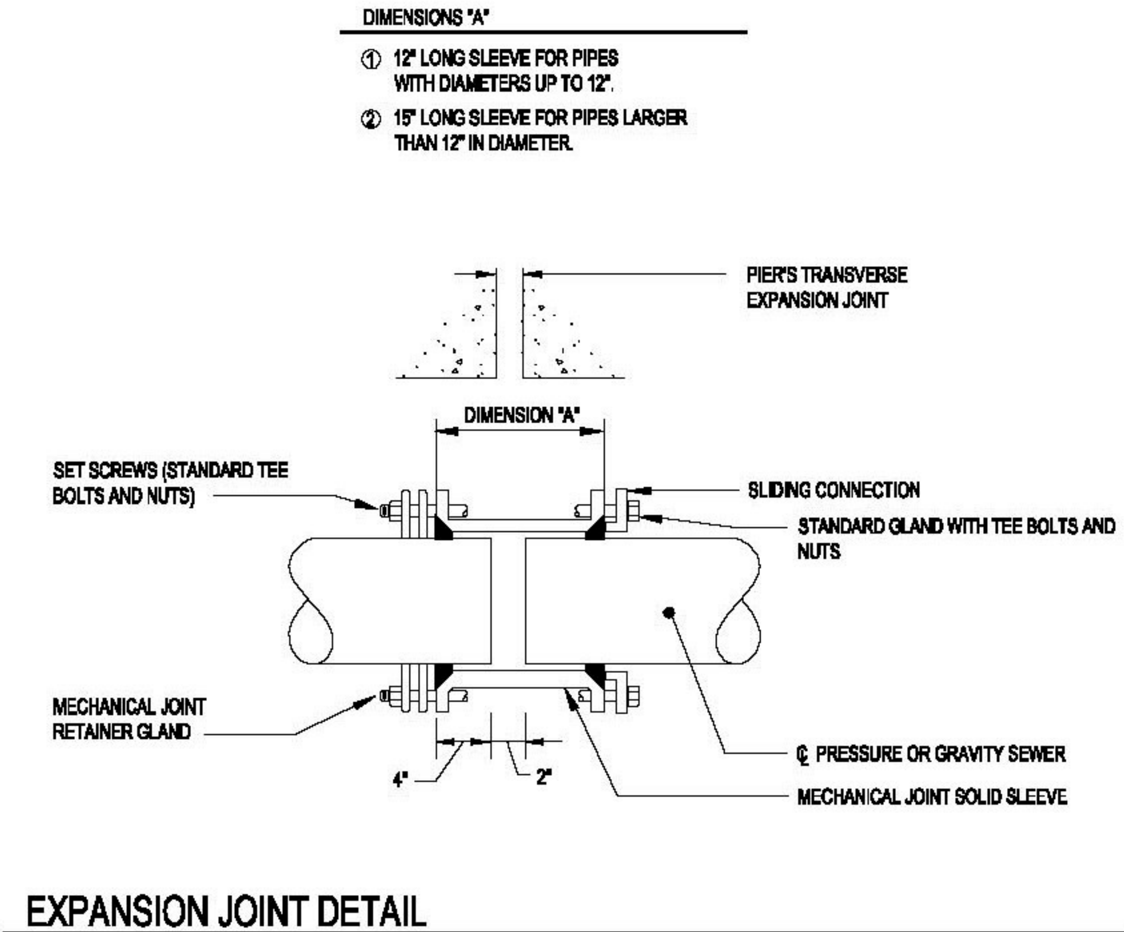
FOR TERMINAL CLEANOUT USE 90° ELBOW IN PLACE OF LATERAL.

Figure 3-13 (a) Piping Details for Sewage Collection Facilities (1 of 2)



FREEZE PROTECTION REQUIRMENTS

Figure 3-13 (b) Piping Details for Sewage Collection Facilities (2 of 2)



3-7.3.6 Structures and Appurtenances.

Some sewer structures and appurtenances have already been defined in Figure 3-11, Figure 3-12, and Figure 3-13. Additional features are defined in Figure 3-14, and Figure 3-15. Also, see Table 3-6.

3-7.3.7 Pump Stations.

The design of sewage pump stations at waterfront facilities requires the careful consideration of all associated parameters including the premium value of real estate. The system must account for all ship flows and the connection to the station's central sewage distribution system. Careful coordination is required with the Activity and the cognizant Service. It is imperative to provide a properly operational system at minimum construction cost and operational cost while optimizing the use of waterfront property.

3-7.3.8 Pipe.

A variety of pipe materials may be acceptable to specify and will vary on a pier-by-pier basis. Consult with the Activity and the cognizant Service for the final material selection. In general, PVC pipe may be used for gravity systems. Ductile iron pipe is preferred for pressurized systems. However, PVC pipe and HDPE pipe has been specified for pressurized systems at some pier facilities. Lined ductile iron with mechanical joints should be used for exposed locations and where high impact resistance is important. Support exposed pipe in accordance with manufacturer's recommendations. In other exposed locations where corrosion resistance is a major concern, consider specifying thermoplastic (high density polyethylene) pressure pipe with butt fusion joints. Plastic piping on pier and wharf systems should be protected from impact by floating debris and other hazards. In these cases, consider a specially designed utility trench. For buried lines, apply general sewer pipe selection guidelines.

Figure 3-14 Ship-to-Shore Sewage Hose Components

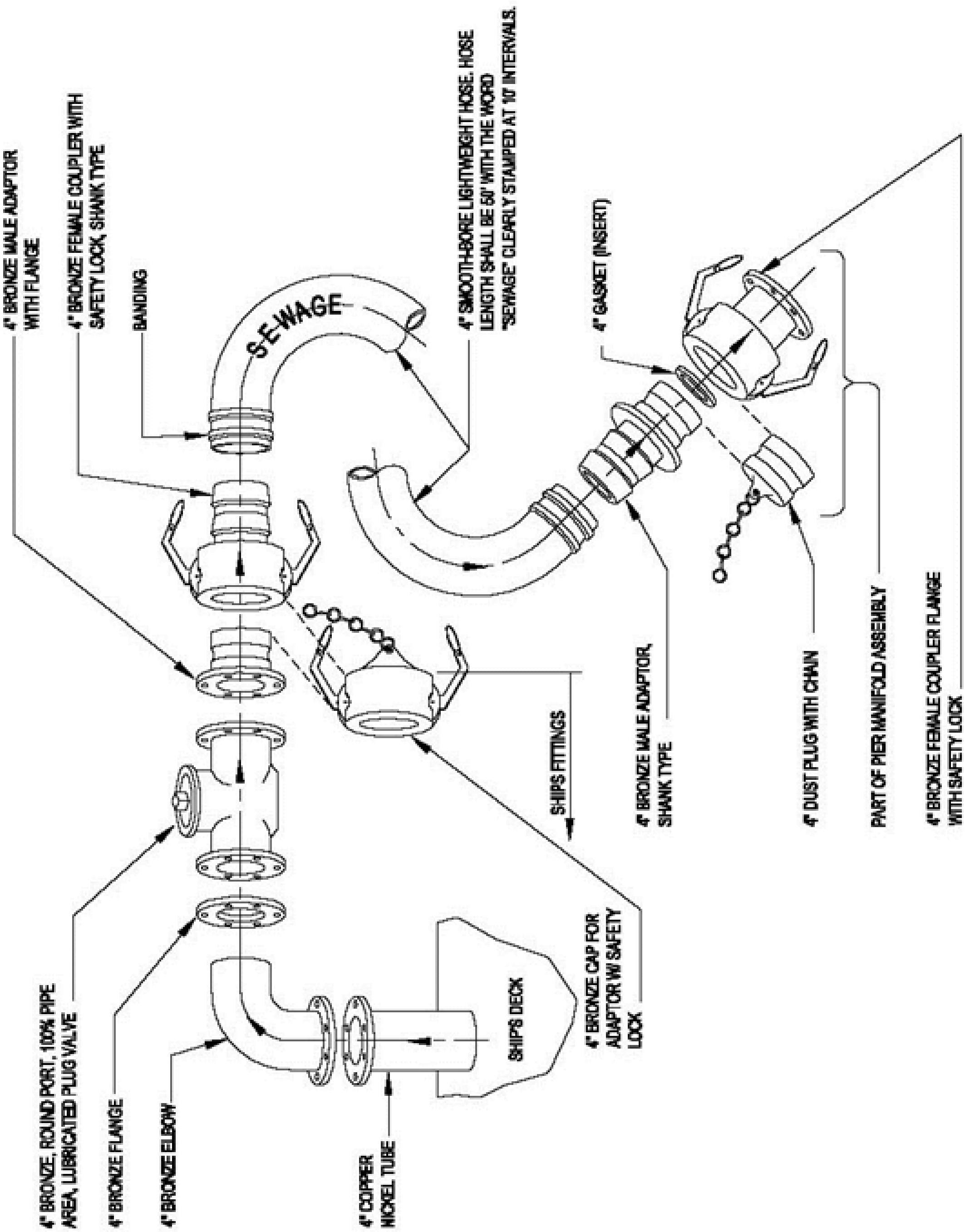


Figure 3-15 Above Pier Hose Connection

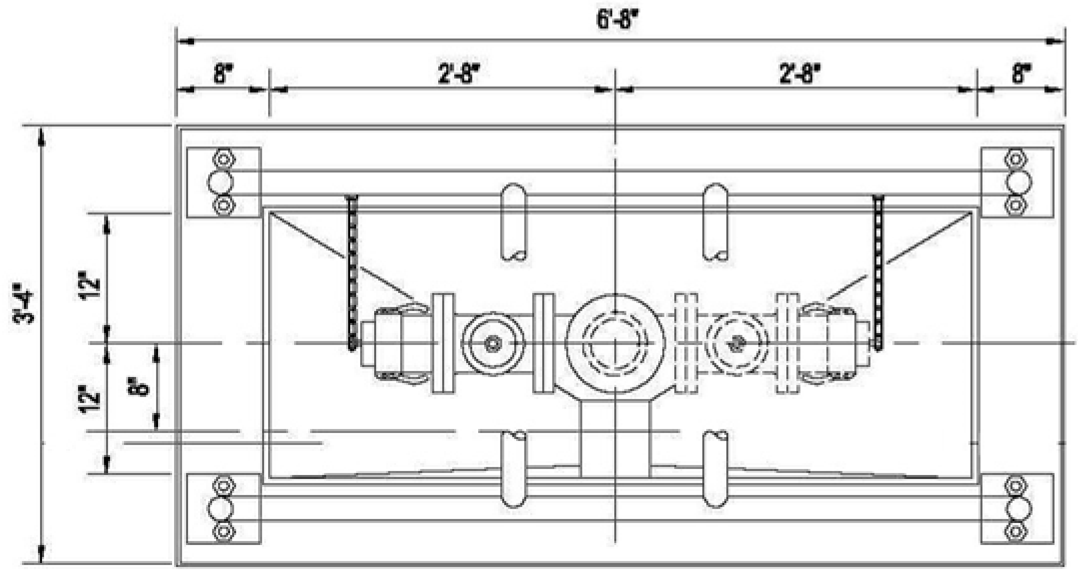


Table 3-6 Special Pier Structures and Appurtenances

Structure or Appurtenance	Where To Use	Details	Requirements
In-line Cleanout	Note 1	See Figure 3-12	
Regular Manhole	Note 2	Refer to UFGS 33 30 00, *Sanitary Sewerage*	Note 3
Drop Manhole	Note 4	Refer to UFGS 33 30 00, *Sanitary Sewerage*	Note 5
Siphons	Note 6	Note 7	Note 8
Intercepting Sewers	Note 9		Note 10
Traps and Interceptors	Note 11	Note 12	
Terminal Cleanout	Note 13	See Figure 3-12	Note 14
Receiving Hose Connections		See Figure 3-14 & Figure 3-15	Note 15
Sewer Pipe Supports	Note 16	See Figure 3-11 & Figure 3-13	

Note:

1. Use in-line cleanout at junctions and changes of direction and when required according to spacing shown in details under regular manhole below.
2. Use regular manhole: terminally on all lines; at all junctions and changes of direction; at changes in invert elevation or slope. Otherwise, according to spacing shown below:

Pipe Size inch (mm)	Maximum Spacing ft (m)
18 (450) or less	400 (120)
18-48 (450-1200)	500 (150)
48 (1200) and greater	600 (180)

3. Requirements for regular manholes: lower invert through manhole a distance equal to expected loss of head in manhole, plus 0.8 times any change in sewer size. For junction manholes, check which upstream invert is critical in determining outlet invert. Raise top of manhole above possible flooding level.
4. Use drop manhole when difference between inlet and outlet inverts exceed 2 ft (0.6 m).
5. Requirements for drop manholes: for difference less than 2 ft (0.6 m), increase upstream sewer slope to eliminate drop.
6. Use siphons for carrying sewers under obstructions or waterways.
7. For siphons: maintain velocity of 3 fps (0.9 m/s). Use no less than two barrels with minimum pipe size of 6 inches (150 mm). Provide for convenient flushing and maintenance.
8. Requirements for siphons: use WEF MOP FD-5 for hydraulic design.
9. Use intercepting sewers where discharge of existing sewers must be brought to a new concentration point.

10. Requirements for intercepting sewers: take special care against infiltration due to depth or proximity of surface water.
11. Use traps and interceptors on all outlets from subsistence buildings, garages, mechanical shops, wash pits, and other points where grease or oil can enter the system.
12. For traps and interceptors: use a displacement velocity of 0.05 fps (0.015 m/s). Grease removal: in absence of other data use 300 to 400 mg/L. Provide for storage of 1 week's grease production (1 day if continuous removal is provided). Length = twice depth.
13. Use terminal cleanouts terminally on all pier collection systems.
14. Requirements for terminal cleanouts: locate where it will not interfere with other operations on the pier or other utilities.
15. Requirements for receiving hose connections: design connections to receive the discharge from ships.
16. Properly support all sewer pipes, especially pipes located under the pier. See Section 2-4.1.3 entitled "Hangers and Support Assemblies".

3-7.3.9 Sewage Transfer Hoses.

See Figure 3-14 and Figure 3-15. Provide a washing facility for washing the end couplings and the exterior of the hose. The facility should include hot potable water and a standard stock detergent. Hose washing/storage facilities must be designed so that manual lifting or pulling of hoses is minimized through the use of mechanical devices and/or arrangement of the area. Caps for each end of the hose should be provided and installed after washing. The clean hose should be stored in drying racks. For further information, refer to NAVFAC MO-340, *Ship-to-Shore Hose Handling Operations Manual*.

3-7.4 Dry Dock Facilities.

For dry dock facilities, design the sewage collection system for the maximum planned docking pattern and the designed peak flow conditions. Consider the following when designing dry dock collection systems.

- Separation of hydrostatic leakage from dry dock wastewater: The dry dock wastewater is generally not contaminated and can be discharged directly to storm sewers or open water depending on regulatory conditions.
- Separation of ship's domestic wastes from the industrial wastes generated by dry dock activities: These industrial wastes include leakage, precipitation runoff, and washdown that carries sandblasting residue and paint.

3-7.4.2 Layout.

Ships fitted with collection-holding-transfer (CHT) should be connected to dockside sanitary sewers for CHT discharge. Ships without CHT should use scuppers and manifold connections to the ship's discharge points and then transfer to the sanitary sewer system. See Figure 3-16 for typical collection system layouts in dry dock facilities.

3-7.4.3 Pump Station Features.

Make capacity equal to that of maximum combined ship's discharge rate of ships in dry dock. Furnish portable auxiliary pumping facilities when required. Refer to UFC 4-213-10.

3-7.4.4 Sewage Receiving Connections and Transfer Hoses.

See Figure 3-17 for underground dry dock receiving hose connections. Figure 3-15 is also applicable for aboveground dry dock receiving hose connections. Aboveground receiving hose connections should be used whenever possible. See Section 3-7.3.9 entitled “Sewage Transfer Hoses” regarding transfer hoses.

3-7.4.5 Special Structures and Appurtenances.

See Figure 3-16 for typical cleanout locations for dry dock sewers. Locate cleanouts in main sewer at a maximum spacing of 300 ft (91 m).

Figure 3-16 (a) Typical Sewage System Layouts for Dry Dock Facilities (1 of 2)

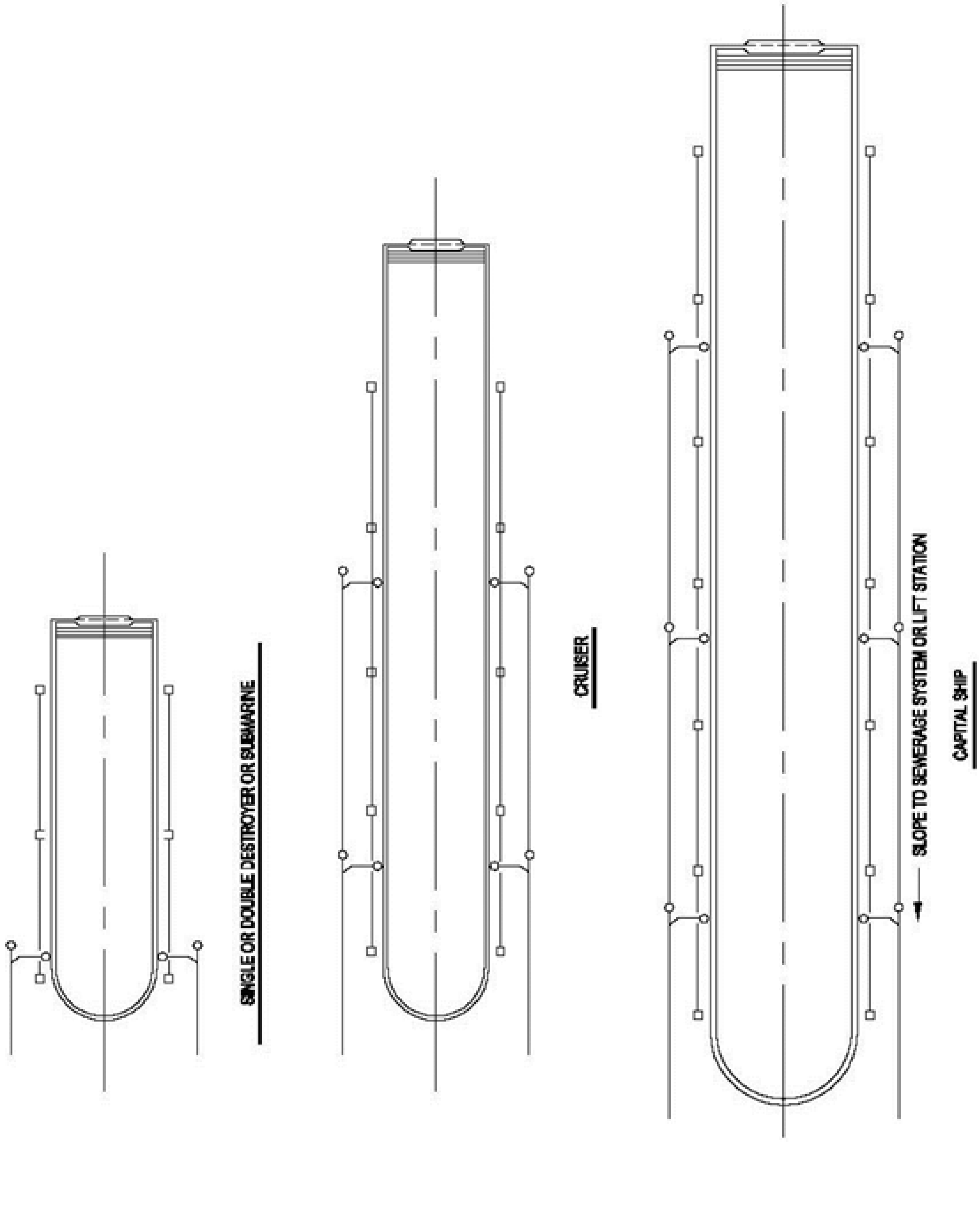


Figure 3-16 (b) Typical Sewage System Layouts for Dry Dock Facilities (2 of 2)

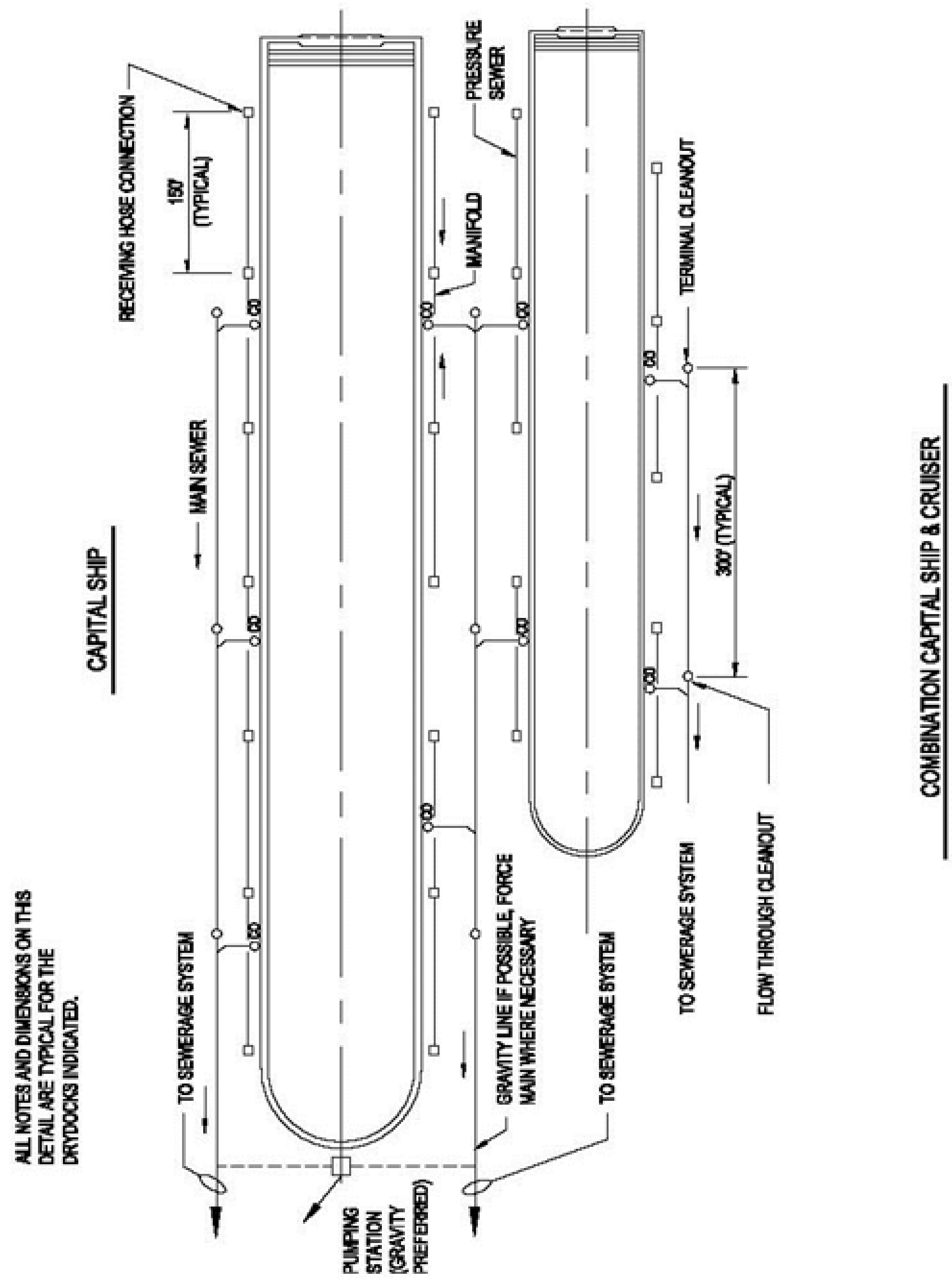


Figure 3-17 (a) Underground Hose Connection (1 of 2)

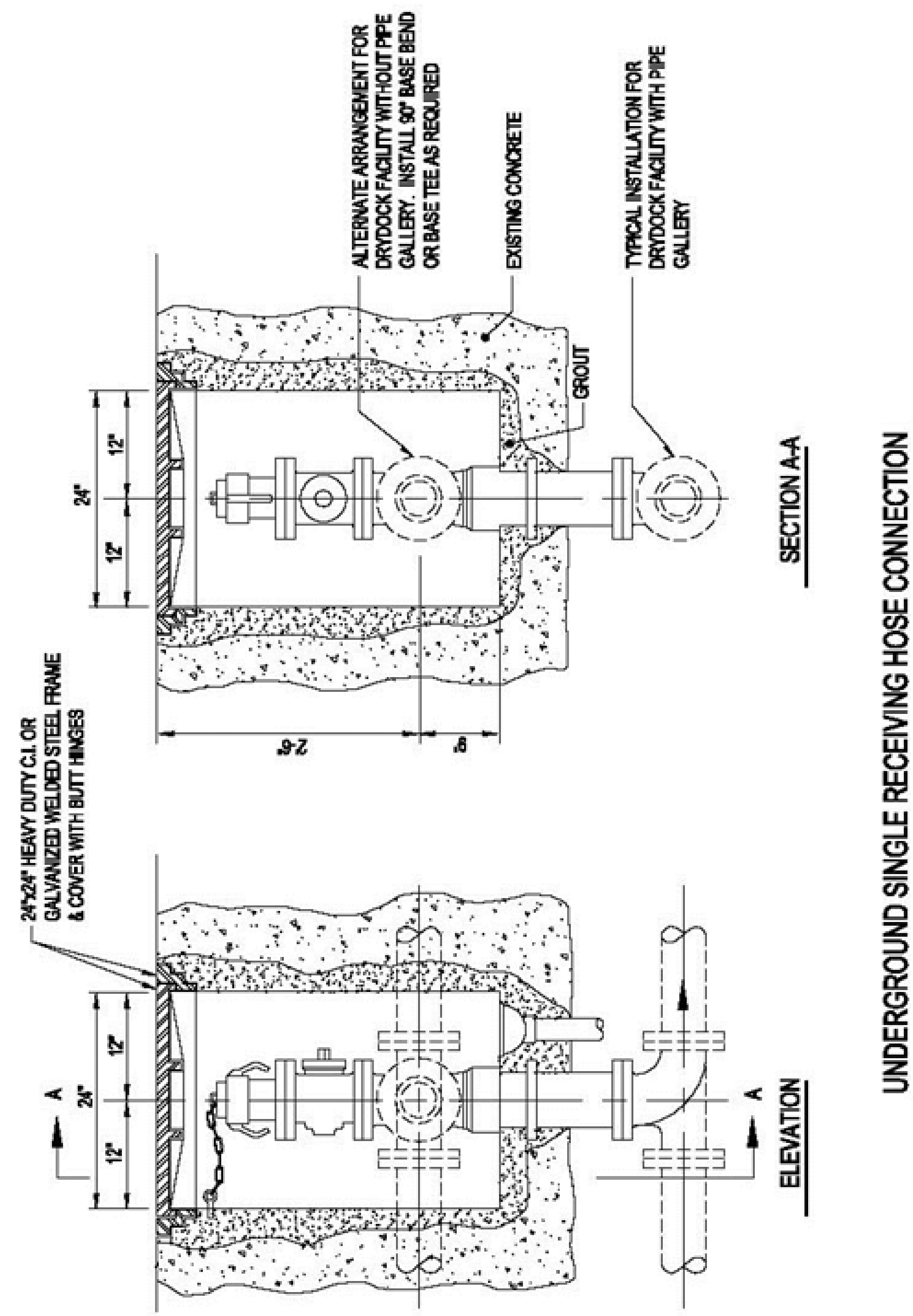
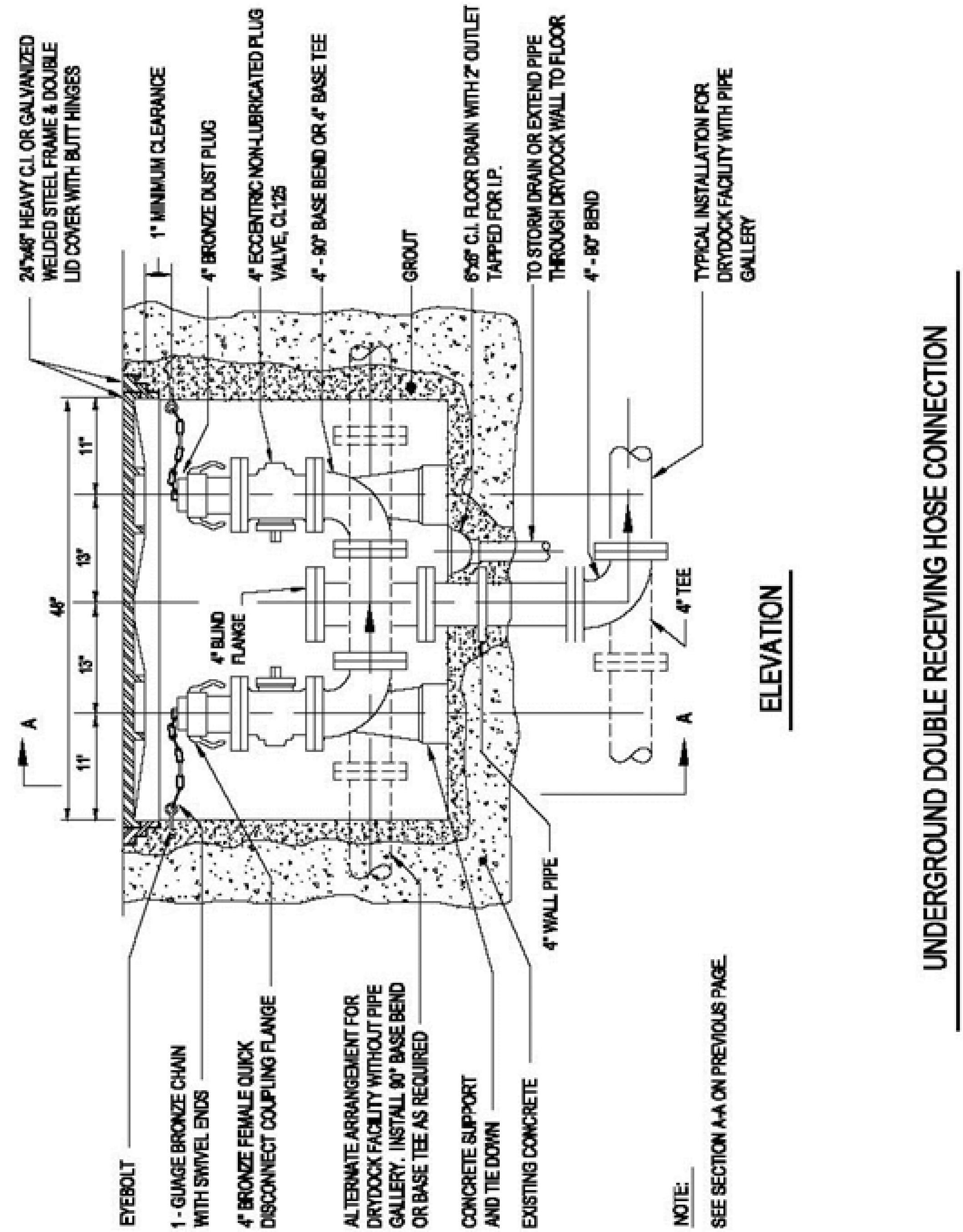


Figure 3-17 (b) Underground Hose Connection (2 of 2)



3-8 ELECTRICAL SYSTEMS.

Electrical power is required on piers, wharves, and at dry docks for ships services. This includes hotel service (shore-to-ship power), ship repair (industrial power), ships systems testing, pier weight-handling equipment, cathodic protection systems, pier lighting, and miscellaneous pier electrical systems. Materials and installation must conform to the requirements given in UFC 3-501-01, *Electrical Engineering*, and in NFPA 70, *National Electrical Code*. For dry docks, refer to additional criteria in UFC 4-213-10. Utility data and specialized technical data is available in APPENDIX A or it may be obtained directly from the cognizant Service. In addition to the design criteria provided in this particular section, operation and maintenance guidance for electrical systems is provided in APPENDIX C.

3-8.1 Types of Electrical Services.

Design electrical services for piers, wharves, and dry docks for one of the two types of service listed below, as directed by the cognizant Service.

3-8.1.1 Permanent Service.

At naval stations, shipyards, repair piers, dry docks, and other continuously occupied waterfront facilities, provide electrical substations and associated facilities to accommodate the normal, maximum electrical demand load. The design may include the use of portable substations. The electrical design must include: (1) ships power requirements (hotel services) on a dedicated un-grounded power system; and (2) other facility loads on a separate grounded power system that includes loads such as lighting, weight-handling equipment, cranes, pumps, general utilization power, and the industrial power system (dedicated for ship's repair work while berthed) when required. There are three basic types of substation installations: (1) the substation is installed on the lower deck of a double-deck pier; (2) the substation is installed on the pier deck of a single-deck pier or at grade level adjacent to the pier or associated waterfront facility, and (3) the substation is installed in an electrical vault located below the pier deck. The vault system has been used on many existing piers, however it is not recommended for new installations and requires approval of the cognizant Service. See APPENDIX C and Section 3-8.4.1 entitled "Substations" for additional information.

3-8.1.2 Temporary Service.

Provide temporary electrical service at waterfront 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 high voltage outlet assemblies (5 kV and 15 kV) for connections to portable substations. Examples of high temporary loads include: (1) power for testing certain ships weapons systems; and (2) power for testing ships plant nuclear systems. That portion of the load serving basic pier, wharf, or dry dock functions (lighting, weight-handling equipment, and receptacles not related to ship service or repair service) must be fed from the permanent service.

3-8.2 Primary Power System.

The primary distribution system on the pier or other waterfront facility normally operates in the medium-voltage range between 5 kV and 35 kV and will depend upon the shore-side utility voltage(s) available. The shore-side utility system is normally already in existence. It may have to be expanded or upgraded to support a new or increased capacity pier, but will rarely require a completely new electrical utility service point. Upgrades to the system should provide the pier with a dedicated normal circuit and provisions for switching to a backup circuit. The Activity is responsible for providing justification for alternate primary feeders and standby power services required for essential operations. Special electrical primary systems may be required for certain classes of ships. These specific requirements are included in APPENDIX A. Provide selective coordination between system equipment components to ensure minimized downtime of ships systems due to external or internal electrical system faults. Refer to UFC 3-501-01, *Electrical Engineering*, for a description of the different types of distribution systems.

3-8.2.1 Pier, Wharf, or Dry Dock Primary Systems.

For permanent service, provide dual primary feeders from the shore primary system to the switching stations or substations serving the ships' hotel services and industrial loads. For temporary service, provide dual primary feeders from the shore primary system to strategic locations that serve portable substations. Conduits, ductbanks, and manholes cast integrally with the pier structure are preferred for new piers. Conduits on piers may also be installed in dedicated electrical trenches or in piping trenches that serve other utilities, or hung from above on double deck piers. To avoid damage to the conductor's insulation, electrical conduits should not be placed in close proximity to high temperature systems such as steam piping. Refer to CHAPTER 2 for general protection requirements.

3-8.3 Secondary Power Systems.

The secondary electrical distribution system is evolving to higher voltages as the power demand on the ships continues to increase. It must be designed with the flexibility to serve the various classes and categories of ships that are anticipated to utilize the facility.

3-8.3.1 Ships Power.

Historically, the electrical system providing power for most ships has been a dedicated 480 V (nominal), three-phase, 60 Hz, ungrounded system. This system has been supplied from substations located on piers (or at the head of the pier for shorter piers), and connected through dedicated receptacles located at the perimeter of the pier, wharf, or dry dock. Currently, 4,160 V (nominal), three-phase, three-wires, 60 Hz power is required for nuclear aircraft carriers (CVN 68 class and higher). These carriers are sometimes capable of accepting 480 V power as well. Future classes of ships (surface combatants and amphibious assault) will require 4,160 V (nominal), three-phase, three-wires, 60 Hz power. CVN 78 class ships will require 13,800 V (nominal), three phase, three wires, 60 Hz power. The pier electrical distribution system must be designed to limit the fault current contribution from the shore power, at the ship's bus, to 100,000 A (rms) for 480 V distribution, 35,000 A for 4,160 V distribution, and 15,000 A (rms) for 13,800 V distribution. The use of UL listed current limiting breakers is recommended to limit the let-thru I^2t energy during a fault to not more than the available energy during a half-cycle of the prospective symmetrical short circuit current.

3-8.3.2 Other Ships Power Requirements.

When required, provide direct current (DC) power and 400 Hz power for ships service. These systems must be derived from portable rectifiers or conversion equipment provided by the Activity. Provide an electrical power connection system that is supplied from the pier's permanent / industrial power system rated 277/480 V, three-phase, four-wires, grounded, 60 Hz. These special power systems must not be connected to the ships' dedicated shore power service(s). Conduit for 400-Hz systems requires the use of non-magnetic conduit such as aluminum conduit. This is due to the higher reactive inductances at 400 Hz which occurs in magnetic conduit resulting in large voltage drop issues (such as when using rigid galvanized steel conduit).

3-8.3.3 Permanent Pier Loads and Industrial Power.

Other electrical requirements such as pier lighting, receptacles, weight-handling equipment and industrial power must be supplied from dedicated 480Y/277 V transformers. A delta primary winding for transformers prevents 3^{rd} harmonics from being transmitted to the primary line and limits voltage distortion impacts to the electrical distribution system whereas a wye-wye wound transformer does not. Industrial power is defined as power specifically for equipment utilized for the repair and overhaul of ships at berth and is normally only required in naval shipyards. Do not provide permanent pier load power or industrial power from the same transformers providing shore to ship hotel power.

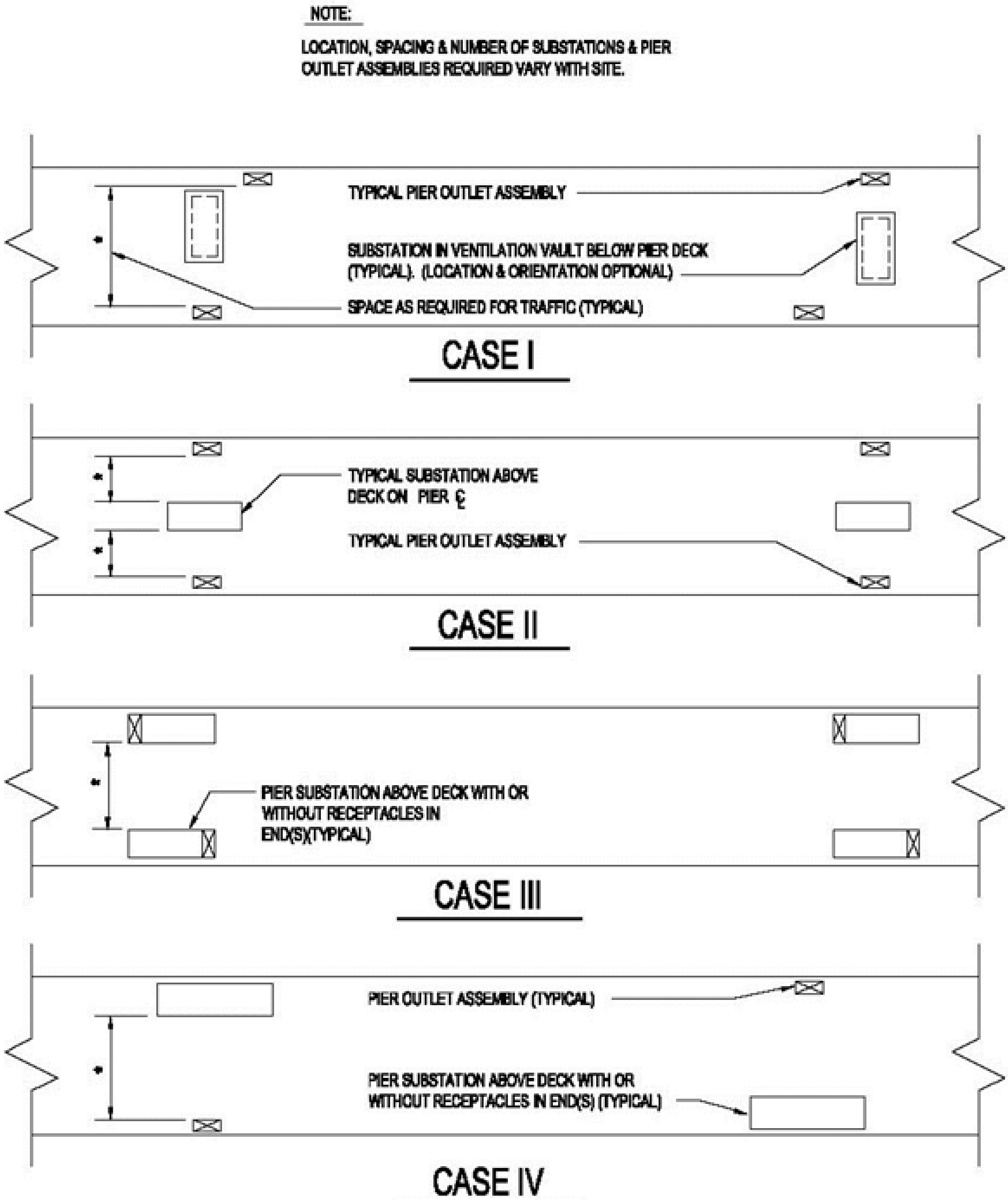
3-8.4 Location and Arrangement of Equipment.

Final locations of equipment must be made on a pier-by-pier basis in concurrence with the Activity and the cognizant Service. Selection must be coordinated with the pier design type, other pier utilities and the pier's operational requirements. In general, provide as much clear space for cranes and vehicular traffic on the pier deck as possible. Examples of pier equipment arrangements are shown in Figure 3-18.

3-8.4.1 Substations.

The three main types of arrangements for substations are discussed in the following subparagraphs with an example of their use, where appropriate. The unit substations should be outdoor construction.

Figure 3-18 Typical Alternative Pier Electrical Equipment Arrangements



3-8.4.1.1 Double-Deck Pier Substations.

On a double-deck pier, the upper deck is used for conventional pier functions while the lower deck serves utility systems and utility connections. The electrical service for a double deck pier should be a permanent service. The substations should be located on the lower deck and may be symmetrically arranged around the pier centerline. Cross sections of a double-deck pier are shown in Figure 2-2. One recent example of substation arrangement and power distribution system is Pier 6 at the NS Norfolk (NSN). It consists of two electrical service clusters with each service cluster consisting of four 4,000 kVA unit substations, totaling 32 MVA. The output of these substations serves fixed low voltage outlet assemblies. These outlets are defined on the Pier 6 project drawings as “shore power stations” (SPS). Each SPS contains 12 sets of three (3), single pole, low voltage cable connectors (36 connectors total) that in turn serve the shore-to-ship service cables. Illustrations of the electrical system for the NSN double-deck Pier 6 are shown in Figure D-1. (Note the one-line drawing in Figure D-1(a) the nominal medium voltage is 34.6 kV and the distribution conductors are 750 MCM EPR copper.) Pier 6 was designed as a general berthing pier to support all ship classes except SSN and CVN, and may not be directly applicable for double-deck SSN and CVN piers or piers designed for specific ships. See Appendix C-5 “Cable Connectors” for additional information on the various types of connectors currently being used.

3-8.4.1.2 Single Deck Pier Substation.

On a single deck pier the substation can be deck mounted or at grade level adjacent to the pier. The unit substation illustrated in the vault system in Figure D-2 could also be utilized in the pier deck mounted or grade level installation system. The deck mounted/grade level substations may include walk-in aisle features, however they are not recommended when located on the pier due to the significant increase in size.

3-8.4.1.3 Existing Pier Vaults.

Many existing piers utilize the electrical vault system. This system is described in Figure D-2. This type of electrical service, commonly used on many existing piers, is not authorized for the design of new piers. It was based upon electrical vaults located below the pier deck that were designed as an integral part of the pier’s structural system. The vaults house secondary unit substations and may also contain primary switching equipment. The vaults require proper ventilation, pumping systems, and an access system integrally designed into the pier’s deck. This type of electrical system has four significant disadvantages: (1) the vaults are considered to be a “confined space”; (2) the vaults are subject to flooding; (3) the vault’s environment is excessively corrosive to the electrical equipment, even under normal conditions; and (4) replacement of a unit substation creates significant interference to pier operations and results in deck pavement removal and replacement.

When a vault system is used, the substation vaults must be ventilated and flood resistant for protection of the electrical equipment. Prevent flooding with dual sump pumps that discharge at a point above highest tide. Provide a "float switch and alarm system" to alert personnel of sump pump failure and high water level. The sump pump power must be connected to a source other than the vault substation. That source must remain energized when the pier electrical hotel service power and permanent / industrial power systems are turned off. Freeze protection must be provided in climates where any element of the pumping system could freeze. Ventilation cooling must be provided with air quantity based upon the highest site temperature and the highest vault temperature that can be tolerated by the electrical equipment. One approved method of vault ventilation is shown in Figure D-2. Separate ventilation air intake and exhaust louvers by as much distance as possible. They may be on opposite sides of the pier if the ventilation ducts are above high tide. Provide an access system for the electrical vault that includes personnel access and equipment replacement access. Personnel access usually consists of manhole frame with cover and vertical ladder. Equipment access systems are a significant structural element that are required to withstand vehicular traffic and must be designed as an integral part of the pier deck.

3-8.4.2 Outlet Assemblies.

The number of electrical shore service stations, their location aboard ship, the per station ampacity, and appropriate voltage for each ship are defined in APPENDIX A. For a general discussion of methods to be used to establish shore utility station spacing on piers and wharves, refer to CHAPTER 2. For spacing at dry docks, refer to UFC 4-213-10.

3-8.4.3 Cable Lengths.

Most ships have to be served from multiple 400 Amp circuits. Design the electrical system to maintain balanced impedances and reduce unbalanced phase currents. Route cable from the substation to the outlet assemblies in the parallel circuits to achieve approximately equal cable lengths (within 10%). When routing shore power feeder conduits through concrete decks, avoid routing individual shore power PVC conduits through closed rebar loops due to possible inductive coupling causing current unbalance with feeder PVC conduits not routed through the same rebar loop(s). Where single phase connections and cabling are used for ship to shore connections, care must be taken to bundle phases of each circuit to maintain balanced impedances and reduce unbalanced phase currents.

3-8.4.4 Combined Equipment.

Electrical substations and outlets may be consolidated in an integral package, with the receptacles placed in the side (or sides) of the substation enclosure. These consolidated outlet assemblies may be spaced as necessary along the pier or dry dock perimeter. See Figure 3-18, Cases III and IV.

3-8.4.5 Outlet Assemblies for Portable Equipment.

When supplying ships loads from portable substations, locate primary outlet assemblies in the same manner as required for regular outlet assemblies. Primary outlet assemblies, provided for temporary services that supplement permanent substations, should be placed in the vicinity of their intended use. Coordinate these locations with the Activity and the cognizant Service.

3-8.5 Distribution System Equipment and Materials.

Equipment and materials selected for waterfront electrical systems must be coordinated with the cognizant Service and the standards and preferences of the Activity. Since significant technical information for many of the distribution system components is available in the Unified Facilities Guide Specifications (UFGS) Sections UFGS 26 11 16, *Secondary Unit Substations*, UFGS 26 13 00, *SF6/High-Firepoint Fluids Insulated Pad-mounted Switchgear*, and UFGS 26 23 00.00 40, *Switchboards and Switchgear*, the nomenclature and requirements for the equipment must be thoroughly coordinated in the project documentation (plans and specifications).

3-8.5.1 Fixed Substations for 480 Volts Service.

There are several methods for providing substations for permanent 480 V services on piers. Based on the overall system design, the substation should contain primary, secondary, auxiliary, and transformer sections. See APPENDIX C. The primary section would either contain the primary overcurrent protection features, a disconnect switch, and a service circuit selector switch if the system includes multiple primary circuits, or it would be limited to the primary circuit terminations if separate pad-mounted primary switchgear is used. Where transformer differential relays are used, the primary section should contain a circuit breaker instead of fused disconnects to allow disconnecting primary side power to the transformer via a trip circuit connection to the breaker from the differential relay. There must be separate 480 V secondary unit substations designated for the ships hotel loads and for the other pier loads including industrial power (if required). The main transformers should be of the liquid-cooled type, standard three-phase, 480 V, with four (4) full-capacity, 2-1/2-percent taps, two above and two below the nominal primary voltage rating unless actual operational conditions require other tap settings. Maximum transformer rating should be 4,000 kVA. Substations, including transformers should be stainless steel with a paint coating system in compliance with ANSI/NEMA C57.12.29. If specific operational conditions require parallel operation with the shipboard generators, coordinate with the cognizant Service to determine the additional features that must be added to the equipment. In these cases, the shipboard generator and other equipment ratings are available upon request from NAVSEA.

Substation must be designed with maintainability in mind and provisions and/or clearance for removing the circuit breakers must be factored into the design.

3-8.5.1.1 Shore Power Circuit Breakers.

The equipment should provide 480 V (nominal), three-phase, 60 Hz power, as defined in ANSI/NEMA C84.1, *Voltage Ratings for Electrical Power Systems and Equipment (60 Hz)*, voltage range "A." via low voltage power circuit breakers. The power circuit breakers shall be electrically operated, drawout-type, with adjustable electronic trip features. Feeder circuit breakers shall provide circuit protection up to a maximum overcurrent setting of 480 Amps and interrupting ratings up to 100 kA at 480 VAC without fuses. Provide a circuit breaker for each individual shore power service receptacle. The adjustable trip module long time pick-up (LT setting) for submarine shore power circuit breakers shall be adjusted per APPENDIX C, C-4.1.

3-8.5.1.2 Shunt Trip Interlocks.

- Provide a shunt trip interlock circuit to open all possible paralleled circuit breakers in the event that any shore power circuit breaker trips due to an overcurrent operation.
- For existing installations, provide a shunt trip interlocking scheme on all ship power service circuit breakers for submarines.
- For new construction a remote trip capability shall be provided on all ship power services for submarines.

3-8.5.1.3 Space Heaters.

Space heaters should be incorporated within individual substation sections in order to prevent condensation.

3-8.5.2 Substations for 4,160 or 13,800 Volts Service.

Provide substations with a secondary voltage of 4,160 V or 13,800 V (nominal, as defined in ANSI/NEMA C84.1, voltage range "A), when required by APPENDIX A for the classes of ships to be berthed. Design of primary unit substations is similar to fixed 480 V substations except for voltage classifications and outlet assembly provisions. Circuit breakers should be 5 kV or 15 kV vacuum drawout type, with interrupting current rating based on available fault.

3-8.5.3 Portable Substations.

See Figure D-3. The pier design must include space allocation for the portable substations and provide the electrical primary distribution system required to energize the portable substations. This includes primary circuits, their disconnect switches, and the primary outlet assemblies. Design is similar to fixed substations except for portability provisions.

3-8.5.4 480 Volt Outlet Assemblies.

480 V outlet assemblies (receptacles and cable connections) vary with Activities but should be standardized on a Station-by-Station basis. Additional information on the outlet assemblies and the actual operational procedures used on the piers is available in UFC 3-560-01, *Electrical Safety O&M*, Section 9, “Shore-to-Ship Electrical Power Connections”. Detailed specifications for the outlet assemblies are also included in guide specification UFGS 26 05 33, *Dockside Power Connection Stations*.

3-8.5.4.1 Receptacles.

Ships hotel service receptacles must be provided in weatherproof, corrosion-resistant pier outlet assemblies, or combined with the substations. Provide the number of receptacles required to serve the specific ship types and classes in accordance with APPENDIX A.

There are currently two types of ship hotel service receptacles being used, a three-pole receptacle and a single-pole receptacle. Existing facilities and NATO, Army, and USCG ships utilize a three-pole, 500 Amp receptacle in accordance with Mil Spec MIL-C-24368/1, *Connector Assemblies; Plug, Power Transfer, Shore-to-Ship and Ship-to-Ship*. A typical MIL-C, three-pole outlet assembly is illustrated in Figure D-4. Other facilities and the Navy utilize a single-pole, 500 Amp receptacle, grouped in a cluster of three. Typical details of the single-pole receptacle system are shown in Figure D-5. The preferred connection is the single-pole receptacle which must be used for new construction for the Navy.

3-8.5.5 Primary Outlet Assemblies.

Primary voltage outlet assemblies must have weatherproof, corrosion-resistant enclosures and high voltage connectors. Connectors must match the standard primary voltage coupler in use by the Activity and as required by the cognizant Service. Disconnects should have an interlocking key which can only be removed when the switch is opened. Design should be such that, after the disconnect has been opened, the interlocking key must be used to unlock and make possible the insertion or removal of the corresponding primary voltage pier coupler plug. Provide 500 Amp coupler receptacles at each 4,160 and 13,800 V pier outlet assembly. Incorporate outlet assemblies into substations as applicable. See Figure D-6 for typical 15 kV details.

3-8.5.6 Coordination of Shipboard Phase Rotation.

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 *NAVSEA 59300-AW-EDG-010/EPISM*, Section 2, Group E, Sheets 14 and 15, to determine phase rotation required for shore power connections.

3-8.5.7 Conduit Systems.

For electrical conduit exposed under or on a pier, wharf, or dry dock, evaluate the relative advantages of Schedule 80 PVC, and Reinforced Thermosetting Resin Conduit (RTRC). Avoid the use of PVC where it will be exposed to sunlight and moving objects. Although PVC Coated steel conduits have been used on many piers, the alternatives are more attractive from an economic and durability standpoint. The potential exists for loss of integrity of the PVC Coating systems in the harsh and corrosive environment. Fiberglass cable trays may be used in lieu of conduit where adequately protected from physical damage and the elements. Coordinate hangers with the requirements in Section 2-4.1.4 entitled “Hangers and Support Assemblies”.

3-8.6 Ships’ Shore Power Requirements.

APPENDIX A provides a listing of shore electrical loads of ships while homeported or undergoing alteration and repair. Substation and feeder sizing on piers and wharves must be based upon the electrical loads given in the "Design Load" 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 in a secondary outlet assembly should match the number of receptacles in the ship’s respective receptacle stations. 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 (AC) Power.

Hotel service loads include the ship's electronics, weapons systems, cargo booms, galley equipment, space heating, and miscellaneous lighting and power loads. The number of circuits shall be as requested by ship’s force. These loads are supplied with either 480 V (nominal) or 4,160 V (nominal) ungrounded power, or 13,800 V (nominal) ungrounded power. The 480 V system shall supply approximately 480 V at no load and 450 V (plus or minus 5%) under loaded conditions and at the ship's load center. The 4,160 V system shall supply approximately 4,160 V plus or minus 5% under loaded conditions and at the ship's load center. The 13,800 V system shall supply approximately 13,800 V plus or minus 1% with up to 60 seconds time delay under loaded conditions. Cable ratings must be sized to exceed the ships’ loading requirements of APPENDIX A and the associated circuit breaker trip settings. System design must be coordinated with the planned nesting requirements of the pier to maintain the voltage within the allowable tolerances at outboard ships.

3-8.6.2 Direct Current (DC) Power.

When required, DC power should be provided for certain ships in accordance with instructions provided by the Activity. Portable rectifier units will be provided by the Activity. Provide sufficient AC power and receptacles to serve such equipment. Coordinate connection requirements with the Activity.

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 to serve such equipment. Coordinate connection requirements with the Activity.

3-8.6.4 Shipboard Equipment Ratings.

Most ship distribution circuit breakers operate at 440 V and are protected with 100,000-Amp interrupting current, 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. The main breaker for the shipboard system on nuclear carriers is an air-type breaker rated at 250,000 Amps asymmetrical interrupting capacity, and without current-limiting fuses. The shore distribution system must be designed in accordance with UFC 3-501-01, *Electrical Engineering*, to ensure that available fault is within the capability of the ship's distribution system. Contact the cognizant Service for information on shoreside fault current data to determine the required interrupting capacities and equipment design characteristics.

3-8.7 Supplemental Requirements for Nuclear Submarines (SSN, SSBN, SSGN) and UUVs.

Nuclear submarine (SSN, SSBN, SSGN) and Unmanned Underwater Vehicles (UUVs) piers and berths should conform to the following shore power requirements.

3-8.7.1 Substations for 480 Volts Service.

Substations serving hotel loads at submarine piers must be designed in accordance with Section 3-8.5.1 entitled "Fixed Substations for 480 Volts Service" for fixed substations, or Section 3-8.5.3 entitled "Portable Substations" for portable substations, and in accordance with the supplemental requirements below. The substation's primary section should be built with dual primary feeders. Switchgear and breaker equipment should be designed so that automatic reset and restoration of power to submarine services will be delayed a minimum of 5 to 10 seconds after loss of commercial power. This is required in order to prevent damage to the submarine's electric plant equipment. The maximum time to restore power should be 5 minutes. Provide undervoltage and underfrequency relays at substations. Relay types and set points for undervoltage and underfrequency should be evaluated separately for each installation and coordinated with the cognizant Service.

3-8.7.2 Standby Power.

Power requirements for normal operation are given in APPENDIX A. Standby backup power to the normal shore supply is required. A standby backup electrical power source for the reactor plant is required which is capable of providing 450 V, 3 Phase 60 Hz power with a capacity of at least 850 kW with the ability to start a 260 hp induction motor with an initial load of 650 kW. The standby backup power source should use the normal ship's shore power connections. This source of standby power will only be required to be available when power from the ship's battery or diesel generator are not available. The standby backup power source can be, for example, a portable generator set, or separate power sources to the facility, provided that the loss of one source will not result in a long duration power outage.

3-8.7.3 Maximum Downtime.

For the shore facility and overhaul yard dry dock permissible outage time allowed is 5 minutes. System downtime is defined as: (1) the time required to restore power to the pier when maintenance or repair activities are required; or (2) 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 standby generators.

3-8.7.4 Super Shore Power.

APPENDIX A lists “super shore power” requirements for nuclear submarines. Super power is required for the ship's testing, checkout, and refueling operations. These super shore power requirements are in addition to the normal power requirements. Provide super power from a separate substation that supplies no other loads. Portable substations connected to temporary service outlets are recommended for this service. Extend primary service and provide connections for these portable substations. The special requirements for submarine piers given in subparagraphs 3-8.7.1, 3-8.7.2, and 3-8.7.3 entitled “Substations for 480 Volts Service,” “Standby Power,” and “Maximum Downtime” above do not apply to super shore power.

3-8.7.5 Shorepower Booms.

Provide permanently installed shorepower booms at submarine/UUV piers and berths. See UFC 4-152-01, *Piers and Wharves*, for additional submarine/UUV pier/berth configuration, construction, berthing, fendering, access, and utility infrastructure requirements.

3-8.7.6 UUV Requirements.

Special considerations must be given to ensure all power and infrastructure requirements for current and future UUVs are met.

3-8.8 Ground System.

Provide a ground system at piers, wharves, quay walls, and other waterfront structures that measures not more than 5 Ohms for all permanent electrical equipment. Ground systems should be in accordance with NFPA 70. Stranded-copper-wire ground conductors, sized in accordance with NFPA 70, should be used to interconnect equipment enclosures and the ground system.

3-8.9 Pier Lighting.

Information on pier lighting is available in UFC 4-152-01, *Piers & Wharves*.

3-8.10 Lightning Protection.

Provide lightning protection systems when required. Coordinate with the cognizant Service. Design in accordance with UFC 3-575-01, *Lightning and Static Electricity*

Protection Systems, and NFPA 780, Standard for the Installation of Lightning Protection Systems. Consider the protection of cranes, above deck substations, pier mounted buildings, and lighting system masts.

3-9 TELECOMMUNICATION SYSTEMS.

The purpose of this section is to provide requirements for Base Level Information Infrastructure (BLII) Pier Connectivity Specifications, telephone service, and other telecommunications systems.

3-9.1 BLII Pier Connectivity.

These guidelines are provided for planning, designing, engineering, and constructing new or repairing existing Navy piers. Figure 3-19 illustrates the three major components that are required to provide end-to-end connectivity to IT-21 compatible ships. They are the Pier Head ITN Building Node; the Pier Fiber Distribution Center, and the Fiber Optic Riser Panels.

3-9.1.1 Pier Head ITN Building Node.

The Pier Head ITN Building Node is connected to the Base Area Network (BAN) and becomes the interface for adding additional piers to the infrastructure for SIPRNET/NIPRNET connectivity. A 144-strand hybrid fiber optic cable (72 multi-mode and 72 single mode) is required between the Pier Head ITN Building Node and the Pier Fiber Distribution Center. Where a hybrid cable is not readily available and the designer deems it appropriate, two individual cables, one 72 strand single-mode and one 72 strand multi-mode, are permitted for use in lieu of the hybrid cable. The fiber optic cable may already exist if the pier is being repaired; however, for new pier construction, the cable will need to be installed. The designer should coordinate with the local Information Technology (IT) group to ensure that the proper Pier Head ITN Building Node has been identified. All cabling and interconnections inside the Pier Head ITN Building Node are the responsibility of the local IT group unless other prior arrangements have been made.

3-9.1.2 Pier Fiber Distribution Center.

The Pier Fiber Distribution Center provides a breakout point for the 144-strand hybrid fiber optic cable coming from the Pier Head ITN Building Node and the Fiber Optic Riser Panels. Figure 3-20 shows the fiber optic cable entering into the splice can from the Pier Head ITN Building Node. The fiber is spliced onto another 144-strand fiber optic cable (72MM/72SM) for submarine piers or 96-strand fiber optic cable (48MM/48SM) for surface ship piers. This is routed to the Environmental Distribution Center 1 (EDC 1) patch panel. Using internal patch cables, EDC 1 is patched to EDC 2. From EDC 2, a 144 or 96 strand hybrid fiber optic cable is routed to a second splice can where it is spliced to several 24-strand hybrid fiber optic cables (12MM/12SM) that run to the Fiber Optic Riser Panels. Figure 3-21 through Figure 3-24 provide detailed information on the EDC 1 and EDC 2 patch panels located inside the Pier Fiber Distribution Center and their interconnections. (Note that the patch panels are shown for both surface ship piers and submarine piers).

Submarine piers/berths require validation that the hardware supports or exceeds the requirements of data throughput and cyber security as mandated by CTF 10, NAVIFOR, and PMW 160.

3-9.1.3 Fiber Optic Riser Panel.

The Fiber Optic Riser Panel is the interface for the ship to shore connectivity. The panel is provided with a 24-strand hybrid fiber optic cable (12MM/12SM) coming from the Pier Fiber Distribution Center. This provides a fiber optic receptacle, J1, to interface with the umbilical cable assembly that goes to the ship (note that details on the J1 pigtail assembly may be found on NAVSEA drawing 7325760D). Figure 3-25 shows the Fiber Optic Riser Panel. Figure 3-26 and Figure 3-27 show the patch panel connections inside the EDC for a surface ship and submarine respectively. Figure 3-28 and Figure 3-29 show the rubber gasket cutouts for a surface ship and submarine respectively.

Figure 3-19 Block Diagram of Pier Structure

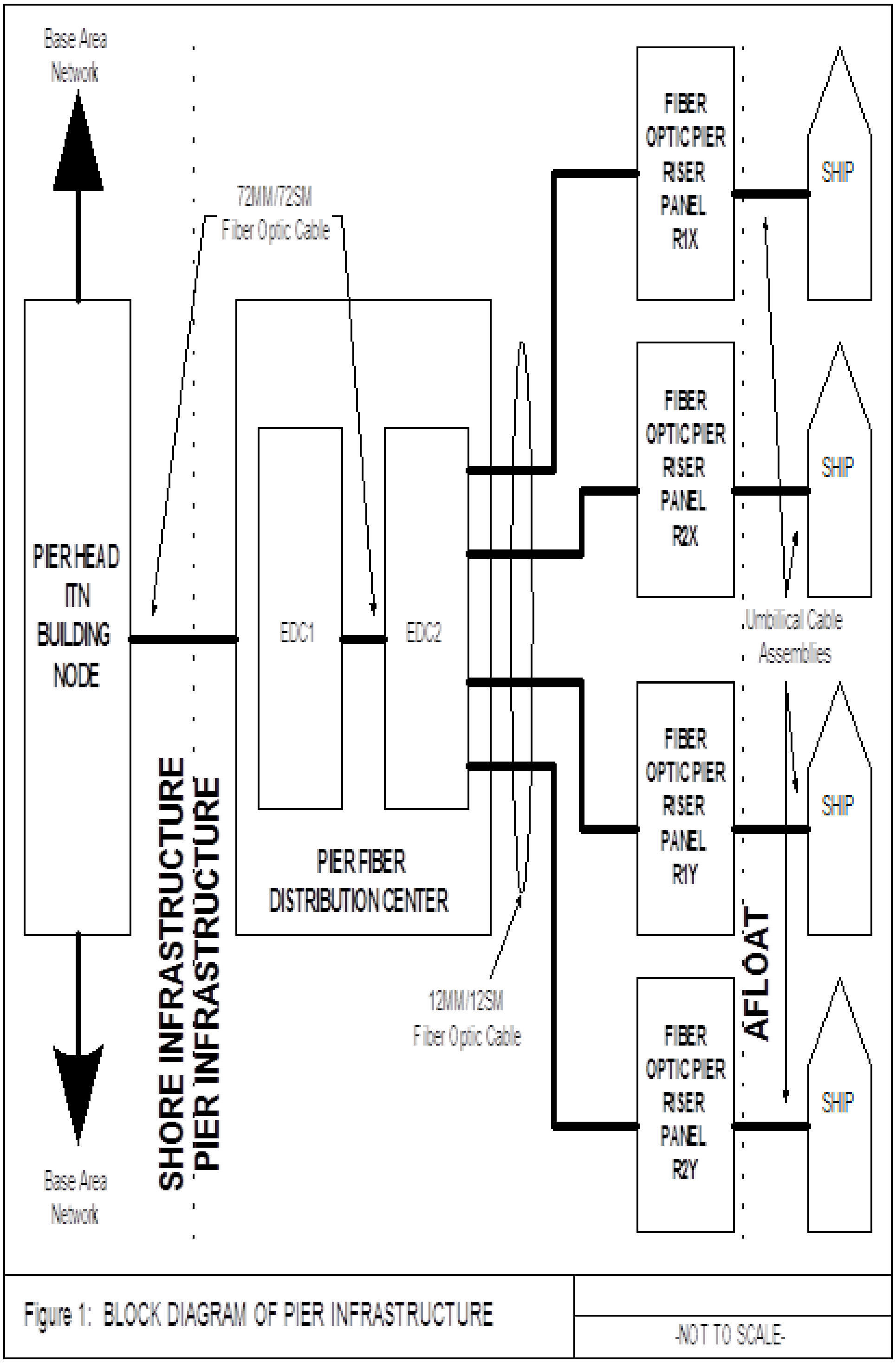


Figure 3-20 Pier Fiber Distribution Center

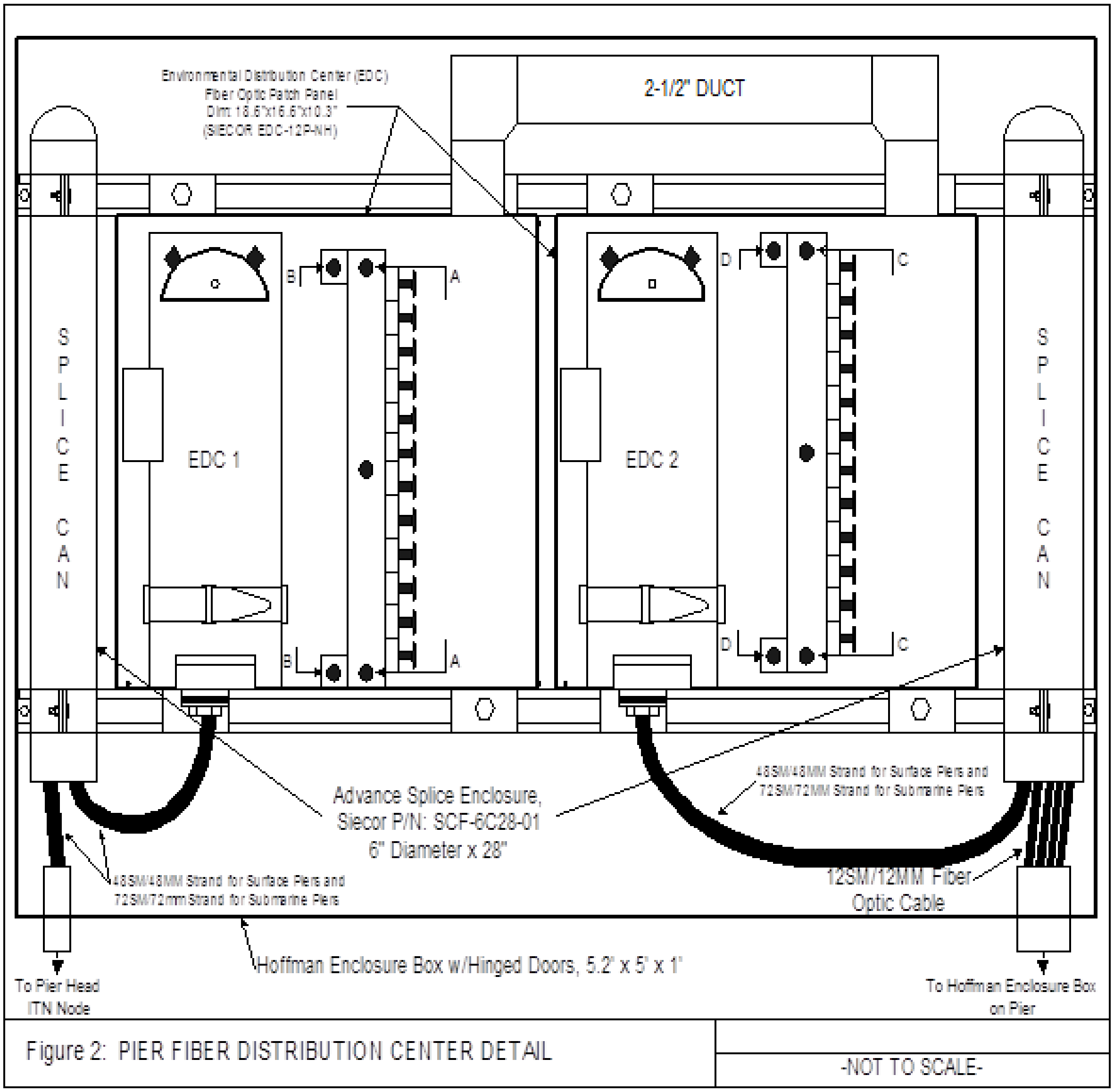


Figure 3-21 Pier Fiber Distribution Center EDC 1 Rear Detail (Surface Ship Pier)

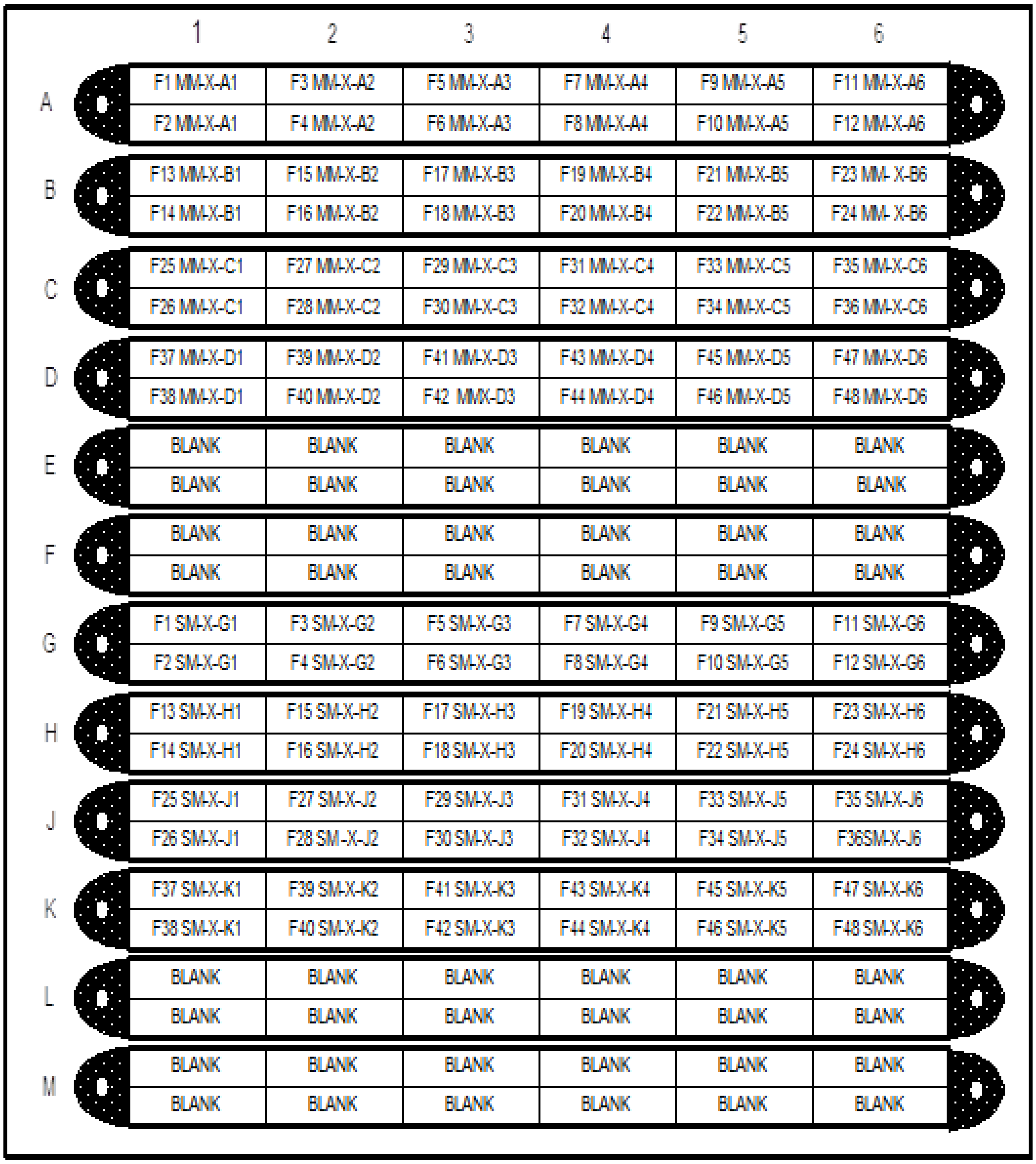


Figure 3: PIER FIBER DISTRIBUTION CENTER EDC 1
B-B REAR DETAIL - SURFACE PIERS

-NOT TO SCALE-

Figure 3-22 Pier Fiber Distribution Center EDC 1 Rear Detail (Submarine Pier)

	1	2	3	4	5	6
A	F1 MM-X-A1	F3 MM-X-A2	F5 MM-X-A3	F7 MM-X-A4	F9 MM-X-A5	F11 MM-X-A6
	F2 MM-X-A1	F4 MM-X-A2	F6 MM-X-A3	F8 MM-X-A4	F10 MM-X-A5	F12 MM-X-A6
B	F13 MM-X-B1	F15 MM-X-B2	F17 MM-X-B3	F19 MM-X-B4	F21 MM-X-B5	F23 MM-X-B6
	F14 MM-X-B1	F16 MM-X-B2	F18 MM-X-B3	F20 MM-X-B4	F22 MM-X-B5	F24 MM-X-B6
C	F25 MM-X-C1	F27 MM-X-C2	F29 MM-X-C3	F31 MM-X-C4	F33 MM-X-C5	F35 MM-X-C6
	F26 MM-X-C1	F28 MM-X-C2	F30 MM-X-C3	F32 MM-X-C4	F34 MM-X-C5	F36 MM-X-C6
D	F37 MM-X-D1	F39 MM-X-D2	F41 MM-X-D3	F43 MM-X-D4	F45 MM-X-D5	F47 MM-X-D6
	F38 MM-X-D1	F40 MM-X-D2	F42 MMX-D3	F44 MM-X-D4	F46 MM-X-D5	F48 MM-X-D6
E	F49 MM-X-E1	F51 MM-X-E2	F53 MM-X-E3	F55 MM-X-E4	F57 MM-X-E5	F59 MM-X-E6
	F50 MM-X-E1	F52 MM-X-E2	F54 MM-X-E3	F56 MM-X-E4	F58 MM-X-E5	F60 MM-X-E6
F	F61 MM-X-F1	F63 MM-X-F2	F65 MM-X-F3	F67 MM-X-F4	F69 MM-X-F5	F71 MM-X-F6
	F62 MM-X-F1	F64 MM-X-F2	F66 MM-X-F3	F68 MM-X-F4	F70 MM-X-F5	F72 MM-X-F6
G	F1 SM-X-G1	F3 SM-X-G2	F5 SM-X-G3	F7 SM-X-G4	F9 SM-X-G5	F11 SM-X-G6
	F2 SM-X-G1	F4 SM-X-G2	F6 SM-X-G3	F8 SM-X-G4	F10 SM-X-G5	F12 SM-X-G6
H	F13 SM-X-H1	F15 SM-X-H2	F17 SM-X-H3	F19 SM-X-H4	F21 SM-X-H5	F23 SM-X-H6
	F14 SM-X-H1	F16 SM-X-H2	F18 SM-X-H3	F20 SM-X-H4	F22 SM-X-H5	F24 SM-X-H6
J	F25 SM-X-J1	F27 SM-X-J2	F29 SM-X-J3	F31 SM-X-J4	F33 SM-X-J5	F35 SM-X-J6
	F26 SM-X-J1	F28 SM -X-J2	F30 SM-X-J3	F32 SM-X-J4	F34 SM-X-J5	F36SM-X-J6
K	F37 SM-X-K1	F39 SM-X-K2	F41 SM-X-K3	F43 SM-X-K4	F45 SM-X-K5	F47 SM-X-K6
	F38 SM-X-K1	F40 SM-X-K2	F42 SM-X-K3	F44 SM-X-K4	F46 SM-X-K5	F48 SM-X-K6
L	F49 SM-X-L1	F51 SM-X-L2	F53 SM-X-L3	F55 SM-X-L4	F57 SM-X-L5	F59 SM-X-L6
	F50 SM-X-L1	F52 SM-X-L2	F54 SM-X-L3	F56 SM-X-L4	F58 SM-X-L5	F60 SM-X-L6
M	F61 SM-X-M1	F63 SM-X-M2	F65 SM-X-M3	F67 SM-X-M4	F69 SM-X-M5	F71 SM-X-M6
	F62 SM-X-M1	F64 SM-X-M2	F66 SM-X-M3	F68 SM-X-M4	F70 SM-X-M5	F72 SM-X-M6

Figure 4: PIER FIBER DISTRIBUTION CENTER EDC 1
B-B REAR DETAIL - SUBMARINE PIERS

-NOT TO SCALE-

Figure 3-23 Pier Fiber Distribution Center EDC 1 Front Detail (Surface Ship Pier)

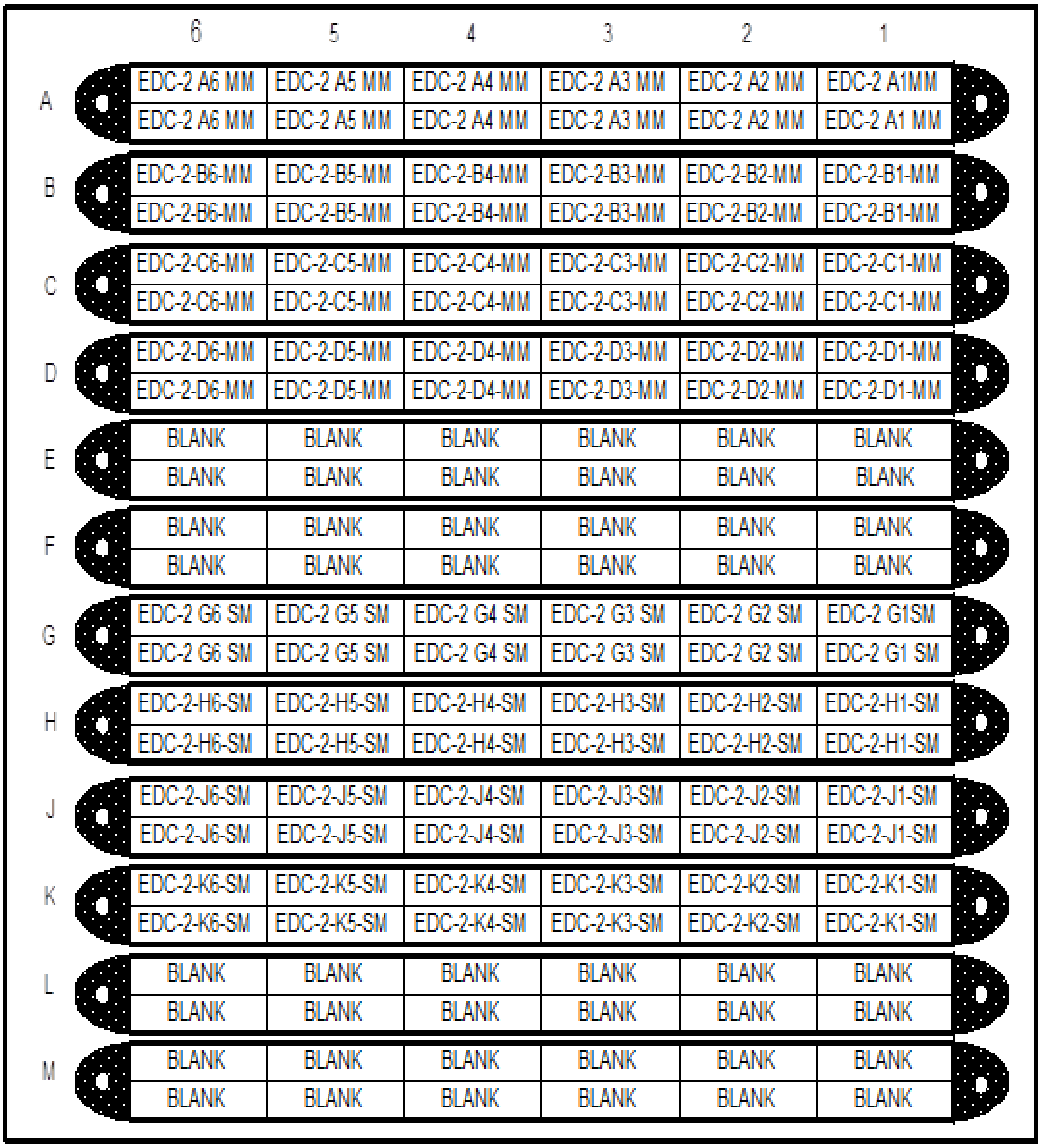


Figure 5: PIER FIBER DISTRIBUTION CENTER EDC 1
A-A FRONT DETAIL - SURFACE PIERS

-NOT TO SCALE-

Figure 3-24 Pier Fiber Distribution Center EDC 1 Front Detail (Submarine Pier)

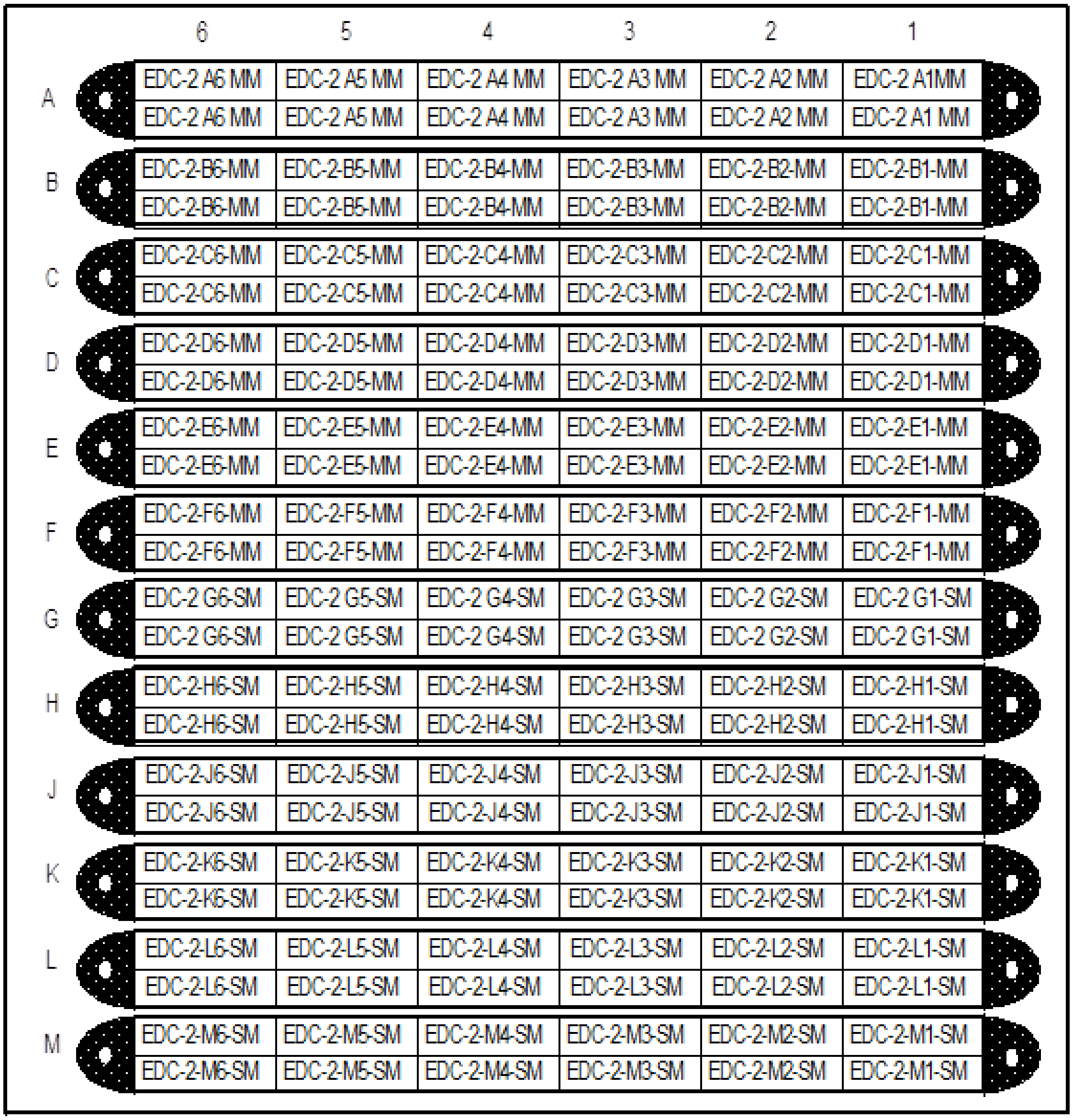


Figure 6: PIER FIBER DISTRIBUTION CENTER EDC 1
A-A FRONT DETAIL - SUBMARINE PIERS

-NOT TO SCALE-

Figure 3-25 Fiber Optic Connectivity Riser Panel Detail

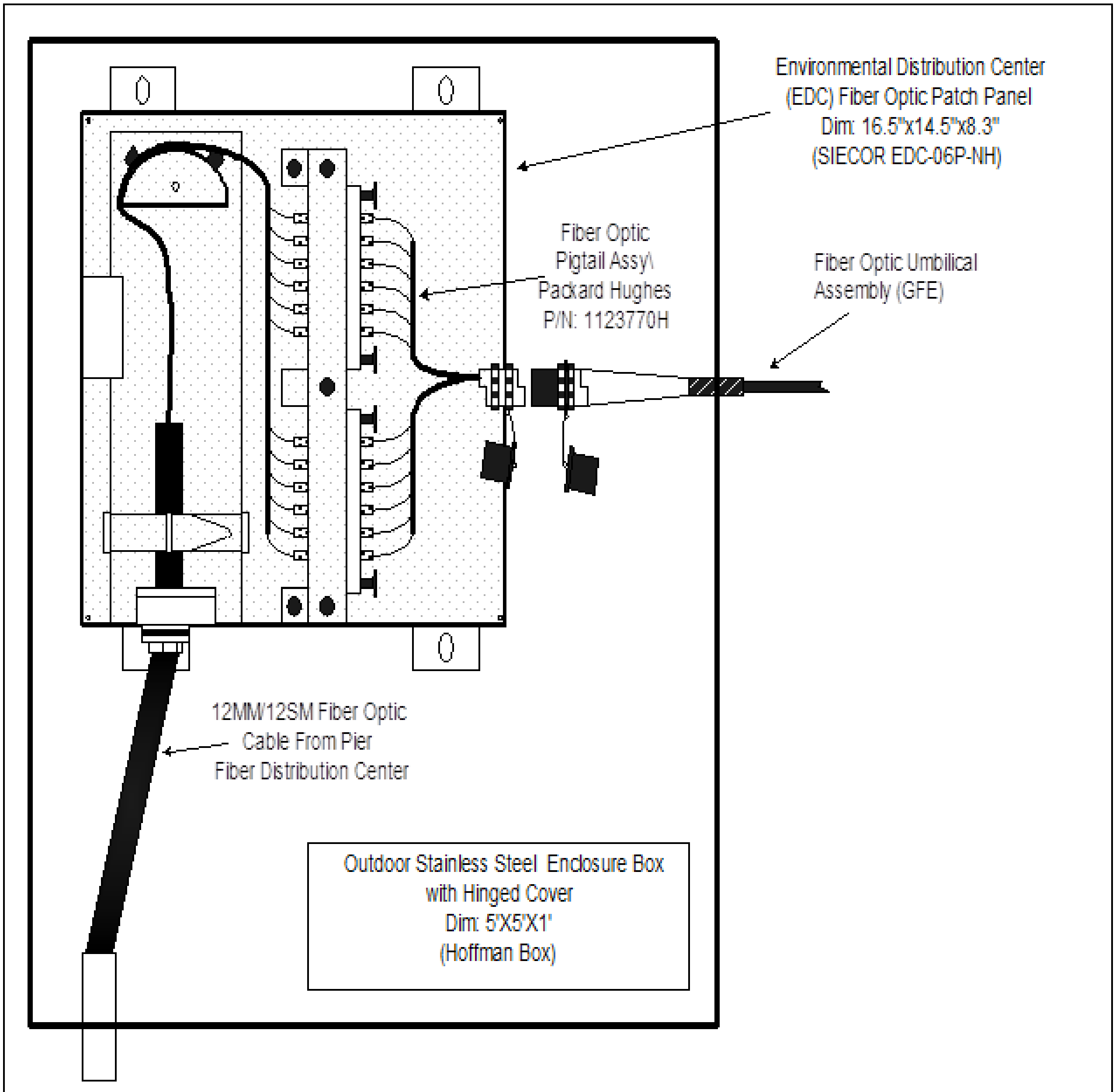


Figure 8: FIBER OPTIC CONNECTIVITY PIER RISER PANEL

-NOT TO SCALE-

Figure 3-26 EDC Fiber Optic Patch Panel Surface Pier

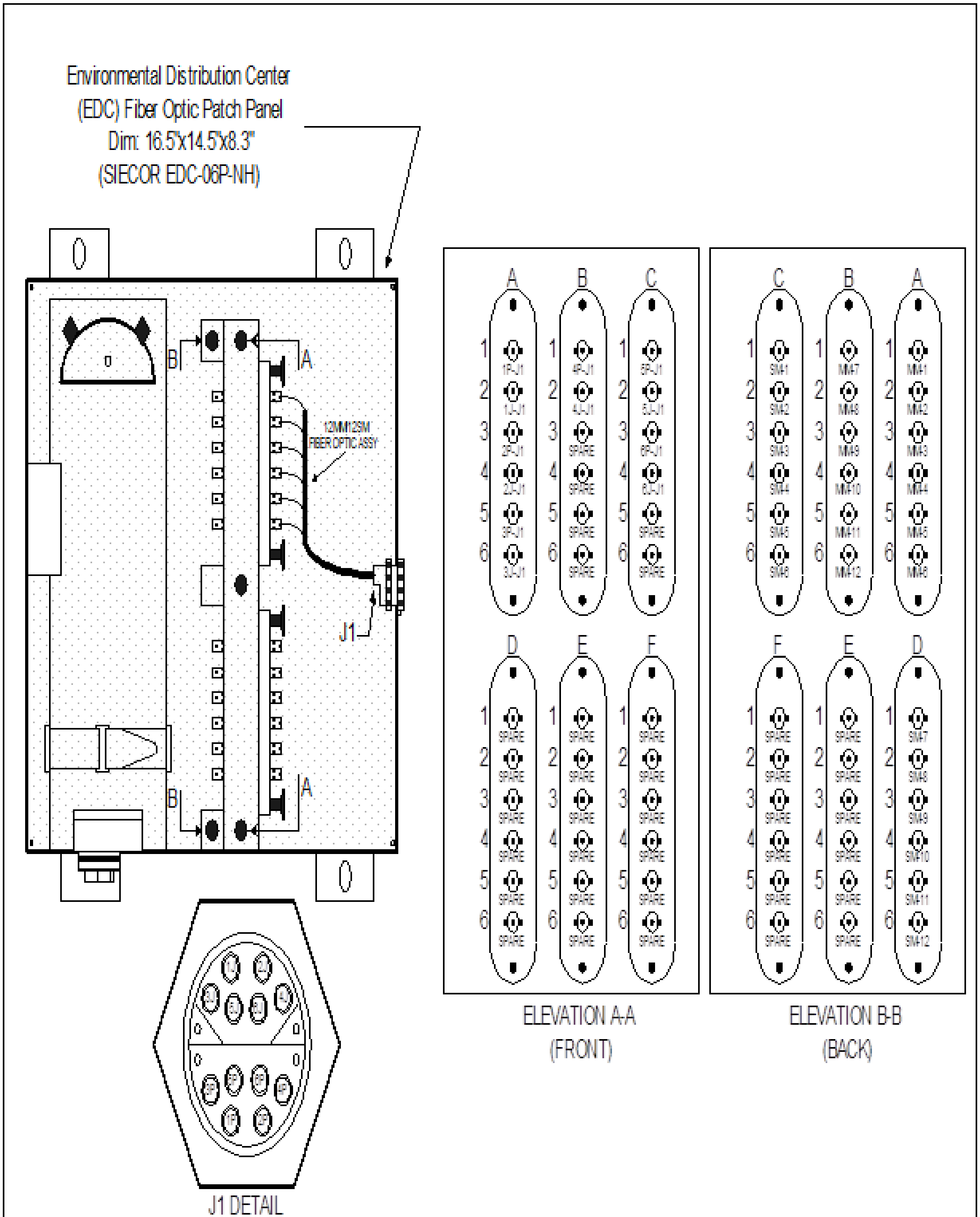


Figure 9: Environmental Distribution Center (EDC)
Fiber Optic Patch Panel (SURFACE PIERS)

-NOT TO SCALE-

Figure 3-27 EDC Fiber Optic Patch Panel Submarine Pier

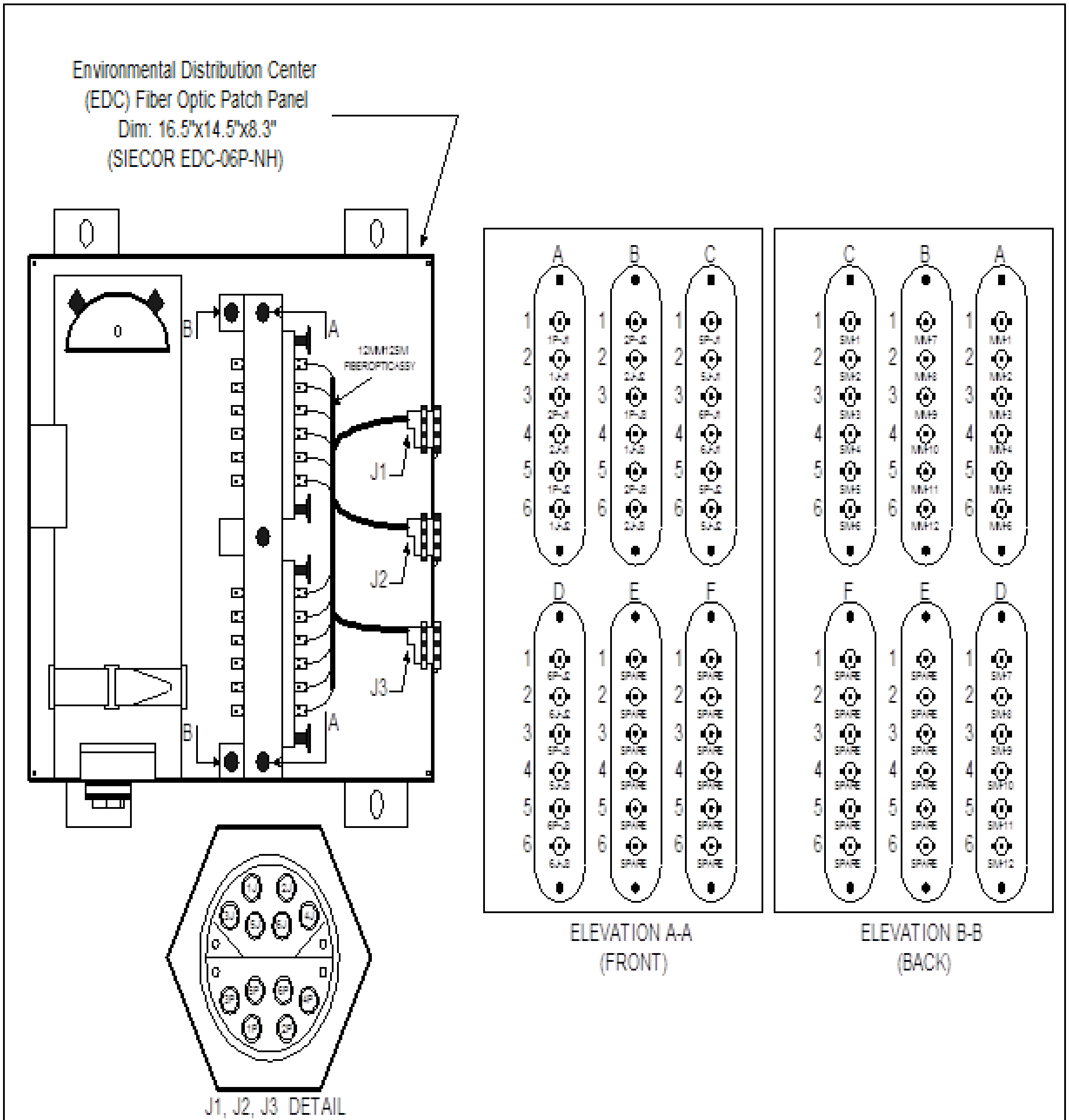


Figure 10: Environmental Distribution Center (EDC)
Fiber Optic Patch Panel (SUBMARINE PIERS)

-NOT TO SCALE-

Figure 3-28 Rubber Gasket Cutout Surface Pier

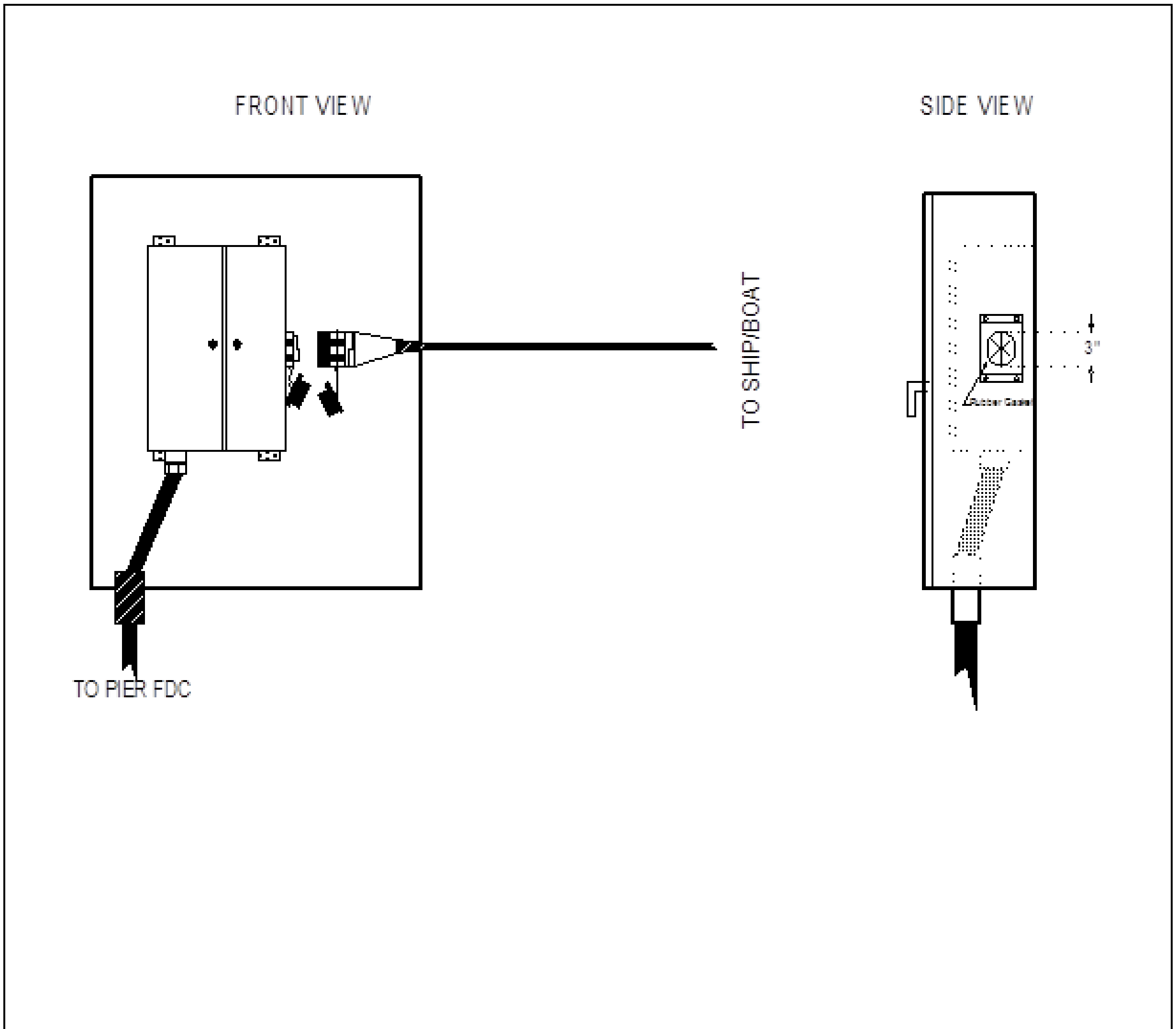


Figure 11: HOFFMAN ENCLOSURE LAYOUT (SURFACE PIERS)

-NOT TO SCALE-

Figure 3-29 Rubber Gasket Cutout Submarine Pier

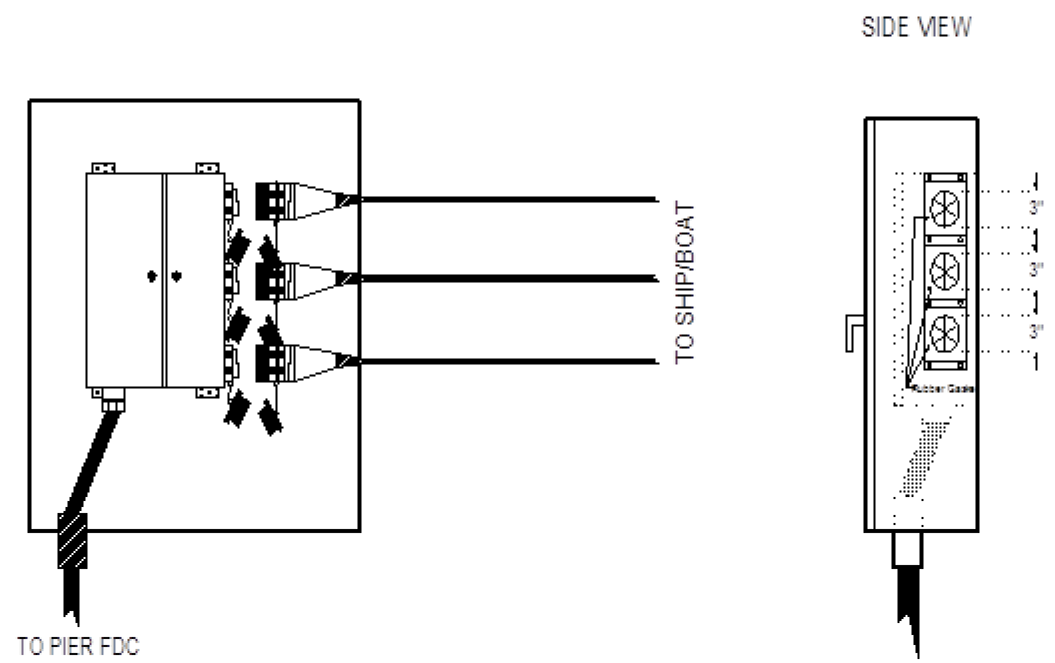


Figure 12: HOFFMAN ENCLOSURE LAYOUT (SUBMARINE PIERS)	-NOT TO SCALE-

3-9.2 Telephone Systems.

Provide a voice telephone distribution system to each berth on piers and at dry docks unless specifically instructed otherwise. Provision should be made for the telephone cable to be terminated in a telecommunications outlet assembly adjacent to each berth. Provide a Main Distribution Frame (MDF) at the shore end of the pier for the cross-connect devices. The assembly must include connectors mounted to the exterior of the enclosure. These connectors will be connected to the shore end of the ship-to-shore telephone cable. Commercial "dial tone" services and the telephone switching system is the responsibility of the Station’s Communications Officer. Figure 3-30 provides a typical telephone connection with surge protector module.

3-9.2.1 Ships Demand.

APPENDIX A identifies the number of telephone pair shorelines required by each ship type. Cable sizes 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 pier's berthing plan. Provide cable sizes based upon 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.

3-9.2.2 Other Demand.

Provide telephone service to security checkpoints and watchstand stations. These requirements may occur at the head and end of the pier, and at intermediate points along the pier. Coordinate with the Activity's security representatives.

3-9.2.3 Location and Arrangement of Pier Telephone Distribution System.

Each berth should be served by an independent run of conduit. The telecommunications outlet assembly must be an independent, freestanding structure. Outlet assemblies must be designed to prevent damage by ships lines and by traffic on the pier.

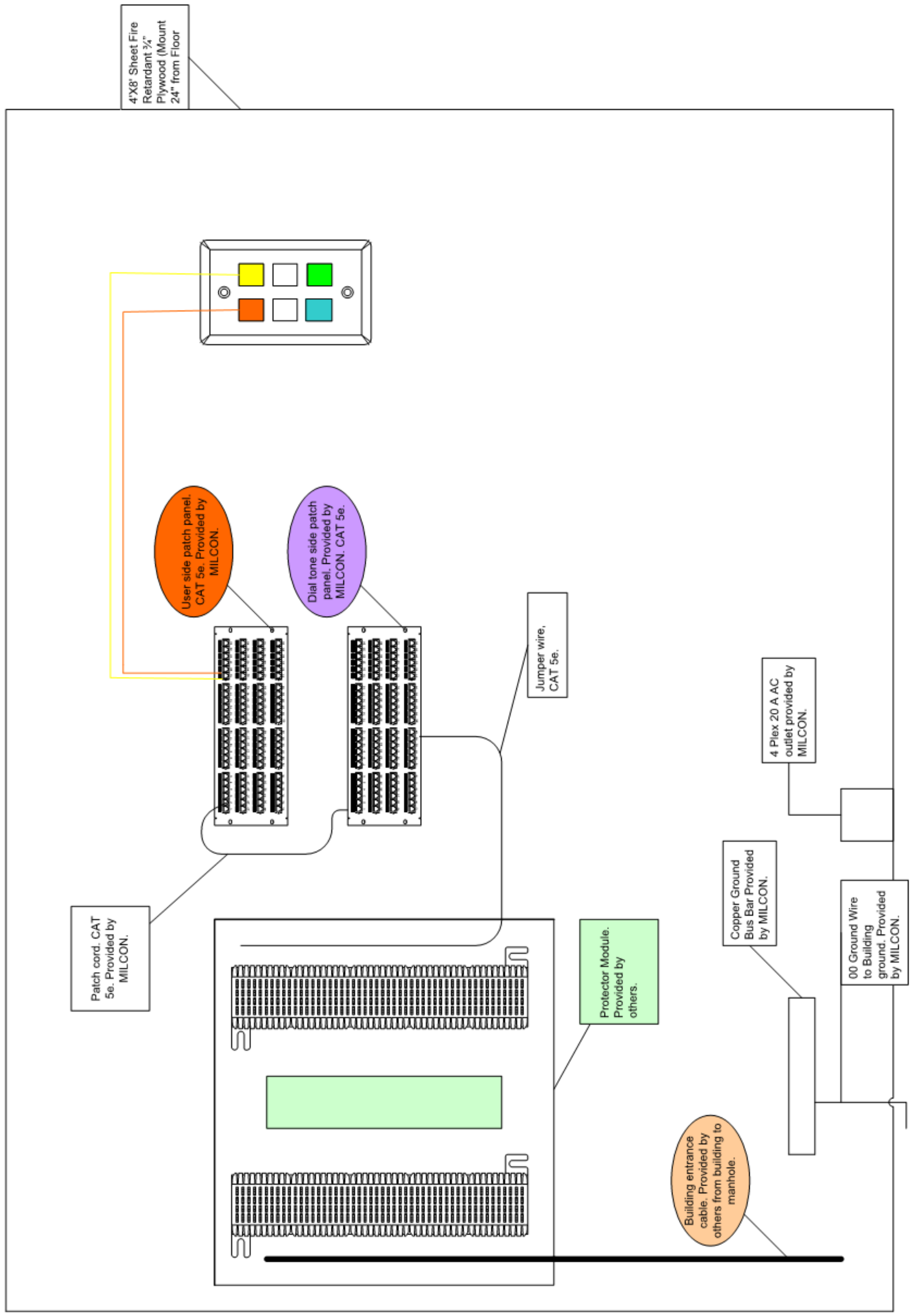
3-9.3 Other Telecommunications Systems.

The need for the systems described below should be evaluated on a site-by-site basis. Provide these systems as directed by the Activity and the cognizant Service.

3-9.3.1 Dedicated Communication Circuits.

Provide one (1) 2 inch (51 mm) conduit from the manhole or cross-connect cabinet at the head of the pier to each telecommunications outlet assembly. This conduit must be dedicated for communication circuits that cannot use the telephone system.

Figure 3-30 Typical Telephone Connection Detail with Surge Protector Module



3-9.3.2 Cable Television.

Provide a conduit system (from the manhole at the head of the pier to each telecommunications outlet assembly) to support cable television requirements. Unless instructed otherwise, the cable television system will be provided by a commercial vendor. The designer must coordinate with the vendor and provide a complete raceway system.

3-9.3.3 Alarm and Signal Circuits.

Provide two (2) 1-1/4 inch (32 mm) conduits (from the manhole at the head of the pier to each telecommunications outlet assembly) to serve alarm and signal circuits that cannot use the telephone system. Provide all conductors to serve these systems unless instructed otherwise. Coordinate with the Activity and the cognizant Service.

3-10 PIER POWER METERING SYSTEMS.

Naval ships connected to shore power utilize a large percentage of the Navy's infrastructure electricity. Many bases are now requiring the electricity usage to be measured and recorded. Since multiple circuits are normally used to provide the required capacity to the ships, often in a "nested" configuration, standard metering/ monitoring equipment may not be appropriate. There are however, commercial and government developed systems, including hardware and software that are available. Coordinate with the cognizant Service to determine if the Activity has a desired or required system that must be utilized.

3-10.1 Pier Power Monitoring System (PPMS).

One of the power measurement systems available has been developed by the NAVFAC Engineering and Expeditionary Warfare Center (EXWC, formerly NFESC). The system is defined as the Pier Power Monitoring System (PPMS) and consists of specialized embedded computer circuit boards, embedded software, and personal computer (PC) software that enable the Activity to measure, record, and study the electricity consumption and usage patterns of the connected ships. The PPMS was developed to be cost effective and to be easily installed. It involves the simple utilization of a conventional utility metering system. Typically, each monitored electrical outlet assembly will have one set of circuit boards. Battery backup features ensure that no data or operating software is lost when electrical power is disconnected. The data are sent to a central PC station. The PC can program the circuit boards and retrieve data. Parameters available on the PC are megawatt-hours and instantaneous values of Amps, Volts, power factor, and megawatts. Time-of-use (TOU) data are also available for the present 24-hour period. The PPMS correctly identifies the receptacles allocated to each ship and the total power consumed. Both the ship (customer) and the Activity (provider) can easily track shore supplied ship electricity. Software can be easily tailored to send the data directly from the PPMS to a master data collection and billing system. By providing complete energy use pattern information and consumption data, the PPMS enables Navy managers to educate, monitor, and encourage energy conservation for ships using shore supplied electricity. An operating PPMS demonstration system is presently installed on Pier 1 at Naval Station San Diego, CA.

3-11 ADDITIONAL SUBMARINE AND UUV REQUIREMENTS.

Submarines and UUVs have specific pier requirements to meet berthing needs. These differ from other platforms and have specific needs to support surge requirements. Additional requirements will be provided as they are identified. Coordinate with the Activity on other unique requirements for these platforms.

See UFC 4-152-01, Piers and Wharves, for additional submarine/UUV pier/berth configuration, construction, berthing, fendering, access, and utility infrastructure requirements.

3-12 OTHER SERVICES.

Although their design is not covered by this UFC other services will occasionally be required at active and repair berthing facilities. Such systems include: 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. The designer must consult with the Activity and the cognizant Service for specific instructions.

CHAPTER 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. However, ammunition piers that serve ballistic submarines require special considerations.

4-2 SALTWATER AND NONPOTABLE WATER.

Provide fire protection water as required for active berthing facilities. However, consult with the Activity and the cognizant Service regarding ammunition piers that are in an isolated area and are 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 L/min) at sufficient pressure to provide 75 psig (517 kPa) residual pressure at the most remote outlet. Outlet connection threads must be national standard male hose threads unless required otherwise to serve an existing system.

4-3 POTABLE WATER, SEWER, AND OILY WASTE.

For supply piers, requirements are the same as those for active berthing facilities. For ammunition piers, provide potable water only when indicated in the project directive. However, oily waste and sewer collection systems should always be provided. For all three systems, see the requirements defined in CHAPTER 3.

4-4 ELECTRICAL SERVICE.

Shore power for ships hotel service, lighting, and power for industrial services (as required) will be provided on ammunition piers and wharves that load missiles for nuclear powered vessels. This provision lengthens the life of vessel reactors and decreases manpower requirements during the loading / unloading operation. Electrical systems provided on ammunition piers must be designed for the hazardous rating actually encountered and in accordance with NFPA 70.

4-5 TELECOMMUNICATION SYSTEMS.

Both supply piers and ammunition piers require telecommunication systems. However, full services that are defined for active and repair berths are not required except for ammunition piers that serve ballistic submarines. Consult with the Activity and the cognizant Service for specific requirements. In general, the design guides for active and repair berths are applicable. The systems required are to be evaluated on a project-by-project basis. Lastly, comply with all hazardous requirements associated with ammunition piers.

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CHAPTER 5 FUELING PIERS

5-1 STEAM AND COMPRESSED AIR.

In general, steam and compressed air services are not required on fueling piers.

5-2 SALTWATER AND NONPOTABLE WATER.

Ships 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.

5-3 POTABLE WATER, SEWER, AND OILY WASTE.

Supply potable water systems at locations where connections may be made to existing systems. Maximum potable water requirements are 1,000 gpm (3,785 L/min) 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. Provide oily waste and sewage collection systems at all fueling piers unless instructed otherwise. Consult with the Activity and the cognizant Service. Provide all three systems in accordance with the criteria defined in CHAPTER 3.

5-4 POL SYSTEMS.

Refer to UFC 3-460-01, *Design: 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. In general, ships use a 6 inch (152 mm) commercial flanged connection. Verify before commencing design of shore connections.

5-5 ELECTRICAL SERVICE.

Ships service, temporary lighting, and ships industrial power are not required for fueling piers and quay walls. Consult with the Activity and the cognizant Service regarding electrical systems that directly serve the pier. Evaluate all hazardous requirements and preferences that may be encountered.

5-6 TELECOMMUNICATION SYSTEMS.

Fueling piers require telecommunication systems. However, full services that are defined for active and repair berths are not required. Consult with the Activity and the cognizant Service for specific requirements. In general, the design guides for active and repair berths are applicable. The systems required are to be evaluated on a project-by-project basis. Lastly, comply with all hazardous requirements associated with fueling piers.

5-7 ADDITIONAL REQUIREMENTS.

Refer to UFC 3-460-01, *Design: Petroleum Fuel Facilities* for additional requirements.

5-8 FIRE PROTECTION.

Refer to UFC 3-600-01, *Fire Protection Engineering for Facilities*. Consult with the Fire Protection Engineering Departments, both at the local level and at the cognizant Service level.

CHAPTER 6 MISCELLANEOUS PROVISIONS

6-1 FREEZE PROTECTION.

6-1.1 Where Required.

Provide freeze protection for saltwater, fresh-water, sanitary-waste (sewage), and oily-waste (bilge) pipes exposed on piers and wharves and in dry docks when located in freezing climates.

6-1.2 Regional Weather Differences.

See Figure B-1 and Table B-1. For design purposes, coastlines within the United States can be divided into the five regions listed below. Table B-1 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 B-1 and design accordingly. The five weather regions are defined as follows:

Region I: "Severe": Alaska, Maine, New Hampshire, Great Lakes and inland locations.

Region II: "Cold": Connecticut, Massachusetts, Rhode Island, and New York.

Region III: "Moderate": Pennsylvania, New Jersey, Delaware, Maryland, and Washington, DC.

Region IV: "Mild": Washington, Oregon, Virginia, and North Carolina.

Region V: "Very Mild": California, South Carolina, Georgia, Texas, Mississippi, Louisiana, Alabama, and Florida.

6-1.3 Methods.

The methods described below vary with climate. Use the methods recommended below when the relative costs of electricity, sewage disposal, and freshwater are not abnormally high. Where the cost of electricity, sewage disposal, or water is abnormally high, then modify the freeze protection system and use an approved method that minimizes operating cost. Use approved life cycle cost procedures and submit analysis.

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 heat tape and pipe insulation. The suggested combinations of insulation thickness and heating (Watt density) for various pipe sizes are shown in Table B-2. Heat tape should be controlled by remote thermostats having sensors taped to the surface of pipes and under the insulation. Consult with the Activity and the cognizant Service regarding preferred heat tape systems and methods. Several sections of heat tape may be required due to overall pipe length. Provide each section of heat tape with a dedicated thermostat. Thermostats must be in a protected location that is also accessible. The heating requirement given in Table B-2 (6 Watts/ft) is the Watt density available for a typical electric heat tape. Any Watt density from 4 to 10 Watts/ft would be suitable, but insulation thicknesses must be adjusted to compensate. Insulation thicknesses given in Table B-2 are based upon polyurethane. Adjust thickness for other insulation materials as based upon their rated thermal conductivity values. Protect backflow devices, valves, and risers with electric heat tape and preformed polyurethane insulation kits. Heat tape systems must be maintainable to be successfully used for the system's expected life span. To improve maintainability, use multiple sections of heat tape instead of extended single circuits. The designer may need to consider special heating systems in which heating elements are placed in channels alongside the pipe. These systems periodically terminate in accessible junction boxes. Maintenance personnel can then easily replace an inoperable section. It is also much easier to troubleshoot when the heating system is divided into reasonable segments with accessible test points.

6-1.4.2 Sewer and Oily Waste Lines.

A combination of electric heat tape and pipe insulation should be used in accordance with Table B-2 for: (1) exposed gravity sewer piping which drains fixtures directly; (2) exposed oily waste piping; and (3) for those portions of exposed pressure lines (sewage and oily waste) which will not completely drain upon cessation of pumping. Heat tape may not be required (insulation only) for exposed pressure and gravity sewer and oily waste piping (or portions thereof) which receive material intermittently and which drain well when pumping stops. Neither heat tape nor insulation may be required for pipe risers and valves above pier decks and in dry dock galleries.

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 a flushing of water through the pipes. Insulation thickness for various pipe sizes, and pipe sizes for which flushing is necessary, are defined in APPENDIX B Table B-3. Insulation thicknesses are such that for expected durations of subfreezing temperatures less than 50 percent of pipe contents will freeze. 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. Thermostats should be in protected locations and sensors are to be taped to the surface of pipes and under the insulation. Thermostats should be factory set to open the flushing valves at 30 °F (-1 °C) and to close the valves at approximately 35 °F (2 °C). Flushing valves (freeze protection valve) and associated thermostats should be located at each ship's connection and at any other line extremity to protect the most remote valve component in the system. Insulation thicknesses given in Table B-3 are based upon polyurethane. Adjust thickness for other insulation materials as based upon their rated thermal conductivity values. Insulation must also be applied to backflow devices and valves. Special care must be taken to prevent the freezing of flushing valves and associated pipe connections. If water is scarce, or if the winter temperature of buried water mains is below 45 °F (7.2 °C), heat tape should be used in lieu of flushing. In this event, the design should be based upon the data defined in Table B-4.

6-1.5.2 Sewer and Oily Waste Lines.

A combination of electric heat tape and pipe insulation should be used in accordance with Table B-4 for: (1) exposed gravity sewer piping which drains fixtures directly; (2) exposed oily waste piping; and (3) those portions of exposed pressure lines (sewage and oily waste) which will not drain completely upon cessation of pumping. Neither insulation nor heating is required for exposed sewer and oily waste piping (or portions thereof) which receive material intermittently and which drain well when pumping stops. This applies to both pressure lines and gravity lines.

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 per inch (132.5 L per 25 mm) of pipe diameter for each 100 ft (30.5 m) of fresh water pipe. This flushing is to be applied over an 8 to 12 hour period on each day that the ambient temperature drops below 25 °F (-4 °C). Pipes need not be insulated, but flushing valves and connections must be located at system extremities and must be protected from freezing.

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 adjustments when designing freeze protection for exposed saltwater mains:

- In Regions I and II, treat saltwater the same as required for freshwater.
- In Region III, design as for region IV.
- In Region IV, design as for region V.
- In Region V, no freeze protection is necessary for saltwater at any location.

6-1.8 Materials.

6-1.8.1 Pipe.

Piping materials must be metallic where heat tape is required. Where a flushing system is utilized, any approved piping material may be used.

6-1.8.2 Heat Tape.

Flat style electric heat tape is recommended. Heat tape should be easy to splice and repair and must be waterproof. A low Watt density (4 to 10 Watts per lineal foot (13 to 33 W/m) of pipe) is recommended, and the ability to lap the tape without damage should be required. When heat tape is used with the insulation thicknesses listed in Table B-2 and Table B-4, they will cycle 30 to 60% 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 if wave action and/or immersion are possible. Cover all insulation with a watertight metallic or plastic system.

6-1.8.4 Valves and Thermostats.

Select single-seated solenoid valve shaving flow constants suitable for bleeding proper quantities of water in the prescribed interval. Temperature sensors should be ambient air temperature sensing type. Thermostats may be bimetallic, thermistor, or Resistance Temperature Detector (RTD) type, having differentials of 2 to 5 °F (-16.6 to -15 °C).

6-2 PIPING IDENTIFICATION.

6-2.1 Primary Identification.

Identify each valve on a pier, wharf, or dry dock by a plain language brass tag, and labeled. (Example: "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 dry dock piping.

6-2.2.1 Distribution Piping On or Under Deck and Ashore.

Such piping, exclusive of shore-to-ship utility connections, must be color coded in accordance with MIL-STD-101, *Color Code for Pipelines and for Compressed Gas Cylinders*. Applicable requirements must be specified in the design documents.

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 6-1. Color-coding may also extend to adjacent curbs, protective rails, posts, and walls.

6-3 OPERATIONAL NOTICES.

Provide the following operational notices. Consult with the Activity and the cognizant Service regarding other desired notices, nameplates, warning signs, and so forth.

- Bleed systems must be marked with the following warning:

  ”Freeze protection valve.
  Water will flow below 35 °F.
  Do not close.”

- Heat tape systems must be marked with the following warning:

  “Heat tape system (self-limiting).
  Do not disconnect power.”

Table 6-1 Color Code for Shore-to-Ship Utility Connections [a, d]

Shore Service [b]	Color	Reference Number [c]
Potable Water 40-81 psi (276-558 kPa)	Blue, Dark	15044
Nonpotable Water for Fire/Flushing/Cooling 100-175 psi (689-1207 kPa)	Red	11105
Chilled Water	Stripped Blue/White	11044/17886
Oily Waste Discharge	Striped Yellow/Black	13538/17038
Sewer	Gold	17043
Steam and condensate 150 psig (1,034 kPa)	White	17886
Compressed Air 100-125 psi (689-862 kPa)	Tan	10324
High Pressure Air 3,000 psi (20.7 MPa)	Stripped Yellow/Gray	13538/16081
Fuel	Yellow	13538

Note:

[a] If additional information is needed on color-coding systems, contact the cognizant Service.
[b] Pressures shown are nominal pressures and represent average conditions.
[c] The reference numbers refer to Federal Standard 595B, Colors Used in Government Procurement.
[d] Also, see “General Specifications for Ships of the U.S. Navy”, COMNAVSEASYSCOM, 1991.

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CHAPTER 7 U.S. ARMY REQUIREMENTS

7-1 APPLICABILITY.

This chapter is applicable for waterfront facilities designed for U.S. Army vessels.

7-2 POTABLE WATER.

Provide potable water in sufficient capacity to permit the filing of a vessel's tank in such time as to avoid delays in the operation of the vessel.

7-2.1 Quantity and Pressure Requirement.

Provide a minimum flow of 100 gpm (6.3 L/s) with a minimum residual pressure of 25 psi (173 kPa) at the most remote outlet.

7-2.2 Piping and Outlets.

Install one (1) 2-1/2 inch (64 mm) connection at each service outlet. Potable water outlets on piers and wharves should have a reduced pressure-type backflow prevention device. The piping must be insulated and provided with electrical heat tape if the lines are normally full of water and subject to freezing temperatures. Where thermal expansion is a problem, provision should be made for expansion joints or loops. Figure 7-1 shows a typical potable water connection in the pier deck.

7-3 ELECTRIC POWER.

7-3.1 Electrical System Characteristics.

The main electrical system providing power to ships will be nominal 480 V, three-phase, 60-Hz, supplied from substations preferably located on the piers. For lighting service, a 120 V, 60-cycle, single-phase power may be provided.

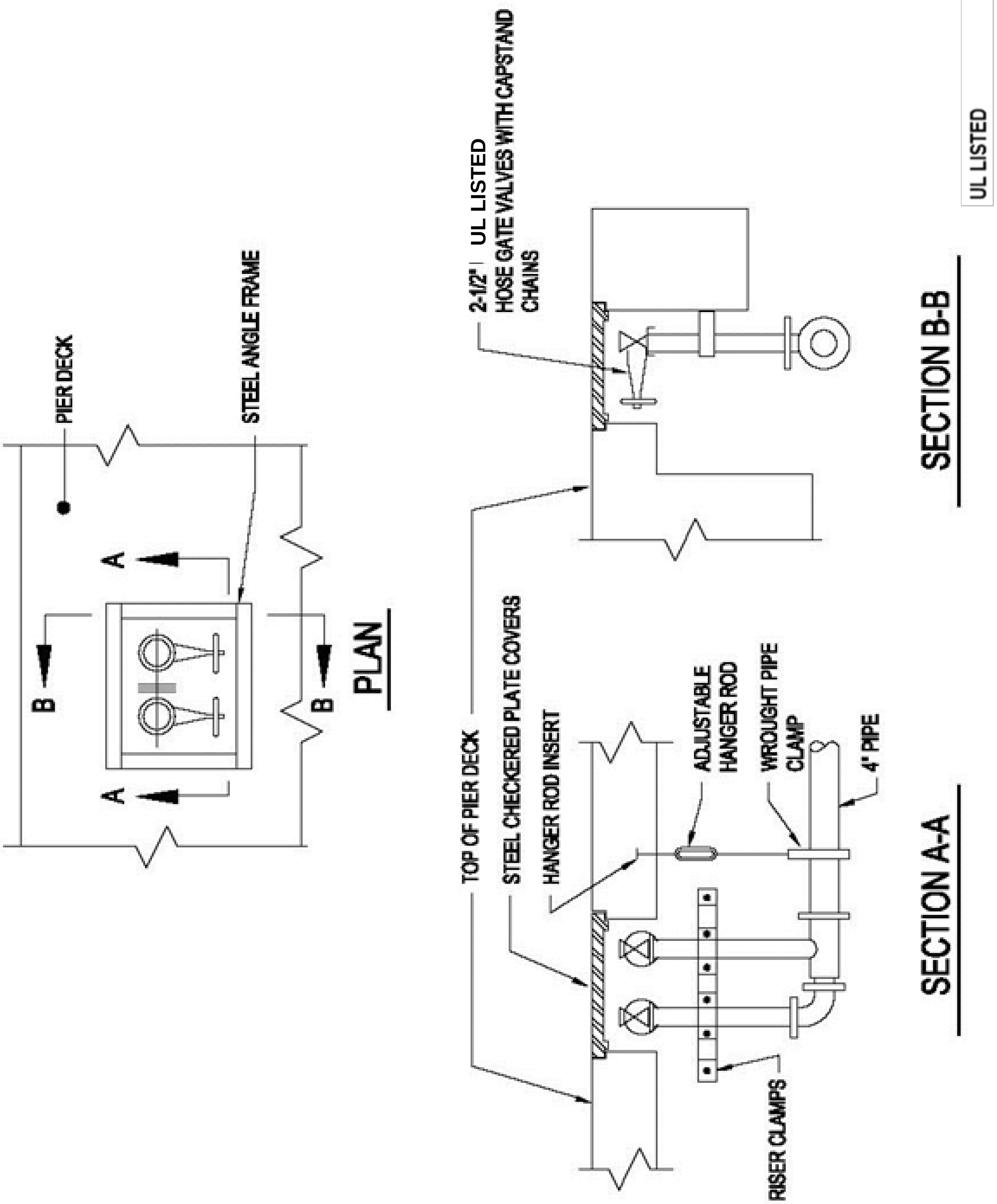
7-3.2 Ground System.

At piers, wharves, and other waterfront structures, a ground system that will measure not more than 3 ohms must be provided for permanent electrical equipment.

7-4 LOCATION AND NUMBERS OF SERVICE POINTS.

A minimum of two service points will be provided for each berth and located for the convenience of the using vessels. Each service point must supply electric power and water service as outlined above. Depending upon the physical site conditions of each specific installation, the point of connection for each service may be located in a single service box, or may be placed in separate but closely grouped boxes. Boxes should be located as close as practicable to the berthing face of the structure so that connected hoses and electric cables are not subject to vehicular traffic damage.

Figure 7-1 Typical Water Supply Connection for an Army Pier



7-5 MISCELLANEOUS.

7-5.1 Telephone Service.

Provide telephone service and outlet connectors for each berth. Locate for the convenience of the using vessels.

7-5.2 Lighting.

Satisfactory illumination shall be ensured for night operations. For open watering areas on the pier where ship loading or unloading occurs, a lighting intensity of at least 5 footcandles (54 lux) should be maintained. The illumination level of 5 footcandles (54 lux) should also be provided for areas of warehouses or storage buildings.

7-5.3 Fire Protection.

Refer to UFC 3-600-01, *Fire Protection Engineering for Facilities*.

7-5.4 Sanitary Facilities and Sewage Disposal.

A dockside connection to a sewage disposal system must be provided for the disposal of sewage and oily wastes from vessels.

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APPENDIX A SHIP UTILITY REQUIREMENTS

Note:

* Data provided in this appendix is for general informational and basic planning purposes only. It is the best data available at the time of publication of this document. Data is incomplete and may not be completely accurate. Ship utility requirements shown are for various classes of ships and may not include all ships, modifications, flights, blocks, and other variants between ships in a class. Information is for ship demands only and may not reflect the full requirements at a berth/pier/facility. If additional shore side utilities are necessary, coordinate with the installation and/or Activity on the requirements.

Designer/Planner needs to verify ship utility requirements with specific ship(s) being berthed, Activity, Facilities Planning Criteria (FPC), PEO, Port Ops, and/or cognizant Command or Service.

Submit any updates, changes, or additions directly to the NAVFAC Engineering and Criteria Program Office or by submitting a CCR (http://www.wbdg.org/ffc/dod).

Table A-1 Shore Services – Steam

Steam *, [a, b, c]										
Ship Classification Symbol	**(a) Intermittent Heating Loads (lb/h) [d] for Outdoor Temperatures of:**				**(b) Constant Load [e] (lb/h)**	**Overhaul (lb/h)**	**Ships Connection Data ****			
	10 °F	**30 °F**	**50 °F**	**70 °F**			**L**	**H**	**N**	**Size**
AIRCRAFT CARRIERS										
CVN 68	45,000				5,000		493 P	23	1	4 - 2" angle stop V.
							528 S	23	1	4 - 2" angle stop V.
							698 S	23	1	6 - 2" angle stop V.
CVN 78 [f]	---	---	---	---	---	---	---	---	---	---
SURFACE COMBATANTS										
CG 47 [g]	11,200	11,200	11,200	8,745	3,270		335 P	25	1	2" male steam boss
							328 S	25	1	2" male steam boss
DDG 51 [f]	---	---	---	---	---	---	---	---	---	---
DDG 1000 [f]	---	---	---	---	---	---	---	---	---	---
FFG 7 [f]	---	---	---	---	---	---	---	---	---	---
LCS 1 [f]	---	---	---	---	---	---	---	---	---	---
LCS 2 [f]	---	---	---	---	---	---	---	---	---	---
SUBMARINES										
SSN 21 [h]										
SSN 688						3,000	210 C			6" 600# weld neck
SSN 774 [l]						50,000	246 S			5" NPS, class 600
SSBN 726 & SSGN [i]										
SSBN 826										
AMPHIBIOUS										
LCC 19, 20	7,000	5,500	4,700	4,100	3,000		304 P/S	26	3	
LHA 1	11,500	7,500	3,800	1,600	2,500		375 P/S	46	2	2" male steam boss
LHA 6 [f]	---	---	---	---	---	---	---	---	---	---
LHD 1	8,000	6,000	4,000	4,000	2,500		375 P/S	46	2	2" male steam boss
LHD 8 [f]	---	---	---	---	---	---	---	---	---	---
LPD 4 (AFSB (I))	6,000	3,700	2,200	1,300	2,200		328 P/S	34	4	
LPD 17 [f]	---	---	---	---	---	---	---	---	---	---
LSD 41 [j, k]					7,400		220 P/S	22	2	
LSD 49 [k]					7,400		220 P/S	35	2	
MINE WARFARE										
MCM 1										

Steam *, a, b, c										
Ship Classification Symbol	(a) Intermittent Heating Loads (lb/h) [d] for Outdoor Temperatures of:				(b) Constant Load [e] (lb/h)	Overhaul (lb/h)	Ships Connection Data **			
	10 °F	30 °F	50 °F	70 °F			L	H	N	Size
AUXILIARY										
T-AH 19										
T-AKE 1 [f]	---	---	---	---	---	---	---	---	---	---
T-AO 187										
T-AO 205										
T-AOE 6							545 P	28		
							515 S	28		
T-APL 2										
T-APL 15										
T-ARS 50	---	---	---	---	---	---	---	---	---	---
T-AS 39	6,000	6,000	6,000	6,000	6,000		636 S	58	2	
T-AVB 3										
EXPEDITIONARY										
T-EPF 1 (JHSV)	---	---	---	---	---	---	---	---	---	---
ESB 3										
ESB 4	---	---	---	---	---	---	---	---	---	---
PATROL										
PC 1										
ARMY										
TBD										
USCG										
NCS (WMSL)										
WAGB 399					370 @ 100 psi					
WAGB 420					@ 150 psi					
WHEC 717										
WLB 201										
WLBB 30										
WLM 551										
WMEC 615	---	---	---	---	---	---	---	---	---	---
WMEC 901										
WPB 1301										

Notes to Table A-1:

* See note (*) at beginning of APPENDIX A; information provided in this table is for general reference purposes only; information is incomplete and may not be accurate; verify utility requirements with ships/program office(s). Blanks in table indicate information is missing or unavailable at this time.

** Designations of locations of ship connections are as follows:

- L is the distance (in feet) of the connection aft of the stem of the ship.
- H is the height (in feet) of the connection above the design waterline.
- P, S, C, CL refer to Port side, Starboard side, and Center/Centerline of a ship respectively.
- P/S indicates one connection on each side of ship at distance L.
- N is the number of shipboard connections at given location(s).
- Where more than one connection exists, all locations are shown.

[a] Loads based on ship's peacetime complement (no air wing or troops).

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

[c] For multiple ships, see Steam Service Diversity Factors.

[d] 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 UFC 3-400-02, Design: Engineering Weather Data, 99 percent 4 basis, whenever available. Design temperatures for sites not listed may be obtained from the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., ASHRAE Handbook, 97-1/2 percent basis.

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

[f] Not required. '---'

[g] Loads based on absolute, worst case condition. Upon completion of ShipAlt CG47-00588K (All Electric), there will no longer be a requirement for steam.

[h] Information contained in NAVSEA Dwg 6726570 Rev C (NOFORN)

[i] Information contained in NAVSEA Dwg 4639983 Rev E (NOFORN)

[j] Figure based on normal supply to ship when berthed at NNSY.

[k] Steam used for hot water and ship services not significantly affected by outside temperatures. Mid-Life electrical upgrades will remove steam from these ships.

[l] Shore steam not expected for commissioned vessels; required only during dry dock periods; if needed, use 5 NPS ANSI B.16.5 flange 600.

Table A-2 Shore Services – Compressed Air

Compressed Air *, [a]								
Ship Classification Symbol	Quantity [b]	Pressure [c]	Minimum Branch Size [d]	Minimum Outlet Risers	Ships Connection Data **			
	(scfm)	(psig)	(inch)	per Berth	L	H	N	Size
AIRCRAFT CARRIERS								
CVN 68 [e]	2,400	125	4	5				
CVN 78 [f]	2,400	115-125	4	5	780 P	25	1	3”
					612 S	25	1	3”
SURFACE COMBATANTS								
CG 47	1,000	125	3	4				
DDG 51	1,000	125	3	3	146 C	21	1	2.5"
					274 S	21	1	2.5"
DDG 79 [g] (Flight IIA)	300 [a]	100	3		144 C	22	1	2.5” fem QDISC, Type V Class 2
					274 S	22	1	2.5” fem QDISC, Type V Class 2
	3,200 [c]	300	3		144 C	22	1	4” flg
					274 S	22	1	4” flg
DDG 1000 [h]	---	---	---	---	---	---	---	---
FFG 7	1,000	125	3	3	360 S	28	1	1.5"
LCS 1 [f]								
LCS 2 [f]								
SUBMARINES								
SSN 21 [i]	750	125						
SSN 688 [i]	750	125	2	2				
SSN 774 [i, j]	150	5,100			at aft charging station			1.750 – 12UN-3A x 0.500 NPS
SSBN 726 & SSGN [i, k]								
SSBN 826								
UUV								
AMPHIBIOUS								
LCC 19	1,050	125	2.5	4	369 P/S	46		
LCC 20	300	125	2.5	4				
LHA 1 [e]	800	125						
LHA 6 [h]	---	---	---	---	---	---	---	---
LHD 1 [e]	800	125						

Compressed Air *, [a]								
Ship Classification Symbol	Quantity [b]	Pressure [c]	Minimum Branch Size [d]	Minimum Outlet Risers	Ships Connection Data **			
	(scfm)	(psig)	(inch)	per Berth	L	H	N	Size
LHD 8 [g]	---	---	---	---	---	---	---	---
LPD 4 (AFSB (I)) [l]	1,000	125						
LPD 17 [m]								
LSD 41	300	125	3	4	220 C	35		
LSD 49	300	125	3	4	220 C	35		
MINE WARFARE								
MCM 1								
AUXILIARY								
T-AH 19								
T-AKE 1	207	125	---	N/A	N/A	N/A	N/A	N/A
T-AO 187								
T-AO 205								
T-AOE 6					475 P	28		
					470 S	28		
T-APL 2								
T-APL 15								
T-ARS 50	---	---	---	---	---	---	---	---
T-AS 39								
EXPEDITIONARY								
T-EPF 1 (JHSV)								
ESB 3	177	125	3	2	600 C	70	1	
ESB 4		150	2	1	600 C	16	2	
PATROL								
PC 1								
ARMY								
TBD								
USCG								
NSC (WMSL)		125						
WHEC 717								
WLB 201								
WLBB 30								
WLM 551								
WMEC 615	---	---	---	---	---	---	---	---
WMEC 901	---	---	---	---	---	---	---	---
WPB 1301								

Notes to Table A-2:

* See note (*) at beginning of APPENDIX A; information provided in this table is for general reference purposes only; information is incomplete and may not be accurate; verify utility requirements with ships/program office(s). Blanks in table indicate information is missing or unavailable at this time.

** Designations of locations of ship connections are as follows:

- L is the distance (in feet) of the connection aft of the stem of the ship.
- H is the height (in feet) of the connection above the design waterline.
- P, S, C, CL refer to Port side, Starboard side, and Center/Centerline of a ship respectively.
- P/S indicates one connection on each side of ship at distance L.
- N is the number of shipboard connections at given location(s).
- Where more than one connection exists, all locations are shown.

[a] Low pressure compressed air requirements shown.

[b] For multiple ships, use diversity factor.

[c] Minimum required at connections. Higher pressures may be necessary where specifically directed by the cognizant Service or the using agency.

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

[e] No shore connection; normal procedure is for ship's force to identify valve in system to be pulled and temporary hoses are attached where valve was pulled

[f] FPC for CVN 78 Class from PMS 378 (Rev 4, May 2015) states, High pressure air: none. Low pressure air, nitrogen, oxygen, and divers air: portable only. NAVSEA 05V3 states the values listed are required.

[g] DDG 51 Arleigh Burke class is currently comprised of three separate variants or “Flights”: DDG 51-71 represent the original design and are designated Flight I ships; DDG 72-78 are Flight II ships; DDG 79 through DDG 123 are or will be built to the Flight IIA design.

[h] Not required. ‘---‘

[i] Submarine and UUV piers/berths require low pressure and high pressure compressed air.

[j] For SSN 774, 1.750 – 12UN-3A X 0.500 NPS adapter assembly at aft charging station. Limited charging flow rate at 150 scfm.

[k] Information contained in NAVSEA Dwg 4639983 Rev E (NOFORN).

[l] No designated shore air connections on board.

[m] Not required at normal pier tie up.

Table A-3 Shore Services – Salt or Nonpotable Water – Overhaul and Dry Dock Berthing

Salt or Nonpotable Water – Overhaul and Dry Dock Berthing *							
Ship Classification Symbol	**Total Demand**	**Fire-Fighting Flow**	**Cooling/ Flushing Flow**	**Ships Connection Data** **			
	(gpm @ psi)	**(gpm)**	**(gpm)**	**L**	**H**	**N**	**Size**
AIRCRAFT CARRIERS							
CVN 68	10,000	3,000	7,000	530 P	25	4	3.5" gate 250 psig
				785 P	34	4	3.5" gate 250 psig
				546 S	25	4	3.5" gate 250 psig
				777 S	25	4	3.5" gate 250 psig
CVN 78 [h, i]	17,620 or 29,000 @ 150-175 [h, i]	3,000	14,620	500 P	25	4	4" hoses
				780 P	25	4	4" hoses
				620 S	25	4	4" hoses
				860 S	25	4	4" hoses
SURFACE COMBATANTS							
CG 47	1,250	1,000	250	158 P	24	4	2.5"
				360 S	24	4	
DDG 51 [g] & (Flight IIA)	2,000 @ 150	1,000		194 P/S	22	4	2.5” NPS
DDG 1000		1,000 @ 175	240-300 @ 20-40			3	2.5"
FFG 7	1,250	1,000	250	282 S	28	4	2.5"
LCS 1 [a]	---	1,000	---	---	---	---	---
LCS 2 [a]	---	1,000	---	---	---	---	---
SUBMARINES							
SSN 21 [b]				144/235			two 2.5”-7.5” NH hose conn. male
SSN 688 [c]				275 P/S			
SSN 774	1,180	230 @ 100	950	150/250		2	2.5"
SSBN 726 & SSGN [d, e]			110				2.5"
SSBN 826							
UUV							
AMPHIBIOUS							
LCC 19	1,250	1,000	250				
LCC 20	1,250	1,000	250	multiple	21		6” flange or multiple 1.5” hose
LHA 1 [f]	3,125	2,500	625				
LHA 6	8,000	2,500		238 P	54	4	4" fire hose
				707 P	55	4	4" fire hose
				273 S	55	4	4" fire hose
				644 S	55	4	4" fire hose

Salt or Nonpotable Water – Overhaul and Dry Dock Berthing *							
Ship Classification Symbol	Total Demand	Fire-Fighting Flow	Cooling/ Flushing Flow	Ships Connection Data **			
	(gpm @ psi)	(gpm)	(gpm)	L	H	N	Size
LHD 1		2,500		210 P	55	4	4" fire hose
				700 P	55	4	4" fire hose
				266 S	55	4	4" fire hose
				644 S	55	4	4" fire hose
LHD 8	8,000	2,500		252 P/S	54	4	4" fire hose
LPD 4 (AFSB (I))	1,875	1,500	375				
LPD 17	2,000 @ 125	1,000		190 P/S	24	2	2 four hose manifolds
				541 P/S	24	2	2 four hose manifolds
LSD 41	2,500	2,000	500				
LSD 49	2,500	2,000	500				
MINE WARFARE							
MCM 1		750					
AUXILIARY							
T-AH 19		1,000					
T-AKE 1	1,000	1,000	N/A				
T-AO 187		1,500					
T-AO 205		1,500					
T-AOE 6	1,875	1,500	375	179 P	28		
				575 P	28		
				180 S	28		
				608 S	28		
T-APL 2							
T-APL 15							
T-ARS 50	750	500	250	110 P/S	18	2	4” fire hose
T-AS 39	1,875	1,500	375				
T-AVB 3							
EXPEDITIONARY							
T-EPF 1 (JHSV)							
ESB 3	792	633	158	600 C	70	1	
ESB 4	2,069	2,069	3,742	600 C	70	1	
PATROL							
PC 1		500					
ARMY							
TBD							
USCG							
NSC (WMSL)							
WHEC 717							
WLB 201							
WLBB 30							

Salt or Nonpotable Water – Overhaul and Dry Dock Berthing *							
Ship Classification Symbol	Total Demand	Fire-Fighting Flow	Cooling/ Flushing Flow	Ships Connection Data **			
	(gpm @ psi)	(gpm)	(gpm)	L	H	N	Size
WLM 551							
WMEC 615							
WMEC 901							
WPB 1301							

Notes to Table A-3:

* See note (*) at beginning of APPENDIX A; information provided in this table is for general reference purposes only; information is incomplete and may not be accurate; verify utility requirements with ships/program office(s). Blanks in table indicate information is missing or unavailable at this time.

** Designations of locations of ship connections are as follows:

- L is the distance (in feet) of the connection aft of the stem of the ship.
- H is the height (in feet) of the connection above the design waterline.
- P, S, C, CL refer to Port side, Starboard side, and Center/Centerline of a ship respectively.
- P/S indicates one connection on each side of ship at distance L.
- N is the number of shipboard connections at given location(s).
- Where more than one connection exists, all locations are shown.

[a] Not required. '---'

[b] Provide 600 gpm @ 65 psi for cooling (inboard connection in engine room) and 336 gpm @ 100 psi for flushing and firefighting.

Inboard connections fore and aft.

[c] Provide 2,000 gpm @ 40 psi; also provide 600 gpm @ 40 psi from separate, but simultaneous source as emergency backup.

Dry dock provides (F10) steel bolted fire hose connection (male) for standard fire hose.

Dry dock also provides connection for 12" ASW hull valves.

[d] For cooling/flushing; only flushing value is provided.

[e] Information contained in NAVSEA Dwg 4639983 Rev E (NOFORN).

[f] Planning Yard (NNSY) advises no shore connections; use 15 hose connections to ships fire plugs.

[g] DDG 51 Arleigh Burke class is currently comprised of three separate variants or "Flights": DDG 51-71 represent the original design and are designated Flight I ships; DDG 72-78 are Flight II ships; DDG 79 through DDG 123 are or will be built to the Flight IIA design.

[h] NAVSEA calculated total minimum 'critical load' saltwater flow is 17,620 gpm. Total (minimum + habitability/testing) saltwater required calculated by NNSY for all ship and dock systems is 29,000 (rounded from 28,072) gpm. Pressure at ship is 150 psi and pressure at shoreside manifold is 175 psi.

[i] NAVSEA letter Ser 14-0452, *Norfolk Naval Shipyard Request for CVN 78 Class Drydock Seawater Flow Requirements*;

NAVSEA Response of 09 May 14; NNSY letter C240 Ser 240-008-17, *Norfolk Naval Shipyard Request for CVN 78 Drydock Seawater Flow Requirements, Follow Up*, 14 Nove 2017 (NOFORN)

Table A-4 Shore Services – Potable Water

Potable Water *							
Ship Classification Symbol	**Normal Requirement with Ships Compliment**		**Requirement with Air Wing or Troops Aboard**	**Ships Connection Data ****			
	(gpd)	**(gpm @ psi)**	**(gpd)**	**L**	**H**	**N**	**Size**
AIRCRAFT CARRIERS							
CVN 68	100,000		185,000	300 P/S	29	1	2.5" globe
				540 P/S	29	1	2.5" globe
CVN 78 [a]	152,750	225 @ 30-40	235,000	501 P	27	2	2.5" hose conn.
				777 P	27	2	2.5" hose conn.
				417 S	27	2	2.5" hose conn.
				673 S	27	2	2.5" hose conn.
SURFACE COMBATANTS							
CG 47	16,000	@ 75		242 P/S	21	1	2.5" hose conn.
DDG 51	9,500	100 @ 40		52 S	34	2	2.5" hose conn.
				202 P/S	22	2	
DDG 79 [b] (Flight IIA)		200 @ 100		202 P/S	22	2	2.5" NPSH, Fed Std H28
DDG 1000		100					2.5" hose conn.
FFG 7	10,800			325 P/S	32	1	2.5" hose conn.
LCS 1	4,500	225 @ 30-40		115 S	23	1	2.5" hose conn.
LCS 2	4,500	225 @ 30-40		230 S	15	1	2.5" hose conn.
SUBMARINES							
SSN 21	5,000			138.3 (16.3' off CL-P)		1	1.5 NPS hose conn.
SSN 688 [c]	5,000			150 (2.5' off CL-P)		1	
SSN 774	5,000	50 @ 50		150 C		1	1.5" hose conn. with 1.5-11.5 NPSH connector/adapter type
SSBN 726 & SSGN	5,000			312.9		1	2.5" hose conn
SSBN 826							
UUV							
AMPHIBIOUS							
LCC 19, 20	33,000		55,000	313 P	44		
				281 S	44		
LCC 20 [d, e]	21,000		40,000	320 P/S	26	1 or 2	1 x 1.5" or 2 x 1.5"
LHA 1	28,000		85,000	337 S	46	1	2.5" hose conn.
LHA 6		200 @ 87		371 P	15	1	2.5" hose conn.
				427 S	63	1	2.5" hose conn.
				553 S	34	1	2.5" hose conn.

Potable Water *							
Ship Classification Symbol	**Normal Requirement with Ships Compliment**		**Requirement with Air Wing or Troops Aboard**	**Ships Connection Data ****			
	(gpd)	**(gpm @ psi)**	**(gpd)**	**L**	**H**	**N**	**Size**
LHD 1	32,000		90,000	680 S	45	1	2.5" hose conn.
LHD 8	35,840		101,185	371 P	15	1	2.5" hose conn.
				427 S	63	1	2.5" hose conn.
				553 S	34	1	2.5" hose conn.
LPD 4 (AFSB (I))	15,000		48,300	356 P	35		
				327 S	35		
LPD 17	15,000	200 @ 87	40,000	200 P/S	24	1	2.5”
LSD 41	14,000		25,000	208 P	36		
				260 S	36		
LSD 49	12,000		25,000	216 P	37		
				260 S	37		
MINE WARFARE							
MCM 1		@ 60-70					
AUXILIARY							
T-AH 19							
T-AKE 1	6,000			487 P	30	1	2.5" hose conn.
				487 S	45	1	2.5" hose conn.
T-AO 187							
T-AO 205							
T-AOE 6	21,000			321 P/S	68		
				449 P	68		
				433 S	68		
T-APL 2							
T-APL 15							
T-ARS 50		75	N/A	128 P/S	18	1	2.5" hose conn.
T-AS 39				fan tail	main deck	1	2.5" hose conn.
T-AVB 3							
EXPEDITIONARY							
T-EPF 1 (JHSV)							2”
ESB 3	10,000		18,000	600 C	70	1	
ESB 4	18,800		31,800	670	60	2	2.5”
PATROL							
PC 1							
ARMY							
TBD							

Potable Water *							
Ship Classification Symbol	Normal Requirement with Ships Compliment		Requirement with Air Wing or Troops Aboard	Ships Connection Data **			
	(gpd)	(gpm @ psi)	(gpd)	L	H	N	Size
USCG							
NSC (WMSL)	3,000						1.5” hose conn.
WHEC 717		200 @ 50					
WLB 201	1,500	@ 55-65					1.5” threaded conn.
WLBB 30							
WLM 551							
WMEC 615		20 @ 50-55					1.5” hose conn.
WMEC 901	4,000	@ 40-50					
WPB 1301		@ 55					1.5” hose valve

Notes to Table A-4:

* See note (*) at beginning of APPENDIX A; information provided in this table is for general reference purposes only; information is incomplete and may not be accurate; verify utility requirements with ships/program office(s). Blanks in table indicate information is missing or unavailable at this time.

** Designations of locations of ship connections are as follows:

- L is the distance (in feet) of the connection aft of the stem of the ship.
- H is the height (in feet) of the connection above the design waterline.
- P, S, C, CL refer to Port side, Starboard side, and Center/Centerline of a ship respectively.
- P/S indicates one connection on each side of ship at distance L.
- N is the number of shipboard connections at given location(s).
- Where more than one connection exists, all locations are shown.

[a] Reduce requirement by 35% if airwing is not embarked.

[b] DDG 51 Arleigh Burke class is currently comprised of three separate variants or “Flights”: DDG 51-71 represent the original design and are designated Flight I ships; DDG 72-78 are Flight II ships; DDG 79 through DDG 123 are or will be built to the Flight IIA design.

[c] Connection is PW-8; 1.5" NPS globe valve w/hose connection; silver-bronze union end (MIL-F-1183) w/adaptor for Hose 'B' thread size; 1.5" male x 11.5 fem.

[d] Includes additional capacity to fill technical (flushing) water system. Technical water system is not dependent on shore potable water and may be filled using dedicated onboard water generating equipment if required.

[e] LCC-20 Potable water connections are configurable to either 2 x 1.5” or 1 x 2.5” Hose Connections.

Table A-5 Shore Services - Oily Waste/Waste Oil (OWWO) Discharge

Oily Waste/Waste Oil (OWWO) Discharge *									
Ship Classification Symbol	Pump Station	Pump	Pump Rating	Q_{PEAK}	Q_{AVE}	Ship Connection Data **			
			(gpm @ psi)	(gpd)	(gpd)	L	H	N	Size
AIRCRAFT CARRIERS									
CVN 68 to 71	1	1A	90 @ 50	80,000	35,000	512 P	23	1	2.5"
						680 S	23	1	2.5"
CVN 72 to 77	1	1A	90 @ 50	80,000	35,000	512 P	23	1	2.5"
		1B	90 @ 50			680 S	23	2	2.5"
CVN 78 [a]	1	1A, 1B	90-180	[a]	[a]	316 S	25	1	2.5"
				[a]	[a]	673 S	25	1	2.5"
				[a]	[a]	819 S	25	1	2.5"
SURFACE COMBATANTS									
CG 47	1	1A, 1B	50 @ 60 each	12,000	3,000	386 P, 384 S OW transfer pump	24	1	2.5"
	2	2A, 2B	15 @ 60 each			380 P, 386 S gas turbine drain pump	24	1	2.5"
DDG 51	1	1A, 1B	50 @ 10 each	12,000	3,000	244 P/S	22	1	2.5"
DDG 79 [c] (Flight IIA)	1	1A, 1B	100 @ 10			244 P/S	22	1	2.5"
DDG 1000								1	2.5"
FFG 7	1	1A	50	6,750	1,500	244 P/S	28	1	2"
LCS 1	1	1A	90-180 @ 60		500	208 S	45	1	2.5"
LCS 2	1	1A	90-180 @ 60		500	230 S	15	1	2.5"
SUBMARINES									
SSN 21	1	1A	280	500	250	202.5' (14' off CL-S)		1	
		1B	280			205.2' (4' off CL-S)		1	
SSN 688	1	1A	230	500	250	215		1	2.5"
SSN 774	1	1A	230			159.56' (15.4' off CL-P)		1	1.5"
						218.47' (8.87' off CL-S)		1	1.5"
SSBN 726 & SSGN	1	1A	230	500	250	152'-11" (12'-10" off CL-P)		1	2.5"
SSBN 826									
UUV									
AMPHIBIOUS									
LCC 19, 20	1	1A	100	21,000	6,400				
LCC 20	1	1A	100	6,000	4,000	324 P/S	26	1	2.5"

Oily Waste/Waste Oil (OWWO) Discharge *									
Ship Classification Symbol	Pump Station	Pump	Pump Rating	Q_{PEAK}	Q_{AVE}	Ship Connection Data **			
			(gpm @ psi)	(gpd)	(gpd)	L	H	N	Size
LHA 1	1 (fwd)	1A	18	21,000	6,400	448 S	45		2.5"
		1B	18			448 P	45		2.5"
		1C	18						
		1D	18						
	2	2A	54						
LHA 6	1	1A				455 P (oily waste)	24	1	2.5"
		1B				455 P (synthetic oil)	24	1	2.5"
	2	2A				553 S (oily waste)	34	1	2.5"
		2B				553 S (synthetic oil)	34	1	2.5"
LHD 1	1 (fwd)	1A	54	21,000	6,400	441 P	55		2.5"
		1B	54			539 S	45		2.5"
		1C	54						
LHD 8 [b]	1	1A				455 P (oily waste)	24	1	2.5"
		1B				455 P (synthetic oil)	24	1	2.5"
	2	2A				553 S (oily waste)	34	1	2.5"
		2B				553 S (synthetic oil)	34	1	2.5"
LPD 4 (AFSB (I))	1	1A	18	21,000	6,400				
	2	2A	90						
LPD 17	1	1A	54	21,000	6,400	338 P (mineral oily waste)	13	1	2.5"
		1B	18			338 P (synthetic oil)	13	1	2.5"
	2	2A	54	21,000	6,400	463 S (mineral oily waste)	24	1	2.5"
		2B	18			463 S (synthetic oil)	24	1	2.5"
LSD 41				4,800	2,700				
LSD 49				4,800	2,700				
MINE WARFARE									
MCM 1									
AUXILIARY									
T-AH 19									
T-AKE 1	1	1A	22	N/A	N/A	487 P	30	1	3"
	2	2A	22	N/A	N/A	487 S	45	1	3"
T-AO 187									

Oily Waste/Waste Oil (OWWO) Discharge *									
Ship Classification Symbol	Pump Station	Pump	Pump Rating	Q_{PEAK}	Q_{AVE}	Ship Connection Data **			
			(gpm @ psi)	(gpd)	(gpd)	L	H	N	Size
T-AO 205									
T-AOE 6	1	1A	50			526 P	30	1	2.5"
	2	2A	15			528 P	30	1	2.5"
	3	3A	15			515 S	30	1	1.25"
	4	4A	50			516 S	30	1	1.25"
T-APL 2									
T-APL 15									
T-ARS 50	1	1A	168	500	275	128 P/S	18	1	2.5"
T-AS 39				15,000	10,000				
T-AVB									
EXPEDITIONARY									
T-EPF 1 (JHSV)									1.5” OW 2.5” BW
ESB 3									
ESB 4									
PATROL									
PC 1									
ARMY									
TBD									
USCG									
NSC (WMSL)									
WHEC 717									
WLB 201									
WLBB 30									
WLM 551									
WMEC 615									
WMEC 901			@ 10-15						2” ship conn.
WPB 1301									2.5” BW to 4” flange 4 bolt

Notes to Table A-5:

* See note (*) at beginning of APPENDIX A; information provided in this table is for general reference purposes only; information is incomplete and may not be accurate; verify utility requirements with ships/program office(s). Blanks in table indicate information is missing or unavailable at this time.

** Designations of locations of ship connections are as follows:

- L is the distance (in feet) of the connection aft of the stem of the ship.
- H is the height (in feet) of the connection above the design waterline.
- P, S, C, CL refer to Port side, Starboard side, and Center/Centerline of a ship respectively.

- P/S indicates one connection on each side of ship at distance L.
- N is the number of shipboard connections at given location(s).
- Where more than one connection exists, all locations are shown.

[a] Oily Water 8,000 gpd (45,000 gal); Waste Oil 40,000 gal/offload; Aircraft Waste Fuel 9,400 gal/offload. All use same 2.5” deck connection.

Ship OWWO system has two 90 gpm pumps and is capable of discharging 90-180 gpm. Shipboard standard operating procedure while pierside is to operate with only one pump and discharge at the lower rate of 90 gpm.

[b] Oily waste requirement to be determined; Synthetic oily waste = 54 gpm.

[c] DDG 51 Arleigh Burke class is currently comprised of three separate variants or “Flights”: DDG 51-71 represent the original design and are designated Flight I ships; DDG 72-78 are Flight II ships; DDG 79 through DDG 123 are or will be built to the Flight IIA design.

Table A-6 Shore Services – Sanitary (CHT) Discharge

Sanitary (CHT) Discharge *							
Ship Classification Symbol	Pump Station	Pump	Pump Rating (gpm @ psi)	Ships Connection Data ** L	H	N	Size
AIRCRAFT CARRIERS							
CVN 68 to 71	1	1A	400	485 P	23		4"
		1B		536 S	23		4"
	2	2A		740 P	23		4"
		2B		759 S	23		4"
	3	3A					
		3B					
CVN 72 to 77	1	1A	400	485 P	23		4"
		1B		309 S	23		4"
	2	2A		759 P	23		4"
		2B		802 S	23		4"
CVN 78 [a]	1, fwd	1A	250	500 P	25	1	4"
		1B	250	304 S	25	1	4”
	2, aft	2A	300	764 P	25	2	4"
		2B	300	840 S	25	2	4”
SURFACE COMBATANTS							
CG 47	1	1A, 1B	100 @ 30 each	190 P, 200 S	34	1	4"
	2	2A, 2B		362 P/S	34	1	4"
	3	3A, 3B					
DDG 51	1	1A, 1B	40 @ 30 each	149 P, 146 S	21	1	4"
	2	2A, 2B		331 P, 329 S	21	1	4"
DDG 79 [c] (Flight IIA)	1	1A, 1B	80 @ 40	149 P/S	22	1	4”
	2	2A, 2B		334 P/S	22	1	4”
DDG 1000	1					1	4"
FFG 7	1	1A, 1B	100	204 P/S	28	1	4"
LCS 1			250	115 S	23	1	4"
LCS 2			250	230 S	15	1	4"
SUBMARINES							
SSN 21	1	1A	25	132’ (3' off CL-P)			2.5"
SSN 688	1	1A	25	77’ (11' off CL-P)		1	2.5"
SSN 774	1	1A	100	173’ (12' off CL-P)			2.5"
SSBN 726 & SSGN	1	1A	25	153'-5" (9'-9" off CL-P)		1	2.5"
	2	2A	25	292'-5" (12'-6" off CL-P)		1	2.5"
SSBN 826							
UUV							
AMPHIBIOUS							

Sanitary (CHT) Discharge *							
Ship Classification Symbol	Pump Station	Pump	Pump Rating	Ships Connection Data **			
			(gpm @ psi)	L	H	N	Size
LCC 19, 20	1	1A, 1B	150 each	184 P/S	26	1	4"
	2	2A, 2B	150 each	380 P/S	26	1	4"
LHA 1	1	1A, 1B	400	231 P/S	45	1	4"
	2	2A, 2B	300	448 P/S	45	1	4"
LHA 6	1	1A	400 each	301 P	24	2	4"
	2	2A		294 S	34	2	4"
	3	3A		455 P	24	2	4"
	4	4A		434 S	24	2	4"
LHD 1	1	1A	300 each	280 S	55	1	4"
		1B		287 P	55	1	4"
	2	2A		420 S	55	1	4"
		2B		441 P	55	1	4"
LHD 8	1	1A	400 each	301 P	24	2	4"
	2	2A		294 S	24	2	4"
	3	3A		455 P	24	2	4"
	4	4A		434 S	24	2	4"
LPD 4 (AFSB (I))	1	1A, 1B	150	2 P/2 S		1	
	2	2A, 2B	150			1	
	3	3A, 3B	150			1	
LPD 17	1	1A, 1B	200	200 P/S	24	2	4"
	2	2A	200	338 P	13	2	4"
	3	3A	200	463 S	24	2	4”
LSD 41	1	1A, 1B	100	P/S		1	
	2	2A, 2B	100	P/S		1	
LSD 49	1	1A, 1B	100	P/S		1	
	2	2A, 2B	100	P/S		1	
MINE WARFARE							
MCM 1	1	1	25	FR 32 (14.5’ off CL–P/S)	01 level	1	1.5"
AUXILIARY							
T-AH 19							
T-AKE 1	1	1A	50	407 S	45	1	3"
	2	2A, 2B	17	414 P	31	1	3"
	3	3A, 3B	310				
		3A	200	487 P/S	30	1	3"
		3B	200	487 S	45	1	3"
T-AO 187							
T-AO 205							
T-AOE 6 [b]	1	1A, 1B	100	265 P/S	33	1	
	2	2A	100	440 P	33	1	
		2B	100	430 S	33	1	
T-APL 2							

Sanitary (CHT) Discharge *							
Ship Classification Symbol	Pump Station	Pump	Pump Rating	Ships Connection Data **			
			(gpm @ psi)	L	H	N	Size
T-APL 15							
T-ARS 50	1	1A, 1B	100	92 P/S	18	1	
T-AS 39	1	1A, 1B	100	P/S		1	
	2	2A, 2B	100	stern		1	
	3	3A, 3B	100				
	4	4A, 4B	100				
	5	5A, 5B	100				
T-ATF 166							
T-AVB 3							
EXPEDITIONARY							
T-EPF 1 (JHSV)							
ESB 3	2	2	150	619 P/S	116	1	
ESB 4	2	1	264	660	60	2	3”
PATROL							
PC 1	1	1	60	FR 30.5 (3' fwd of midships; 9' off CL-S)	10’ above WL, main deck	1	2.5"
ARMY							
TBD							
USCG							
NSC (WMSL)			350 gpm, 4,000 gpd				4” camlock
WHEC 717			120				
WLB 201			500 gpd				3” camlock
WLBB 30							
WLM 551							
WMEC 615			30 @ 12				3” camlock
WMEC 901			8,000 gpd				4” camlock
WPB 1301			550 gpd	P	main deck	1	4"

Notes to Table A-6:

* See note (*) at beginning of APPENDIX A; information provided in this table is for general reference purposes only; information is incomplete and may not be accurate; verify utility requirements with ships/program office(s). Blanks in table indicate information is missing or unavailable at this time.

** Designations of locations of ship connections are as follows:

- L is the distance (in feet) of the connection aft of the stem of the ship.
- H is the height (in feet) of the connection above the design waterline.

- P, S, C, CL refer to Port side, Starboard side, and Center/Centerline of a ship respectively.
- P/S indicates one connection on each side of ship at distance L.
- N is the number of shipboard connections at given location(s).
- Where more than one connection exists, all locations are shown.

[a] CVN 78 utilizes a Type III Vacuum CHT (VCHT) system (50,000 gal tank forward and 100,000 gal tank aft). CHT transfer (discharge) pumps come on and empty tanks at ratings indicated. CHT tanks are only opened when there is maintenance/repair required in the tank. HMR 104 and HMR 104 Rev 1 authorized the change to a Type III VCHT system from a Type II (treatment).

[b] CHT fwd and aft systems are independent and must both be hooked up for shore discharge of sewage.

[c] DDG 51 Arleigh Burke class is currently comprised of three separate variants or “Flights”: DDG 51-71 represent the original design and are designated Flight I ships; DDG 72-78 are Flight II ships; DDG 79 through DDG 123 are or will be built to the Flight IIA design.

Table A-7 Shore Services – Electrical

Electrical *						
Ship Classification Symbol	Ampacity Per Station [a]	Required Ampacity of Shore Power Service [b]	Ships Connection Data **			
			L	H	N	Size
AIRCRAFT CARRIERS						
CVN 68, 69	1,440 [c]	2,800	548 S	30	1 - 4	
	1,440 [c]		704 S	30	1 - 4	
	4,000	16,000	300 S	30	1	
	4,000		312 S	30	1	
	4,000		1,000 S	40	1	
	4,000		1016 S	40	1	
CVN 70 to 77 [d]	1,440 [c]	2,800	548 S	30	1 - 4	
	1,440 [c]		704 S	30	1 - 4	
	4,000	16,000	296 S	30	2	
	4,000		1,016 S	40	2	
CVN 78 [e]	837	1,674	460 S	25	4	3 conductor (350 kcmil)
	837		704 S	25	4	
SURFACE COMBATANTS						
CG 47 to 51 [f]	4,000	5,200	316 P/S	44	1 - 10	
	1,200		316 P/S	44	1 - 3	
CG 52 and up [f]	4,000	4,000	511 C	18	1 - 10	
DDG 51	4,800	4,800	265 C	25	1 – 10 to 12 cables	400 A 3 conductor
DDG 79 [g] (Flight IIA)	3,800 to 4,800	4,800	274 S	22	1 - 10 to 12 cables	Std 400 A 3 conductor
DDG 1000 [c]		470	260 P/S	10	1 - 2	
FFG 7	2,800	2,800	252 C	35	1 - 7	
LCS 1	1,600	1,600	208 S	45	1 - 4	
LCS 2	1,600	1,600	152 C	35	1 - 4	
SUBMARINES [h]						
SSN 21	1,600	1,600	52 C		1 - 4	
	1,600		73 C		1 - 4	
SSN 688	1,600	1,600	146 C		1 - 4	
	1,600		210 C		1 - 4	
SSN 774 [i] (Block I-IV)	400	2,400	144 C		1 - 1	
	800		222 P		1 - 2	
	1,200		222 S		1 - 3	
SSN 774 (Block V) [i, j]	400	2,800	fwd		1 - 1	
	1,200		aft P		1 - 3	
	1,200		aft S		1 - 3	
SSBN 726 & SSGN	1,600	1,600	137 C		1 - 4	
	1,600		406 C		1 - 4	
SSBN 826	1,600	1,600	C		1 - 4	
	1,600		C		1 - 4	

Electrical *						
Ship Classification Symbol	Ampacity Per Station [a]	Required Ampacity of Shore Power Service [b]	Ships Connection Data **			
			L	H	N	Size
UUV						
AMPHIBIOUS						
LCC 19, 20			442 P/S	28	2	
LCC 20	4,000	4,000	424 P/S	28	10	400 A ea
LHA 1	4,000	7,200	445 P/S	37	1 - 10	
	3,200		791 P	57	1 - 8	
LHA 6 [c]	1,600	1,903	441 P	24	2 - 2	
	1,600		434 S	24	2 - 2	
	800		812 C	53	1 - 2	
LHD 1	4,000	7,200	420 P	25	1 - 10	
	4,000		440 S	25	1 - 10	
	3,200		800 C	48	1 - 8	
LHD 8 [c]	1,600	2,400	420 P	25	2 - 2	
	1,600		440 S	25	2 - 2	
	800		800 C	48	1 - 2	
LPD 4 (AFSB (I))	1,600	1,400	240 C	50	1 - 4	
LPD 17	8,000	8,000	88 C	48	1 - 20	
LSD 41 [k]	2,400	2,400	252 C	34	1 - 6	
LSD 49 [k]	3,200	2,160	252 P	34	1 - 8	
MINE WARFARE						
MCM 1		800				
AUXILIARY						
T-AH 19						
T-AKE 1 [l]	4,000	8,000	310 C	55	1 - 10	
			333 C	55	1 - 10	
T-AO 187						
T-AO 205						
T-AOE 6	4,000	3,200	435 P/S	55	1 - 10	
T-APL 2						
T-APL 15						
T-ARS 50	400	1,200	92 P	30	4	
T-AS 39 [m]	4,000	A 4,200	370 P/S	38	1 - 1	
	4,000		370 P/S	48	1 - 1	
	8,000	B 8,000	610 S	28	1 - 2	
T-AVB						
EXPEDITIONARY						
T-EPF 1 (JHSV)	800	800	320 P/S	28	1 - 2	
ESB 3	6,000	6,000	708 P/S	229	2 - 15	
ESB 4	6,000	6,000	650 P/S	135	1 - 15	THOF-400
PATROL						

Electrical *						
Ship Classification Symbol	**Ampacity Per Station [a]**	**Required Ampacity of Shore Power Service [b]**	**Ships Connection Data** **			
			L	**H**	**N**	**Size**
PC 1	200	170	107 P	11	1	
ARMY						
TBD						
USCG						
NSC (WMSL)	400	1,600			4	
WHEC 717					2	
WLB 201	400				2	
WLBB 30						
WLM 551						
WMEC 615					1	
WMEC 901	400				2	
WPB 1301	200					97.7 kW recp.

Notes to Table A-7:

* See note (*) at beginning of APPENDIX A; information provided in this table is for general reference purposes only; information is incomplete and may not be accurate; verify utility requirements with ships/program office(s). Blanks in table indicate information is missing or unavailable at this time.

** Designations of locations of ship connections are as follows:

- L is the distance (in feet) of the connection aft of the stem of the ship.
- H is the height (in feet) of the connection above the design waterline.
- P, S, C, CL refer to Port side, Starboard side, and Center/Centerline of a ship respectively.
- P/S indicates one connection on each side of ship at distance L. 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.
- ST is stern station location; if power is delivered to the stern station, the port and starboard stations would normally not be used for receiving power.
- N is the number of service points - number of cables per service point (ex: 1 – 4, one service point with four cables).
- Where more than one connection exists, all locations are shown.

[a] Capacity is given in amperes. Unless otherwise indicated, power to load center is 450 V, 3-phase, three-wire, 60 Hz, ungrounded. Power factor is approximately 0.8. The number of receptacles per station may be obtained by dividing per station ampacity by 400.

[b] Required ampacity of shore power service is the maximum power that the ship will demand from the shore power system. The shore power service transformer shall be sized to provide the "Required ampacity of shore power service" for the ship moored at the respective berth. Note that the shore power service transformer is not necessarily sized to provide the ampacity equivalent to the product of the required number of shore power circuits and the rating (400 A) of the shore power circuits.

[c] Power is 4,160 V, 3-phase, three wire, 60 Hz, ungrounded. .

[d] CVN 70 and higher will not require any 480 V electrical services.

[e] Power to load center is 13,800 V, 3-phase, three wire, 60 Hz, ungrounded; 1307/1569 correspond to 25 MW load (without air wing) and 30MW load (with air wing). For additional information regarding the shore-to-ship interface, refer to *NAVSEA Drawing 802-7094558*, CVN Class Aircraft Carrier Electrical Interface Characteristics (NOFORN).

[f] CG 47 through CG 51: A total of 26 shore power receptacles are provided, 13 at each port and starboard station. Three receptacles (1,200 A) are used for a feed-through circuit to a tended ship and 10 receptacles (4,000 A) are used for the ships shore power station. CG 52 and following have no feed-through circuits.

[g] DDG 51 Arleigh Burke class is currently comprised of three separate variants or “Flights”: DDG 51-71 represent the original design and are designated Flight I ships; DDG 72-78 are Flight II ships; DDG 79 through DDG 123 are or will be built to the Flight IIA design.

[h] Normal hotel service load is 1,600 Amps.

Special testing of submarines, usually conducted at shipyards, requires an increased level of shore power (super shore power). Depending upon local operating policies, either additional circuits from the same service(s) are connected in conjunction with the normal "hotel" circuits to provide a combined increased level of shore power or additional circuits from completely separate service(s) are provided in addition to the normal "hotel" service. Note that for both modes of operation, the additional circuits are connected directly to the ship's switchboard bus.

[i] It is required that the shunt interlock circuits for the three SSN 774 Class services be independent of each other and the interlock should insure that all of the breakers for a given service (e.g. port) trip open at the same time in the event of an overcurrent condition.

[j] Only SSN 774 Block V (with VPM) requires a total of 6 circuits (cables) to the aft service points, 3 Port and 3 Starboard. One additional circuit (cable) is required to the Port bus for Block V (with VPM). Block V (w/o VPM) does not require an additional circuit. SSN 774 Block V (w/o VPM) – 2,400 A total. SSN 774 Block V (with VPM) – 2,800 A total.

[k] Between FY08 & FY14 LSD Class goes through a Mid Service Life Electrical Upgrade.

- LSD 41-48 goes from 6 cables (2,400 A) to 10 cables (4,000 A).
- LSD 49-52 goes from 8 cables (3,200 A) to 12 cables (4,800 A).

[l] T-AKE 1 requires that shore power be delivered at 505 to 515 V.

T-AKE 1 uses its own DC system to detect grounds, whereas shoreside facility uses an AC system to detect grounds. Prior to arrival at berth, shoreside facility must disable its ground detection system for that particular berth and rely upon the T-AKE 1 ground detection system.

[m] 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.

Table A-8 Shore Services – Telecommunications

Telecommunications *						
Ship Classification Symbol	**Telephone Lines (Pairs)**		**Ships Connection Data ****			
	Active Lines [a]	**Cable Size at Berth [b]**	**L**	**H**	**N**	**Size**
AIRCRAFT CARRIERS						
CVN 68	60	200	303 S	26	1	
			1,008 S	35	1	
CVN 78 [c]	60 min/100 max		545 P	25		
			613 S	25		
SURFACE COMBATANTS						
CG 47	15	50	287			
DDG 51	15	50	274 P/S	21		
DDG 79 [c] (Flight IIA)	15	50	274 P/S	21		
DDG 1000 [d]	20 to 40 lines					
FFG 7	8	50				
LCS 1 [e]	10					
LCS 2 [e]	10		230 S	15		
SUBMARINES						
SSN 21	8		80			
SSN 688	5	25	98			
SSN 774	10		95.69' (0.67' off CL-P)			
SSBN 726 & SSGN	10	25	136'-10"			
SSBN 826						
UUV						
AMPHIBIOUS						
LCC 19	150	180	208 P/S			
LCC 20	12	100	188 P/S			
LHA 1	120		80 P/S			
LHA 6 [f]	80		434 S	24		
			441 P	24		
			812 S	54		
LHD 1	120		78 P/S			
LHD 8 [f]	80		434 S	24		
			441 P	24		
			812 S	54		
LPD 4 (AFSB (I))	10	15	270 C			
LPD 17			463 P/S			

Telecommunications *						
Ship Classification Symbol	Telephone Lines (Pairs)		Ships Connection Data **			
	Active Lines [a]	Cable Size at Berth [b]	L	H	N	Size
LSD 41	10	50	250 P/S			
LSD 49	20	30	250 P/S			
MINE WARFARE						
MCM 1						
AUXILIARY						
T-AH 19						
T-AKE 1	16 Digital	18 AWG	415 P/S	30	1	18 AWG
T-AO 187						
T-AO 205						
T-AOE 6	10	50	205 C			
T-APL 2						
T-APL 15						
T-ARS 50	20		92 P	30		
T-AS 39						
T-AVB 3						
EXPEDITIONARY						
T-EPF 1 (JHSV)						
ESB 3	10		610 P/S	116		
ESB 4	2	FHOF4	470	140	1	FHOF4
PATROL						
PC 1						
ARMY						
TBD						
USCG						
NSC (WMSL)	*TBD*					
WHEC 717	*TBD*					
WLB 201						6 pair
WLBB 30						
WLM 551						
WMEC 615						
WMEC 901						
WPB 1301		SKW				4 pair

Notes to Table A-8:

* See note (*) at beginning of APPENDIX A; information provided in this table is for general reference purposes only; information is incomplete and may not be accurate; verify utility requirements with ships/program office(s). Blanks in table indicate information is missing or unavailable at this time.

** Designations of locations of ship connections are as follows:

- L is the distance (in feet) of the connection aft of the stem of the ship.
- H is the height (in feet) of the connection above the design waterline.
- P, S, C, CL refer to Port side, Starboard side, and Center/Centerline of a ship respectively.
- P/S indicates one connection on each side of ship at distance L.
- N is the number of shipboard connections at given location(s).
- Where more than one connection exists, all locations are shown.

[a] Total number of active lines required for any ship is sum of column for "active lines" for the ship class and the embarked staff requirements necessary where specifically directed by the cognizant Service or the using agency.

[b] Column "cable size at berth" lists the size of cable to be provided at berths designated for various ship types. Cable sizes given in column "cable size at berth" include the ship requirement, the appropriate embarked staff requirement, and an allowance for spare pairs.

[c] Also requires Internet T-1, T-100, ISDN, SIPRNET/NIPRNET Digital T-1/ISDN type, 2 lines.

[d] Also requires fiber optic LAN connectivity.

[e] Also requires (1) Internet T-1, T-100, ISDN Digital T-1/ISDN - 1 line; (2) SIPRNET/NIPRENET BL II 1 connection.

[f] Also requires 2 fiber optic connections for IT21/ISNS and BFTT.

[g] Embarked staff requirements.

Fleet Commander - 20

CARGRU Commander - 8

CREWDESGRU COMMANDER - 12

DESRON COMMANDER - 10

PHIBGRU COMMANDER - 12

PHILBRON COMMANDER - 15

MAB STAFF - 12

SERVGRU COMMANDER - 8

SUBRON COMMANDER - 15

PHMRON COMMANDER - 12

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APPENDIX B CLIMATOLOGICAL DATA

Figure B-1 U.S. Winter Weather Severity by Region

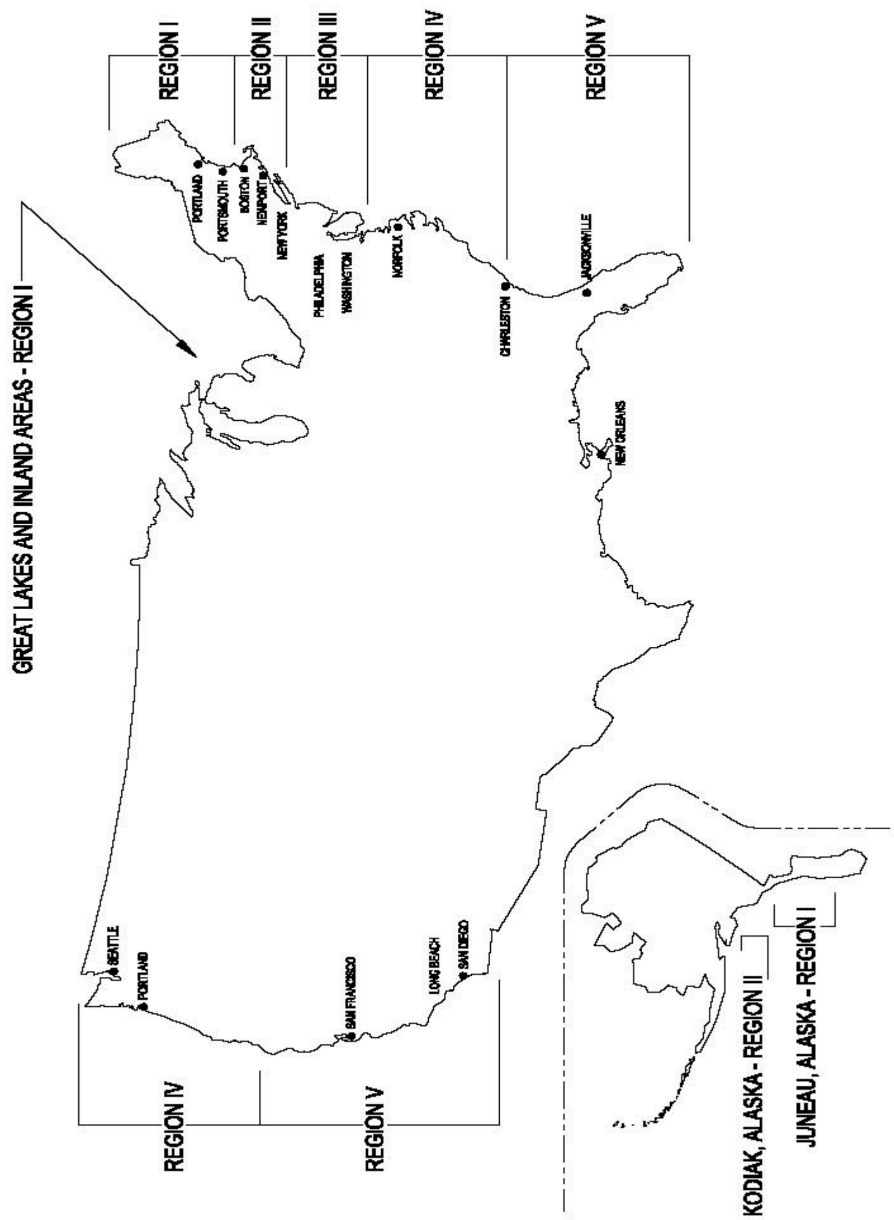


Table B-1 Regional Weather Data

Region	Average January Temp.	Extreme Minimum Temp.	Median Annual Extremes	97.5% Temp.	Average of 97.5% Temp. and Extreme Minimum	Degree Days
	(°F)	(°F)	(°F)	(°F)	(°F)	
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

Table B-2 Freeze Protection by Insulation and Heating: Suggested Combinations for Regions I and II

Nominal Pipe Size	Region I		Region II	
	Insulation Thickness	Heating	Insulation Thickness	Heating
(inch)	(inch)	(Watts/ft)	(inch)	(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	1-1/2	6
10	1-1/2	6	1-1/2	6
12	1-1/2	6	1-1/2	6

Table B-3 Freeze Protection by Insulation and Flushing: Suggested Combinations for Regions III and IV

	Region III		Region IV	
Nominal Pipe Size	Insulation Thickness	Heating	Insulation Thickness	Heating
(inch)	(inch)	(Watts/ft)	(inch)	(Watts/ft)
2	1	Yes	1	Yes
3	1	Yes	1	Yes
4	1	Yes	1	Yes
6	1	Yes	1	Yes
8	1	No	1	No
10	1	No	1	No
12	1	No	1	No

Table B-4 Freeze Protection by Insulation and Heating: Suggested Combinations for Regions III and IV

Nominal Pipe Size	Region III		Region IV	
	Insulation Thickness	Heating	Insulation Thickness	Heating
(inch)	(inch)	(Watts/ft)	(inch)	(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	6
8	1	None	1	None
10	1	None	1	None
12	1	None	1	None

APPENDIX C OPERATION AND MAINTENANCE CRITERIA FOR SHORE-TO-SHIP POWER

C-1 CRITICAL COMPONENTS.

All electrical components whose failure could affect the reliability of the electrical distribution system supplying power to ships are identified as critical components of the shore to ship power system and are placed under the maintenance program defined in this enclosure. Critical components are the shore power primary circuit breaker, step down transformer, secondary circuit breakers, the permanently installed cables between the shore power circuit breakers and the power connection station (turtleback), the power connection station receptacles, and the portable power cable assemblies used for supplying shore power services to ships. Each portable power cable assembly is defined to consist of two electrical connectors and the cable in between.

C-1.1 Critical Component Inventory Records.

A history record will be established and maintained covering each shore to ship power system critical component. The record will document via inspection checklists all work completed and by whom. Cable and connections shall be tagged in accordance with the Shore Power Cable Assembly Nomenclature Detail, as shown in Figure C-6 and entered into Single Platform MAXIMO and other appropriate maintenance planning databases.

- **One-line diagram:** One-line diagrams, illustrating the equipment ratings and system configuration from the utility point of service, are prepared and kept current by the activities in accordance with the cognizant Service Manual MO-201, Electric Power Distribution Systems. Plot plans will be annotated to show the location of all shore to ship power system components.
- **Power System Study:** An activity power system study, including load flow, fault current analysis, coordination of protective devices, and arc flash is prepared in accordance with MO-201, Electric Power Distribution Systems.

C-2 PARALLELING TRANSFORMERS.

If a ship is supplied by two or more shore transformers, the ship's force will be directed, through standard ship operating procedures, not to parallel the transformers through the ship's bus unless the senior ship's electrician verifies correct phase orientation between power sources, and the supplying activity authorizes the parallel operation. If shore transformers are paralleled through the ship's bus, short circuit currents may be increased to unsafe levels and circulating currents may overheat and destroy cables, transformers, and switchgear on board ship or on shore.

C-2.1 Paralleling Shipboard Generation with the Shore Power System.

Paralleling of ship's service generators with the shore power system is prohibited except for the shortest time necessary to transfer load to or from shore power.

C-3 CABLES FOR SHORE-TO-SHIP SERVICE.

Shore-to-ship cables are normally provided by the Activity. For 480 V, three-phase, three-wire service, cables should be ungrounded, standardized lengths of single cable with three conductors, Type THOF-500, conforming to military spec MIL-DTL-915, Cable, Electrical, for Shipboard Use, and should be used for loads not exceeding 400 A. For 4,160 V, three-phase service to nuclear aircraft carriers, cables should be SHD350GC 8 kV, non-shielded insulated, PVC-jacketed cable, in accordance with Insulated Cable Engineers Association (ICEA) S 66 524, Cross-Linked-Thermosetting Polyethylene Insulated Wire and Cables.

C-3.1 Low Voltage Cables.

- Existing portable cables used for 480 V shore to ship power service may be MIL-DTL-915 type THOF-500 or type SHOF-500 in accordance with MIL-DTL-915. Low smoke cable specified by MIL-DTL-24643 which is for use on ships, shall not be used for shore-to-ship power applications. Its softer jacket is susceptible to damage.
- New portable cables used for 480 V shore to ship power service shall be three conductor type "Enhanced THOF-500" or "Enhanced Plus THOF-500" as shown in Figure C-6, Figure C-6, Figure C-6. Equivalent or better cables from other sources may be considered as approved by Navy technical authority.

C-3.2 Medium Voltage Cables.

The portable cables used for 4,160 V and 13,800 V shore to ship power service shall be three conductor, 350 kcmil type SHD-GC with Chlorinated Polyethylene (CPE) jacket. Insulation and jacket shall conform to ICEA S-75-381. Cables for 4,160 V service shall be 8 kV or 15 kV. Cables for 13,800 V service shall be 15 kV. However, cable sizes larger than 350 kcmil may be used with approval by Navy technical authority.

C-3.3 Standard Cable Lengths.

Activities will maintain an inventory of portable shore to ship electric power cables in lengths required for the ships. Lengths will be selected and constructed to service ships without the use of in-line connectors. Approval by Navy technical authority is required for an exception allowing the use of in-line connectors for specific conditions. All cable runs will be of equal length to minimize unequal load sharing.

C-3.4 Cable Storage.

Cables not in use should be stored appropriately. Covered off pier storage locations are highly desirable.

C-4 SHORE POWER CIRCUIT BREAKERS.

C-4.1 Low Voltage Cable Overcurrent Protection for Submarines.

The long-time pickup settings of the 450 V shore to ship power service circuit breakers for submarines shall be adjusted so that they match nominal ratings of equipment on the submarine. (Currently, the limiting ratings for equipment on the submarine is 435 A. If the 435 A setting is not a standard setting on the existing equipment, then the next higher setting is acceptable up to 480 A. Circuit breaker settings in excess of 435 A shall be documented and submitted to the cognizant Service with sufficient technical justification of the setting. Shore activities shall provide written notification to the submarines prior to connection focusing on the load requirements and load monitoring, breaker settings, and safety impacts. The instantaneous pickup setting shall be coordinated with the available short circuit amperes and associated system devices.

C-4.2 Low Voltage Cable Overcurrent Protection for Surface Ships.

The long-time pickup settings of the 450 V shore to ship power service circuit breakers for surface ships shall be adjusted to 430 A. If the 430 A setting is not a standard setting on the existing equipment, then the next higher setting is acceptable up to 480 A. Circuit breaker settings in excess of 430 A shall be documented and submitted to the cognizant Service with sufficient technical justification of the setting. The instantaneous pickup setting shall be coordinated with the available short circuit amperes and associated system devices.

C-4.3 Medium Voltage Cable Overcurrent Protection.

The long-time pickup setting of the shore to ship power service circuit breakers shall be adjusted to 400 A. If the 400 A setting is not a standard setting on the existing equipment, then the next higher setting is acceptable. The cable overcurrent protection will be based on the lowest rated service system device which is usually the fixed cables (normally 350 kcmil 105C conductors rated 440 A in conduit in air) between the substations and the receptacles for the portable cables, therefore the service rating could be as high as 440 A. Metal-clad switchgear with vacuum power circuit breakers will be equipped with programmable microprocessor relays which will allow the over current pickup to be set precisely to the desired setting. Circuit breaker settings in excess of 400 A shall be documented and submitted to the cognizant Service with sufficient technical justification of the setting. The instantaneous pickup setting shall be coordinated with the available short circuit amperes and associated system devices.

C-5 CABLE CONNECTORS.

Connectors. Cable connectors are available in two types: (1) one single, multiple conductor type (1-3/c cable); and (2) single conductor type grouped in a cluster of three (3-1/c cables). A typical three-conductor outlet assembly is illustrated in Figure D-4. Figure D-5 illustrates the single-conductor type connector.

- Low Voltage Terminations:
    - All low voltage portable power cables will be terminated with a MIL-C-24368/1 (procured from vendors on the Qualified Products List (QPL)) plug at the ship end of the cable for surface ships.
    - All low voltage portable power cables will be terminated with a MIL-C-24368/5 (procured from vendors on the QPL) plug at the ship end of the cable for submarines.
    - The termination device at the service end of the cable must be compatible with the design of the dockside power connection station (turtleback) and may be terminated with one of the following:
        - a MIL-C-24368/1 plug, for existing installations
        - a single pole connector which meets the environmental and test requirements of the MIL-C-24368 and the additional requirements identified is shown in Figure D-5
        - a UL 486A listed plug
        - an equivalent or better connector as approved by Navy technical authority
    - Install terminations in accordance with manufacturer's recommendations.
- Low Voltage In-line Connections: In-line single pole connectors and lug to lug connections shall meet the same requirements as identified above. Male and female cable mount in-line connectors may be used to connect shorter cable segments together to make longer cable circuits as necessary.
- Medium Voltage Terminations: All medium voltage portable power cables will be terminated at the ship end of the cable with a heat shrinkable termination (Institute of Electrical and Electronics Engineers standard IEEE-48 class 1) specifically designed for SHD-GC cables. Medium Voltage portable power cables for CVN 78 will be terminated at the ship end of the cable with a 15 KV Patton & Cooke cable coupler specifically designed for SHD-GC cables. The termination device at the service end of the cable must be compatible with the design of the dockside power connection station (turtleback) and may be terminated the same as the ship end of the cable or with a coupler plug that is compatible with the receptacle at the dockside power connection station. The termination devices shall be assembled on to the cable per the manufacturer's instructions. Terminate the SHD-GC cable ground and check

conductors within the cable breakout boot or to the appropriate termination pin integral with the coupler plug.

C-6 MAINTENANCE OF PORTABLE POWER CABLE ASSEMBLIES.

C-6.1 Tests and Inspections for Submarine Portable Power Cable Assemblies.

Electrical tests and inspections shall be in accordance with Maintenance Standard (MS) Number 3420-08 1-089. These tests and inspections shall be conducted annually. Results of the contact tightness checks, conducted in accordance with paragraph 1.g of Maintenance Standard (MS) Number 3420-081-089, shall be included on the written notification provided to ships forces prior to each shore power service connection to the submarine, identified in Section C-4.1 above entitled “Low Voltage Cable Overcurrent Protection for Submarines”.

C-6.2 Tests and Inspections for Surface Ship Portable Power Cable Assemblies.

Electrical tests and inspections shall be in accordance with ANSI/NETA MTS Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems (most recent edition) for cables and the manufacturer's instructions for connectors. Over potential tests are not required, but may be performed on the cable assemblies that fail insulation-resistance tests as a means to locate cable faults and to verify cable integrity. These tests and inspections shall be conducted annually.

C-6.3 Cable Repair.

Cables with damage other than to the outer jacket shall be removed from service permanently. Repair jackets using a heat shrinkable wrap around mining cable repair sleeve, cold repair elastomeric strips for mining cables, or a similar product. Repair of the coupler plugs and receptacles shall be performed in accordance with the manufacturers' instructions of these cable repair products or shall be in accordance with reference (b) MS NO.3420-08 1-089.

C-6.4 Connector Repairs.

Repairs to MIL-C-24368/5 connectors shall be in accordance with reference (b) MS NO. 3420-08 1-089 Repairs to MIL-C-24368/1 and MIL-C-24368/4 connectors, and medium voltage coupler plugs shall be in accordance with manufacturer's instructions.

C-6.5 Splicing.

Splicing of portable shore to ship power cables is not recommended for 480V shore power cables. Medium voltage portable power cables shall not be spliced under any conditions.

C-7 MAINTENANCE OF SHORE TO SHIP POWER PERMANENT COMPONENTS.

C-7.1 Electrical Tests and Inspections.

Electrical tests and inspections for shore power circuit breakers and associated protective relaying and the permanently installed cables between the shore power circuit breaker and the power connection station (turtleback) shall be performed in accordance with the latest edition of ANSI/NETA Maintenance Testing Specifications (MTS).

Note: Complete visual inspection of inaccessible components is not required.

For low voltage power air circuit breakers, Visual and Mechanical Inspections and Electrical tests shall follow ANSI/NETA MTS recommendations and be performed every two years, with the exception of primary current injection testing. Primary current injection testing shall be performed every 3rd breaker maintenance cycle (6 years) unless a problem is suspected, in which case the test shall be done immediately. Secondary current injection testing with primary current verification to verify proper operation of the current transformers and remaining connection points shall be a substitute for primary current injection testing every 1st and 2nd breaker maintenance cycle (2 and 4 years respectively).These intervals may be reduced, as required, based upon equipment condition or operating environment.

For medium voltage circuit breakers, Visual and Mechanical Inspections and Electrical tests shall follow ANSI/NETA MTS recommendations and be performed every two years. This interval may be reduced, as required, based upon equipment condition or operating environment.

All new low and medium voltage circuits breakers shall follow acceptance testing requirements set forth in ANSI/NETA Acceptance Testing Specification (ATS).

Electrical tests and inspections for the power connection station receptacles shall be in accordance with the manufacturer’s instructions. Over potential tests are not required, but may be performed on the cable assemblies that fail insulation-resistance tests as a means to locate cable faults and to verify cable integrity.

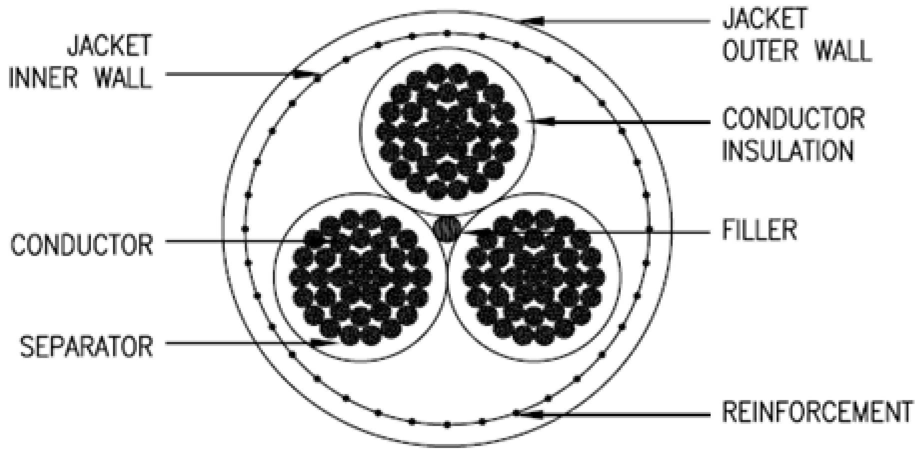
C-7.2 Repair.

Repair of permanent components shall be performed in accordance with the manufacturer's instructions.

C-7.3 Breaker Operation.

Whenever shore power circuit breakers operate on instantaneous trip, do not re-energize associated shore power circuits until the cause of the fault has been cleared and the circuit breaker has been inspected for damage to contacts, arc chutes, frame and operating mechanism. Whenever shore power circuit breakers operate because of an over current, the ships forces shall be notified and the associated shore power circuits may be reenergized per local SOPS with concurrence from the ships forces.

Figure C-1 3/C Enhanced THOF Cable

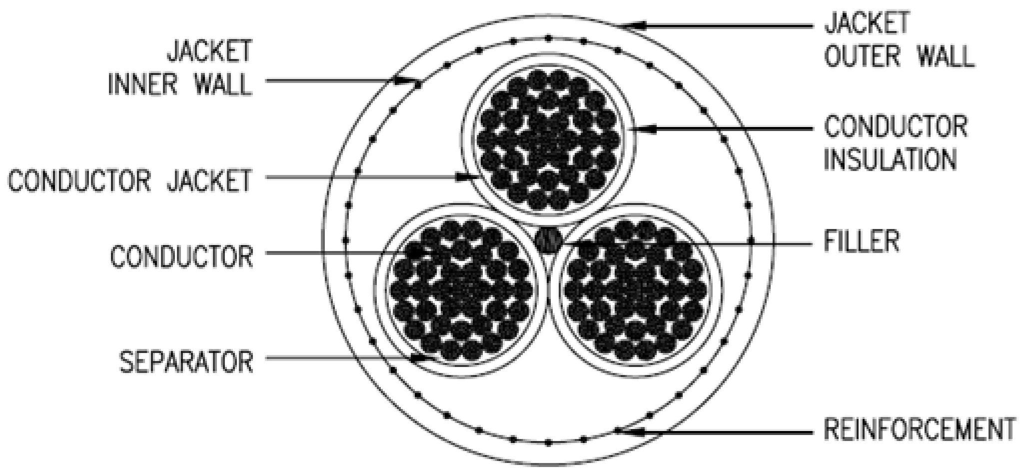


		TYPICAL
1.	CONDUCTOR – 500 KCMIL (37 x 33 / 0.0201") 1221W TINNED COPPER.	OD: 0.888"
2.	SEPARATOR – 2 MIL WHITE MYLAR PULLED LONGITUDINALLY.	OD: 0.893"
3.	CONDUCTOR INSULATION – 90 MILS (MIN AVG) OF UV RESISTANT ETHYLENE PROPYLENE RUBBER (EPR).	OD: 1.100"
4.	PHASE ID – PIGMENT COLORED INSULATION (BLACK, WHITE, RED).	
5.	FILLER – RUBBER AS REQUIRED TO FILL CENTER INTERSTICE.	
6.	JACKET INNER WALL – APPX. 100 MILS OF BLACK HEAVY DUTY CHLORINATED POLYETHYLENE (CPE).	
7.	REINFORCEMENT – TWO REVERSE/OPEN WRAPS OF POLYPROPYLENE FILAMENT.	
8.	JACKET OUTER WALL – APPX. 135 MILS OF BLACK EXTRA–HEAVY DUTY CHLORINATED POLYETHYLENE (CPE) 90°C RATED.	
9.	APPX WEIGHT – 7,563 POUNDS PER THOUSAND FEET.	OD: 2.875"
10.	CABLE IDENTIFICATION – INDENT MARKING TO READ: (MFG NAME) 500 KCMIL 3/C 600V ENHANCED SHORE–TO–SHIP POWER CABLE 90C (YEAR OF MFG) PROPERTY OF U.S. NAVY.	
12.	VOLTAGE RATING – 600 VOLTS.	
13.	TEMPERATURE RATING OF CONDUCTOR – 90°C.	
14.	TOLERANCE: +/–5%, DRAWING NOT TO SCALE.	
15.	SEE SPECIFICATION SHEET FOR ADDITIONAL INFORMATION.	

3/C ENHANCED THOF

REVISED: CIEE	MARCH 24, 2006	ATTACHMENT 2–1.1

Figure C-2 3/C Enhanced Plus THOF Cable



TYPICAL

1. CONDUCTOR – 500 KCMIL (37 x 33 / 0.0201") 1221W TINNED COPPER. OD: 0.888"
2. SEPARATOR – 2 MIL WHITE MYLAR PULLED LONGITUDINALLY.
3. CONDUCTOR INSULATION – 65 MILS (MIN AVG) OF ETHYLENE PROPYLENE RUBBER (EPR).
4. CONDUCTOR JACKET – 65 MILS (MIN AVG) OF UV RESISTANT CHLORINATED POLYETHYLENE (CPE) OR HYPALON.
5. PHASE ID – PIGMENT COLORED INSULATION (BLACK, WHITE, RED).
6. FILLER – RUBBER AS REQUIRED TO FILL CENTER INTERSTICE.
7. JACKET INNER WALL – APPX. 100 MILS OF BLACK HEAVY DUTY CHLORINATED POLYETHYLENE (CPE).
8. REINFORCEMENT – TWO REVERSE/OPEN WRAPS OF POLYPROPYLENE FILAMENT.
9. JACKET OUTER WALL – APPX. 125 MILS OF BLACK EXTRA-HEAVY DUTY CHLORINATED POLYETHYLENE (CPE) 90°C RATED.
10. APPX WEIGHT – 7,854 POUNDS PER THOUSAND FEET. OD: 3.003"
11. CABLE IDENTIFICATION – INDENT MARKING TO READ:
    (MFG NAME) 500 KCMIL 3/C 600V ENHANCED PLUS SHORE-TO-SHIP POWER CABLE 90C (YEAR OF MFG) PROPERTY OF U.S. NAVY.
12. VOLTAGE RATING – 600 VOLTS.
13. TEMPERATURE RATING OF CONDUCTOR – 90°C.
14. TOLERANCE: +/-5%, DRAWING NOT TO SCALE.
15. SEE SPECIFICATION SHEET FOR ADDITIONAL INFORMATION.

3/C ENHANCED PLUS THOF

REVISED: CIEE | MARCH 24, 2006 | ATTACHMENT 2-1.2

Figure C-3 3/C Enhanced & Enhanced Plus THOF Cable Specification

CONDUCTOR – CLASS I, UNIDIRECTIONAL LAY-UP, MAXIMUM RESISTANCE: 0.0238 OHMS/1000FT AT 25°C.

CONDUCTOR INSULATION – EPR PER ICEA S-75-381.
ABRASION RESISTANCE TEST IN ACCORDANCE WITH ISO 4649 – INDEX OF 50 MINIMUM.
PHYSICAL AND AGING TESTS IN ACCORDANCE WITH ICEA S-75-381.
TEAR RESISTANCE, MINIMUM, 20LB/IN.
UN-AGED VALUES.
TENSILE STRENGTH, MINIMUM – 1200 PSI.
ELONGATION AT RUPTURE, MINIMUM % – 150.
AFTER AGING IN AIR 168 HOURS AT 121 ± 1°C.
TENSILE STRENGTH, MINIMUM % OF UN-AGED VALUE – 75.
ELONGATION AT RUPTURE, MINIMUM % OF UN-AGED VALUE – 75.
LONG TERM INSULATION RESISTANCE IN 75°C WATER SHALL BE IN ACCORDANCE WITH UL 44.

CONDUCTOR JACKET (ENHANCED PLUS ONLY) – CPE OR HYPALON – COMPOSITE, TYPE RHH/RHW-2.
ABRASION RESISTANCE IN ACCORDANCE WITH ISO 4649 – INDEX OF 50 MINIMUM.
PHYSICAL AND AGING TESTS IN ACCORDANCE WITH ICEA S-75-381.
TEAR RESISTANCE, MINIMUM, 30 LB/IN.
UN-AGED VALUES.
TENSILE STRENGTH, MINIMUM – 2000 PSI.
ELONGATION AT RUPTURE, MINIMUM % – 400.

OVERALL JACKET – MOLD CURED, TWO LAYER REINFORCED JACKET FILLING THE CABLE INTERSTICES.
INNER WALL – HEAVY DUTY CPE.
PHYSICAL AND AGING TESTS IN ACCORDANCE WITH ICEA S-75-381.
UN-AGED VALUES.
TENSILE STRENGTH, MINIMUM – 1800 PSI.
ELONGATION AT RUPTURE, MINIMUM % – 300.
AFTER AGING IN AIR 168 HOURS AT 100 ± 1°C.
TENSILE STRENGTH, MINIMUM % OF UN-AGED VALUE – 85.
ELONGATION AT RUPTURE, MINIMUM % OF UN-AGED VALUE – 55.
OUTER WALL- EXTRA HEAVY DUTY CPE.
ABRASION RESISTANCE IN ACCORDANCE WITH ISO 4649 – INDEX OF 75 MINIMUM.
PHYSICAL AND AGING TESTS IN ACCORDANCE WITH ICEA S-75-381.
TEAR RESISTANCE, MINIMUM, 50 LB/IN.
UN-AGED VALUES.
TENSILE STRENGTH, MINIMUM – 2400 PSI.
ELONGATION AT RUPTURE, MINIMUM % – 300.
AFTER AGING IN AIR 168 HOURS AT 100 ± 1°C.
TENSILE STRENGTH, MINIMUM % OF UN-AGED VALUE – 70.
ELONGATION AT RUPTURE, MINIMUM % OF UN-AGED VALUE – 55.

ENHANCED & ENHANCED PLUS THOF SPECIFICATION

REVISED: CIEE	JANUARY 31, 2007	ATTACHMENT 2-1.3

Figure C-4 3/C Enhanced & Enhanced Plus THOF Cable Specification

ASSEMBLY
ENHANCED THOF CABLE SHALL HAVE INSULATED CONDUCTORS.
ENHANCED PLUS THOF CABLE SHALL HAVE INSULATED AND JACKETED CONDUCTORS.
SEE DRAWINGS FOR DIMENSIONS AND SUPPLEMENTAL INFORMATION.

THREE CONDUCTORS SHALL BE CABLED WITH A MAXIMUM LAY LENGTH OF 26 INCHES. EXCEPT FOR A CENTER EXTRUDED RUBBER ROD FILLER, NO OTHER FILLERS ARE PERMITTED. NO ASSEMBLY BINDER TAPE IS TO BE USED. MOLD RELEASE AGENTS, IF USED SHALL NOT CONTAIN SILICONE OR WAX.

FUNCTIONAL TESTS
THE GOVERNMENT RESERVES THE RIGHT TO WITNESS ANY OR ALL CABLE TESTS. ONCE FUNCTIONAL TESTING HAS BEGUN, ALL TESTS MUST BE COMPLETED IN NO MORE THAN 36 HOURS. FUNCTIONAL TESTS ARE REQUIRED USING A TEST CABLE AS DESCRIBED BELOW. TESTS SHALL BE CONDUCTED AFTER THE CABLE HAS BEEN EXPOSED TO THE SPECIFIED TEST TEMPERATURE FOR AT LEAST 8 HOURS. THE FUNCTIONAL TESTS SHALL BE PERFORMED IN THE FOLLOWING ORDER USING THE SAME PIECE OF CABLE:

1. DIELECTRIC PRE–FLEX TEST.
2. SUMMER FLEXIBILITY WITH NATURAL BEND.
3. SUMMER FLEXIBILITY AGAINST NATURAL BEND.
4. WINTER FLEXIBILITY WITH NATURAL BEND.
5. WINTER FLEXIBILITY AGAINST NATURAL BEND.
6. CUT–BACK.
7. DIELECTRIC POST–FLEX TEST.

TEST CABLE DESCRIPTION
THE TEST CABLE WILL BE 12 FEET IN LENGTH CUT FROM A CABLE WITH A MINIMUM LENGTH OF 100 FEET, ROLLED ONTO A CABLE REEL FOR AT LEAST 168 HOURS WHOSE SPOOL DIAMETER DOES NOT EXCEED 3 FEET. THE TEST CABLE WILL BE CUT FROM THE LAYER OF CABLE IN CONTACT WITH THE SPOOL. AFTER THE DIELECTRIC PRE–TEST EACH END WILL BE SEALED TO PREVENT MOISTURE INFILTRATION.

ENHANCED & ENHANCED PLUS THOF SPECIFICATION (CONT'D)

REVISED: CIEE MARCH 24, 2006	ATTACHMENT 2–1.4

Figure C-5 3/C Enhanced & Enhanced Plus THOF Cable Specification

FLEXIBILITY TEST

ALL FLEXIBILITY TESTS WILL BE PERFORMED BY LAYING THE TEST CABLE ON A 20 INCH DIAMETER SHEAVE OR DRUM (IE WHEEL) AND LIFTING IT VERTICALLY UNTIL THE CABLE HANGS FREE IN AIR. THE PLACEMENT OF THE CABLE ONTO THE WHEEL WILL ALLOW APPROXIMATELY ONE-HALF OF THE CABLE TO HANG DOWN ON EACH SIDE. AS THE CABLE HANGS FREE, ATTACH 80 POUNDS TO EACH END AND MEASURE TANGENTIALLY (IE PERPENDICULAR TO VERTICAL) THE SHORTEST DISTANCE BETWEEN THE CABLE MEASURED AT THE BOTTOM OF THE WHEEL. THE CABLE SHALL HANG FOR NO MORE THAN 30 SECONDS BEFORE THE MEASUREMENT IS TAKEN. NO FORCE TENDING TO BRING THE CABLE ON EACH SIDE OF THE WHEEL CLOSER TOGETHER WILL BE PERMITTED. ONLY THE WEIGHT OF THE CABLE AND THE TEST WEIGHTS WILL BEND IT AROUND THE TOP OF THE WHEEL.

DIMENSIONS BETWEEN CABLE AT BOTTOM OF WHEEL.
SUMMER: 25 INCHES MAXIMUM AT 25°C, ± 2°C.
WINTER: 28 INCHES MAXIMUM AT 5°C, ± 2°C.

CUT-BACK TEST

NOT LESS THAN 24 INCHES OF THE CABLE JACKET WILL BE REMOVED FROM BOTH ENDS OF THE TEST CABLE USING A KNIFE, 10 INCH CHANNEL LOCK OR VICE GRIP TYPE PLIERS, AND 8 INCH NEEDLE NOSE PLIERS. REMOVAL OF THE JACKET SHALL BE ACCOMPLISHED WITHOUT THE APPLICATION OF HEAT TO THE JACKET AT ROOM TEMPERATURE OF 20°C ±2°C. VERIFY THE FOLLOWING:

NO BONDING OF CONDUCTOR INSULATION (OR CONDUCTOR JACKET) TO CABLE JACKET
NO REMOVAL OF CONDUCTOR INSULATION (OR CONDUCTOR JACKET) BY TEARING
BOND BETWEEN INNER WALL AND OUTER WALL OF OVERALL JACKET SHALL BE STOCK TEARING.

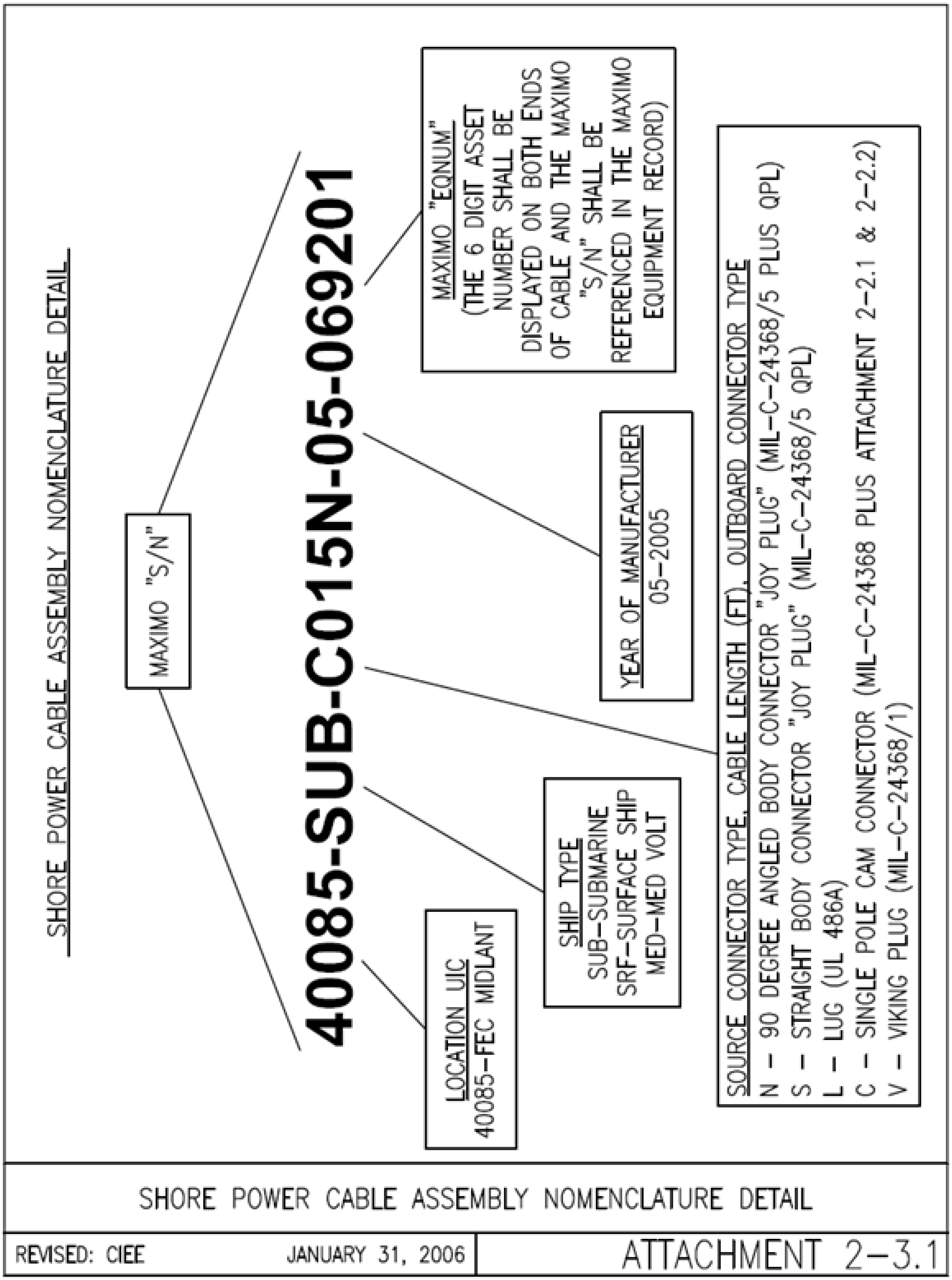
DIELECTRIC TESTS

DIELECTRIC TESTS (BOTH PRE AND POST FLEXIBILITY TESTING), PER ICEA T-27-581.
AC HI POT; 9.5 KV FOR 5 MINUTES.
INSULATION RESISTANCE: NOT LESS THAN 100 MEG-OHMS.

ENHANCED & ENHANCED PLUS THOF SPECIFICATION (CONT'D)

REVISED: CIEE	JANUARY 31, 2006	ATTACHMENT 2-1.5

Figure C-6 Shore Power Cable Assembly Nomenclature Detail



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APPENDIX D TYPICAL ELECTRICAL DIAGRAMS AND DETAILS

Figure D-1 (a) Electrical System for a Double-Deck Pier (1 of 9)

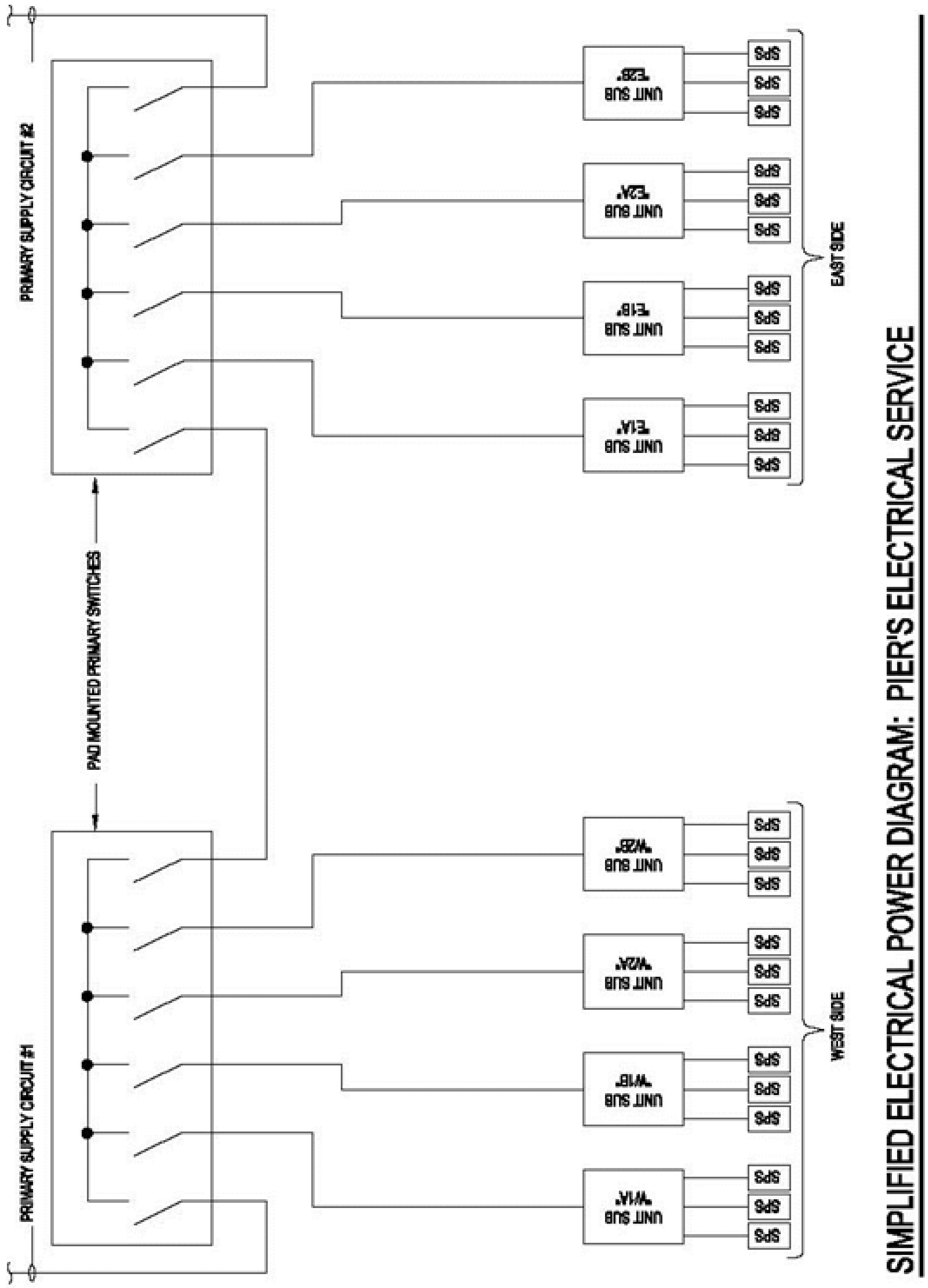


Figure D-1 (b) Electrical System for a Double-Deck Pier (2 of 9)

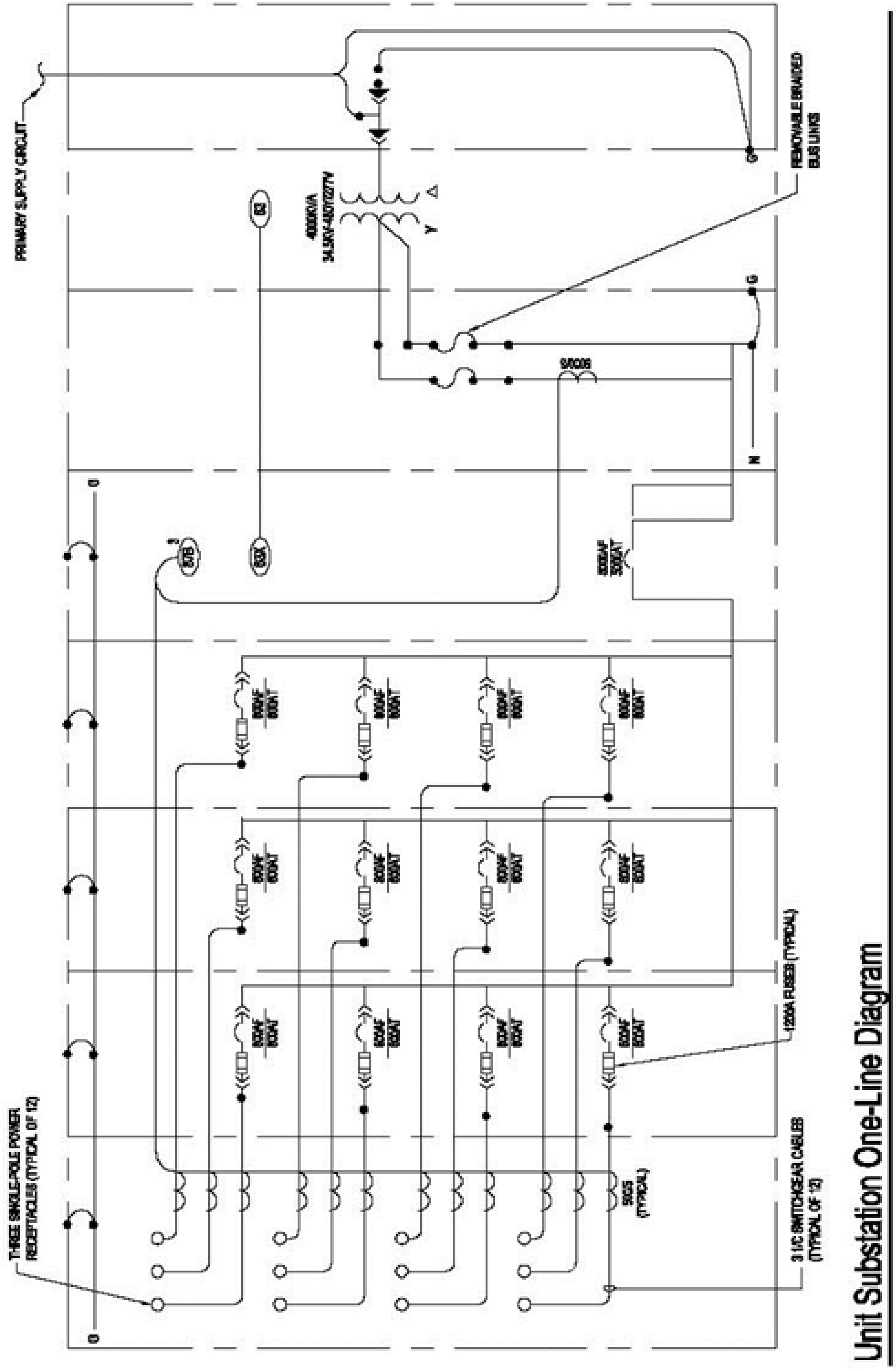


Figure D-1 (c) Electrical System for a Double-Deck Pier (3 of 9)

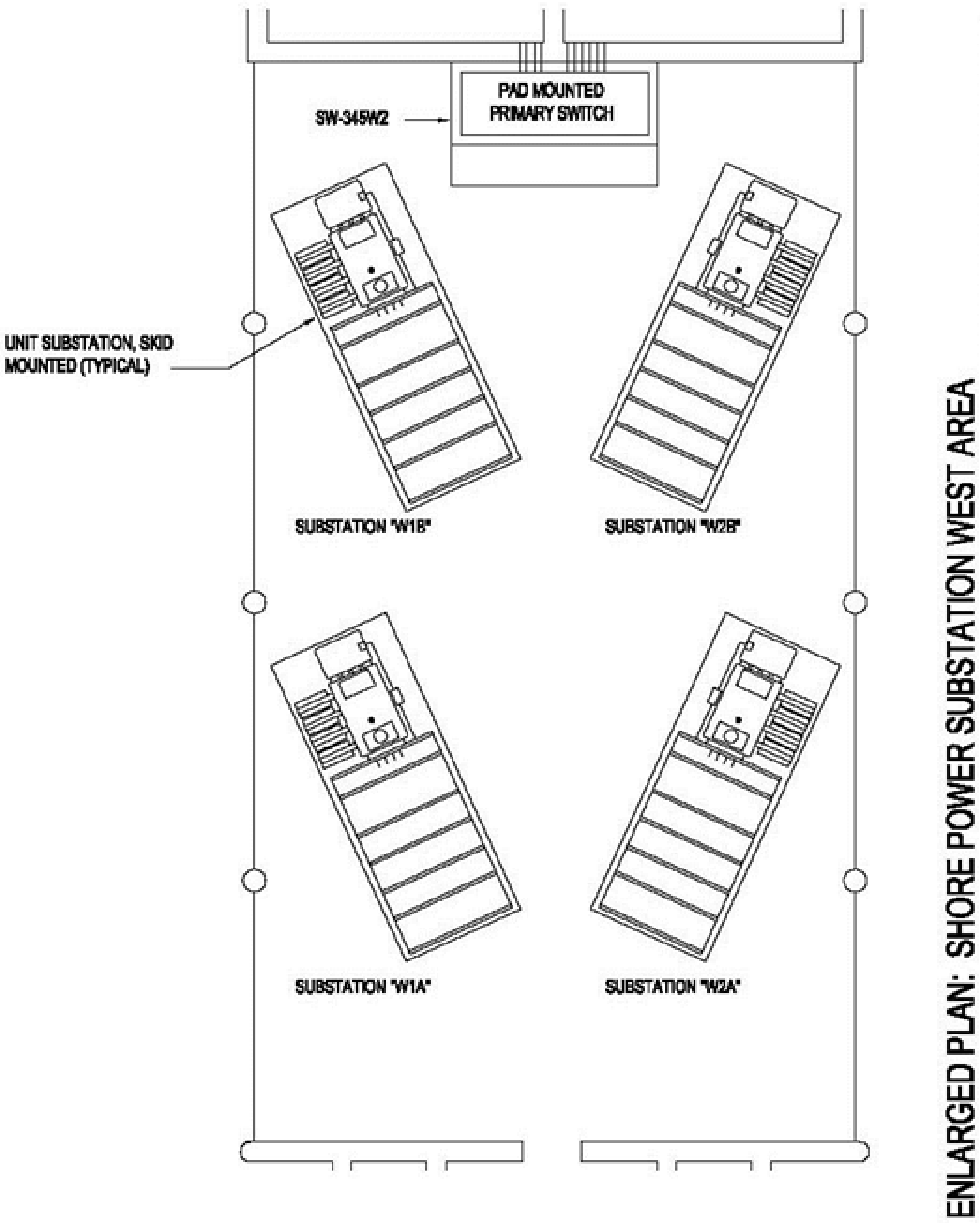
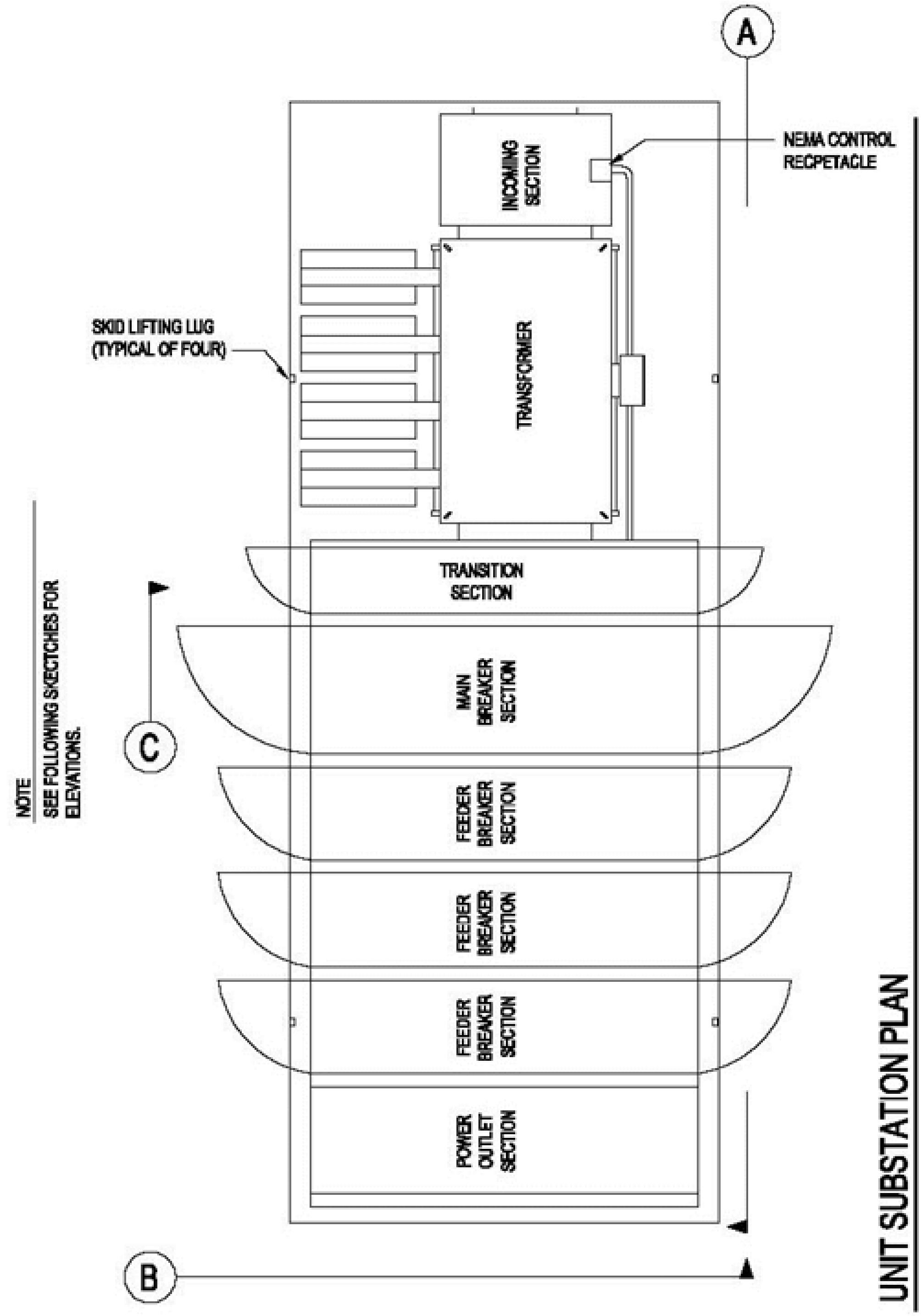


Figure D-1 (d) Electrical System for a Double-Deck Pier (4 of 9)



*** Substation must be designed with maintainability in mind and provisions and/or clearance for removing the circuit breakers must be factored into the design. Provide adequate clearance in front of the circuit breakers for a lifting cart.

Figure D-1 (e) Electrical System for a Double-Deck Pier (5 of 9)

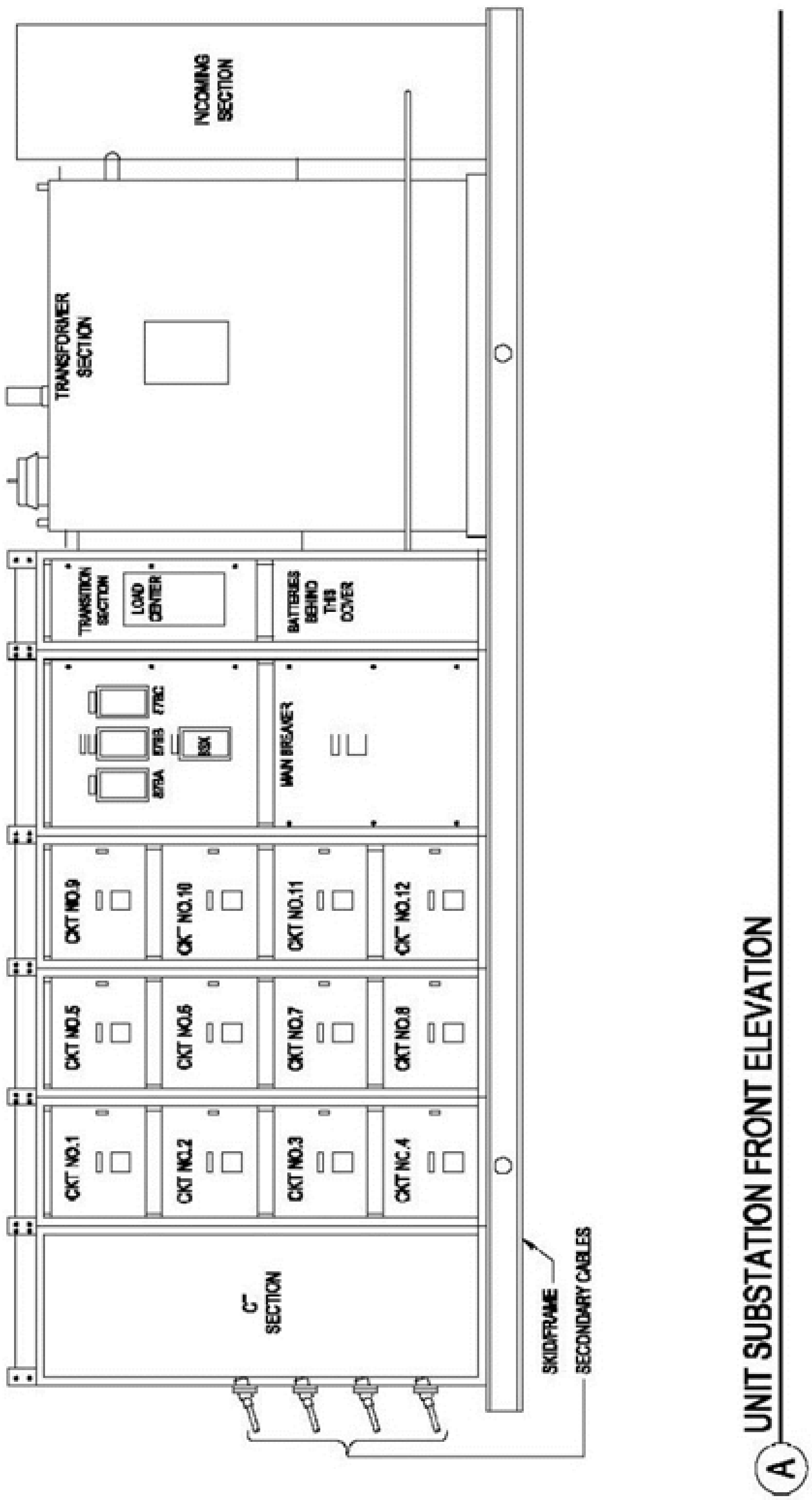


Figure D-1 (f) Electrical System for a Double-Deck Pier (6 of 9)

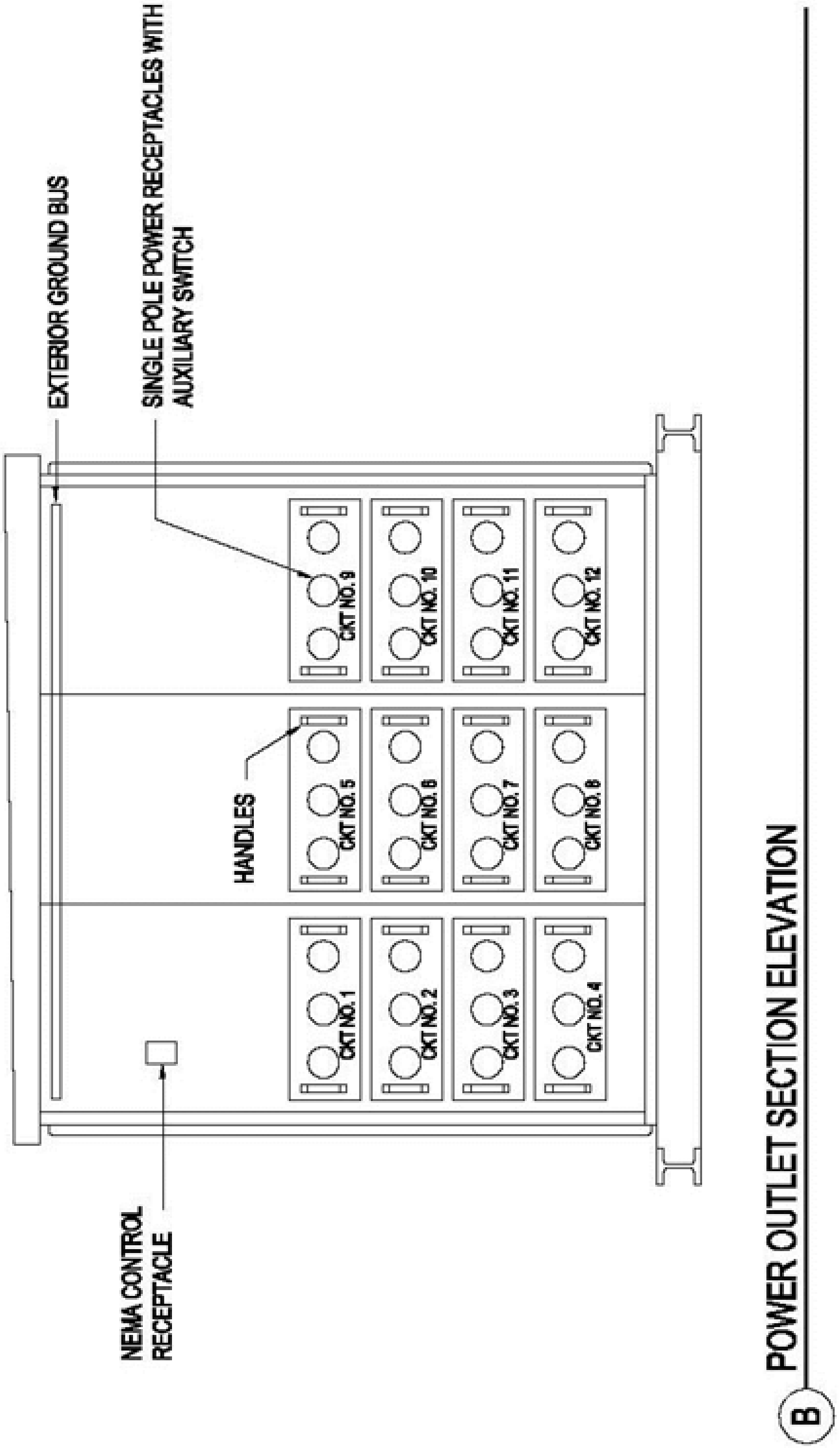
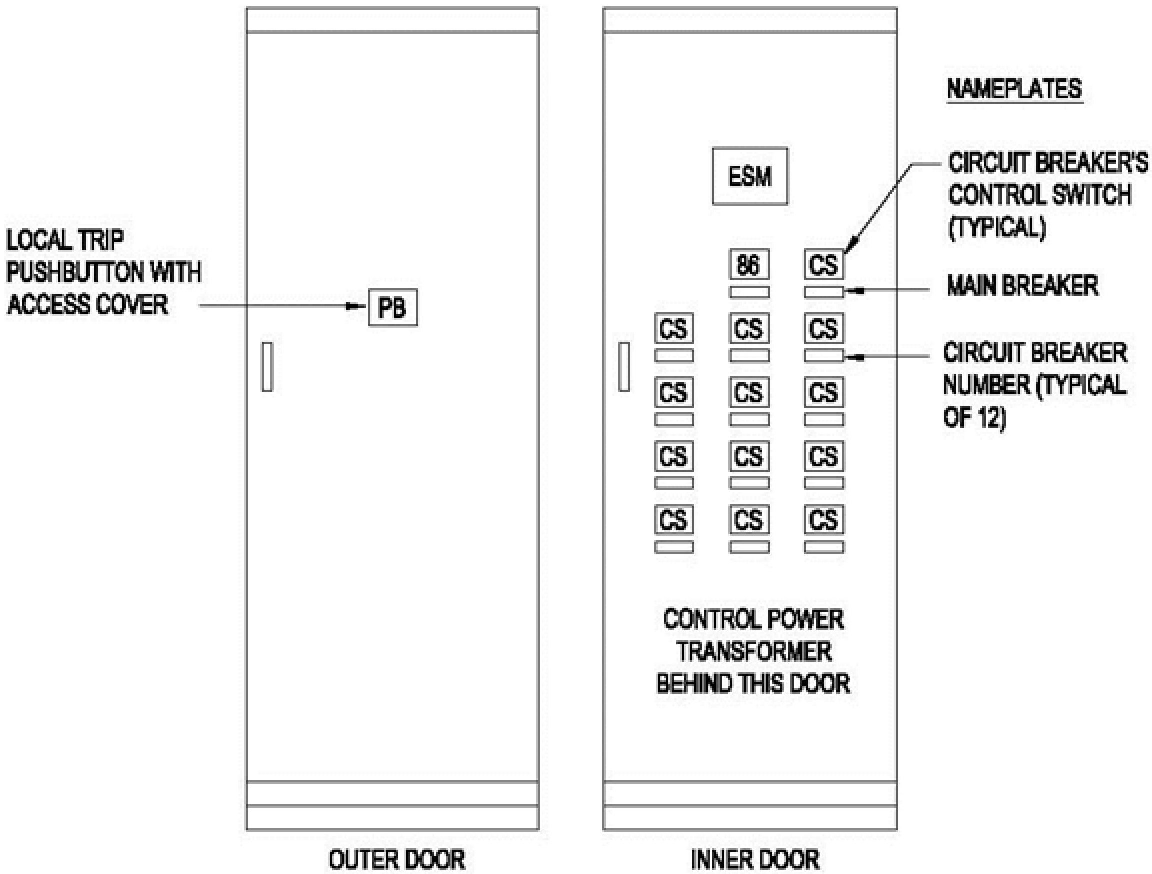


Figure D-1 (g) Electrical System for a Double-Deck Pier (7 of 9)



C CONTROL PANEL ELEVATION

Figure D-1 (h) Electrical System for a Double-Deck Pier (8 of 9)

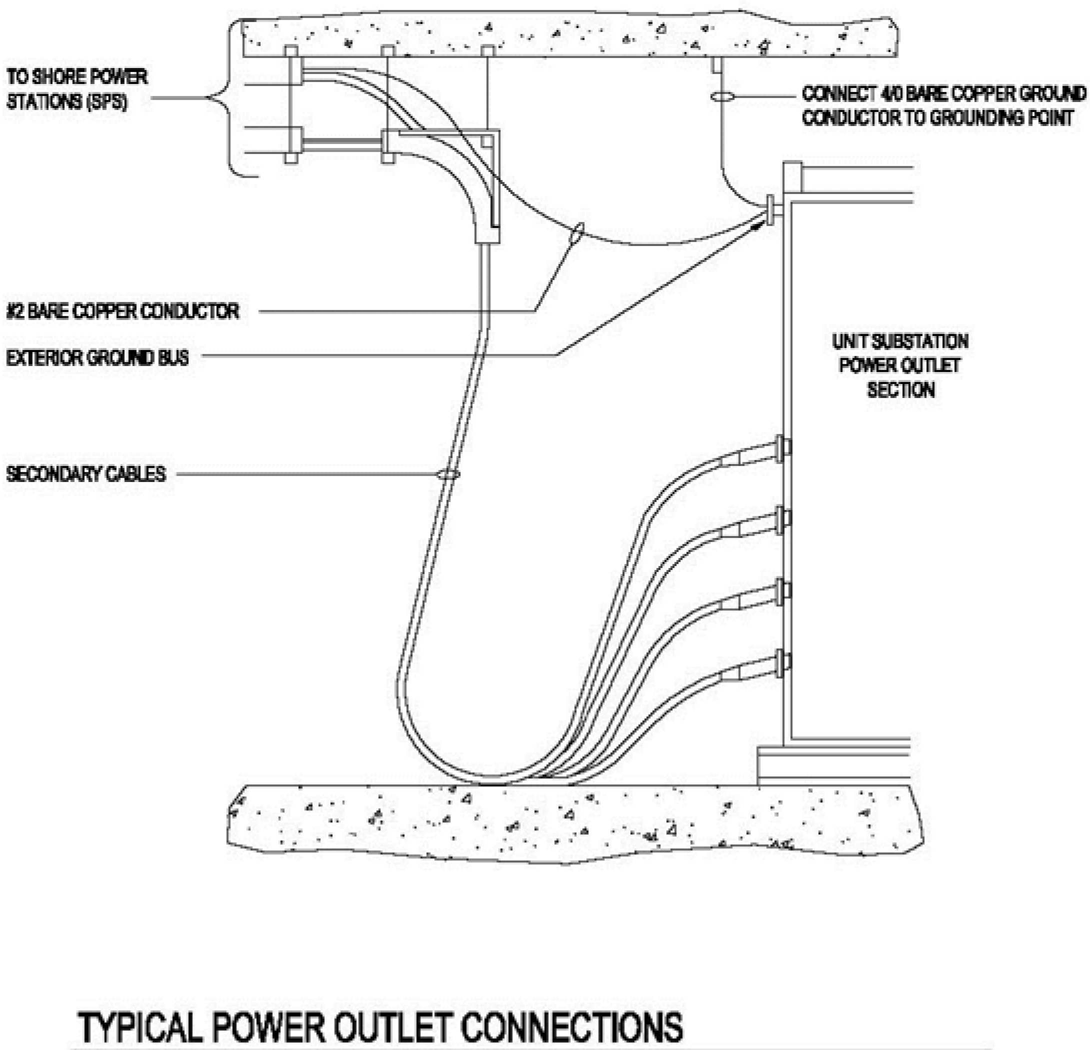


Figure D-1 (i) Electrical System for a Double-Deck Pier (9 of 9)

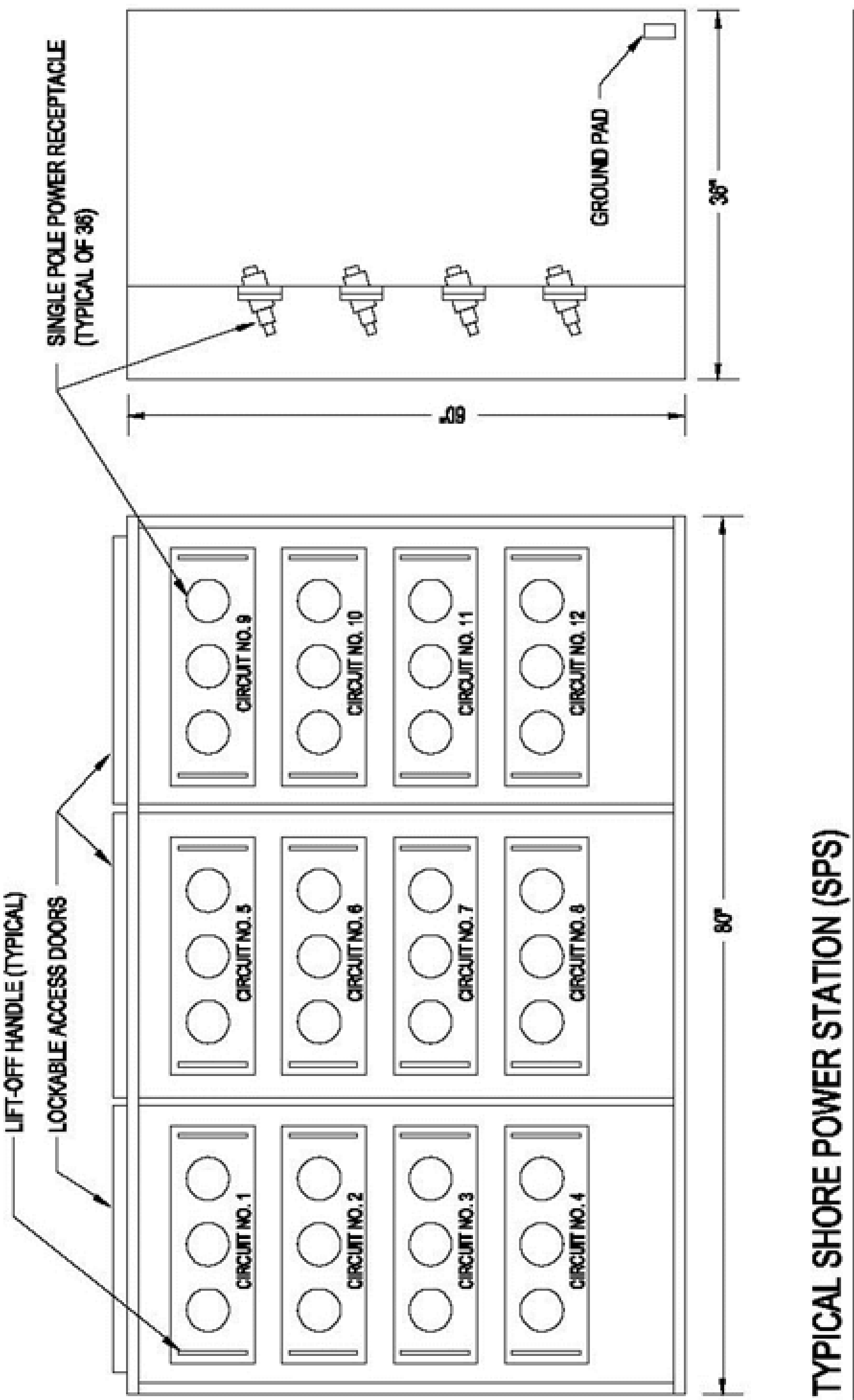


Figure D-2 (a) Pier Electrical Distribution: Typical Vault System (1 of 5)

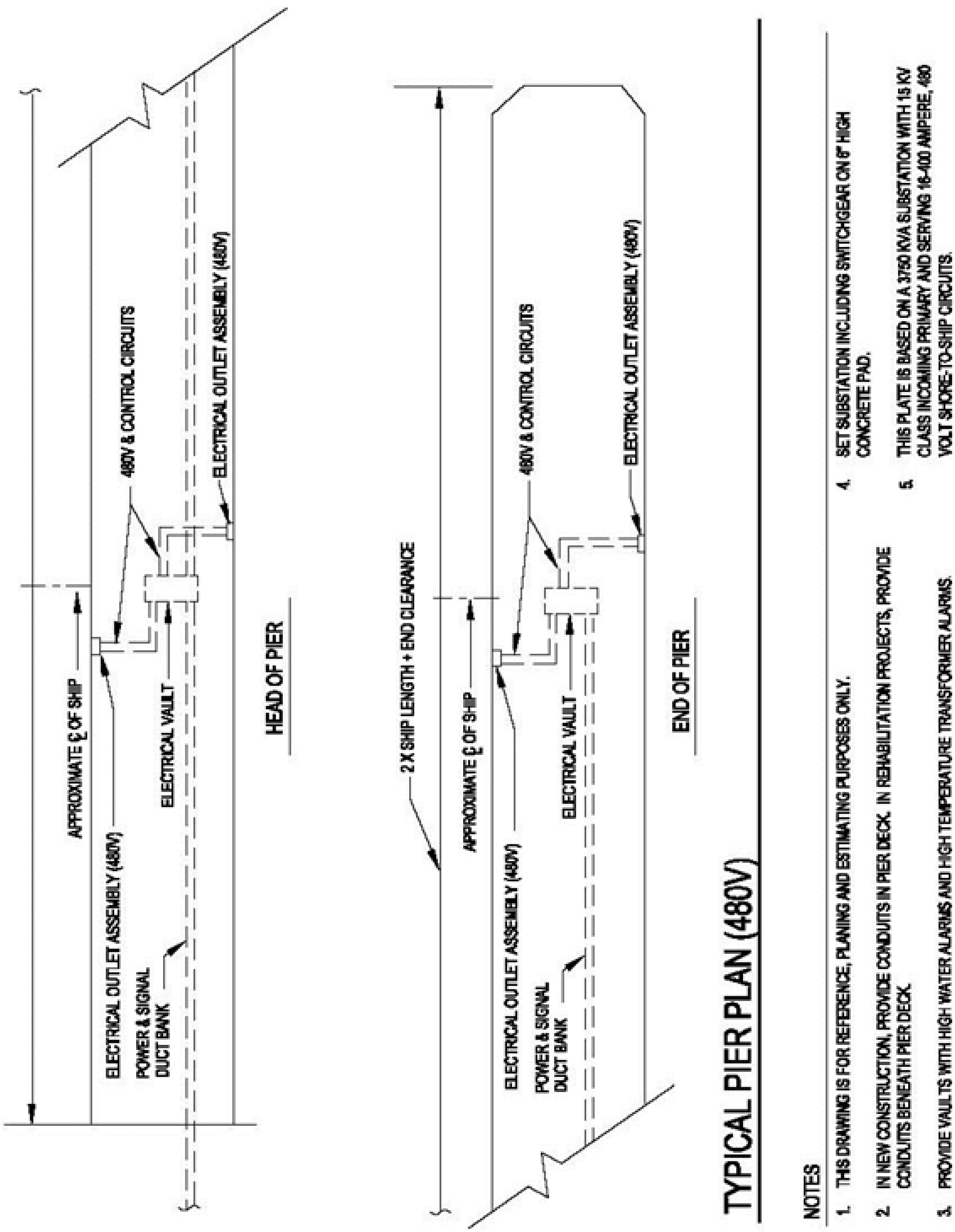
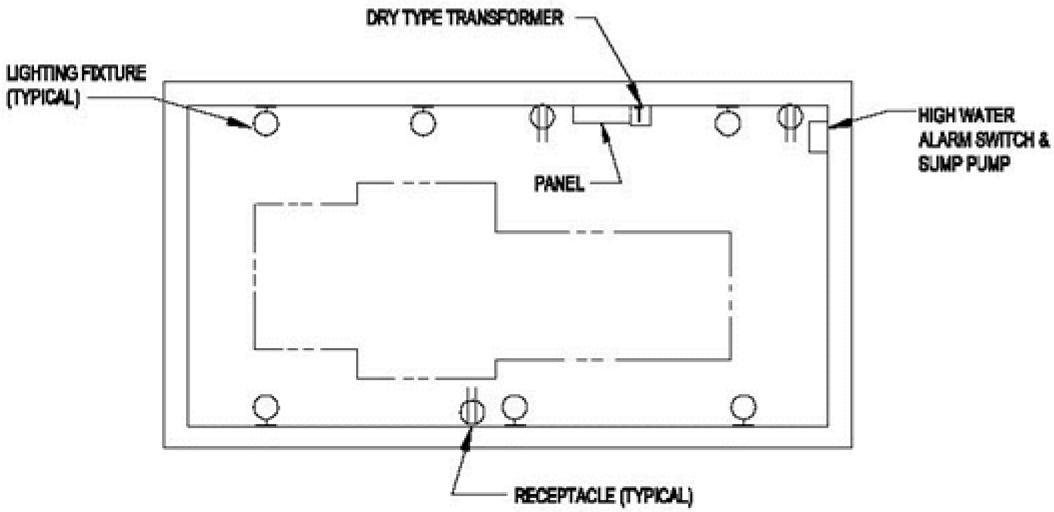
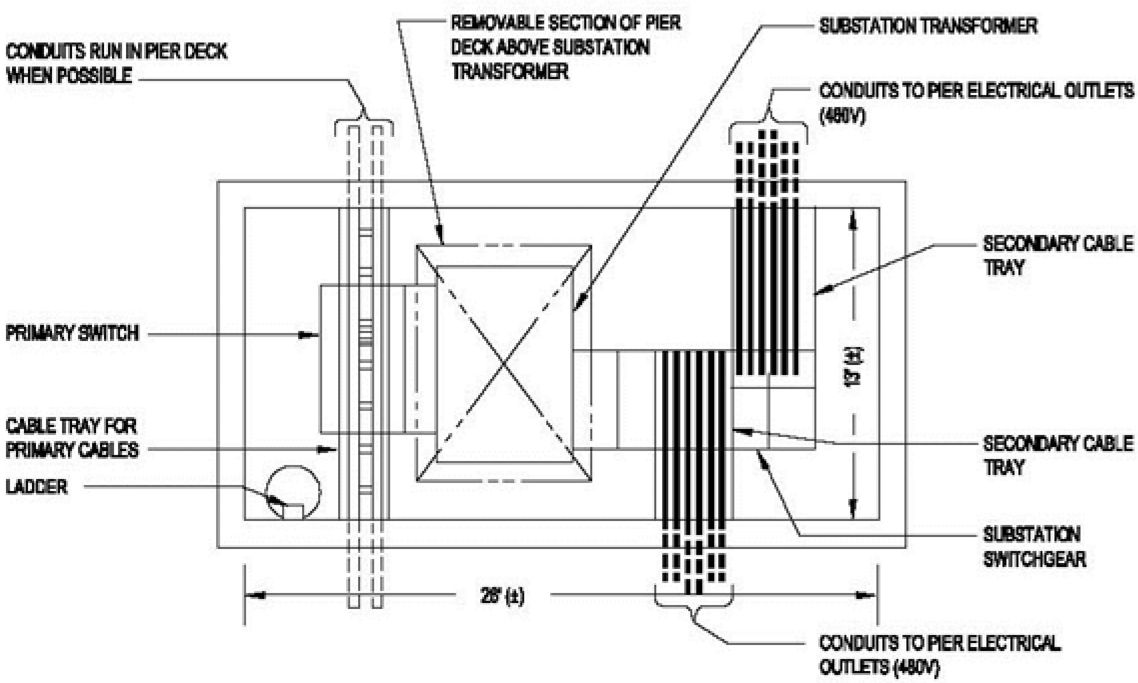


Figure D-2 (b) Pier Electrical Distribution: Typical Vault System (2 of 5)

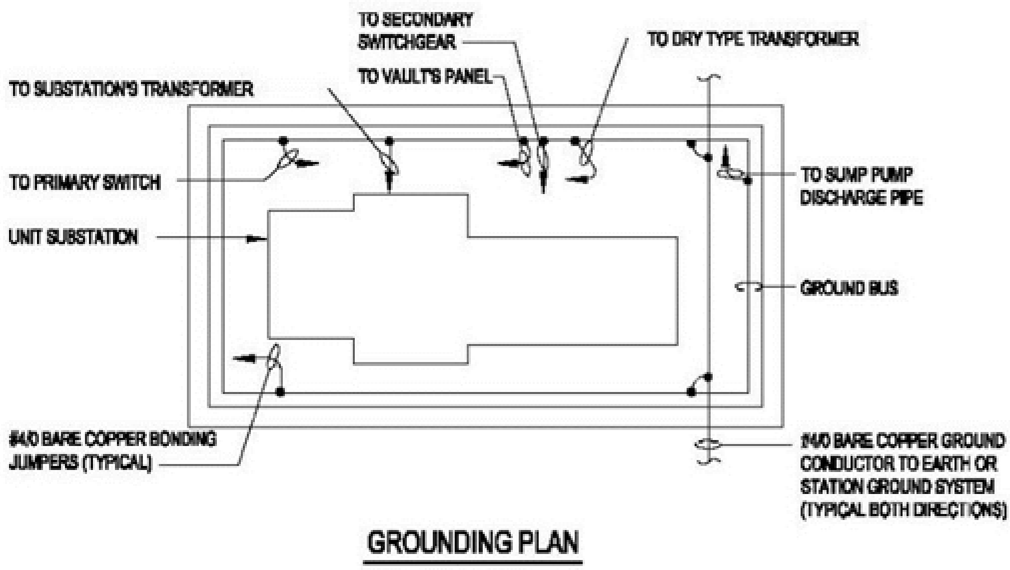


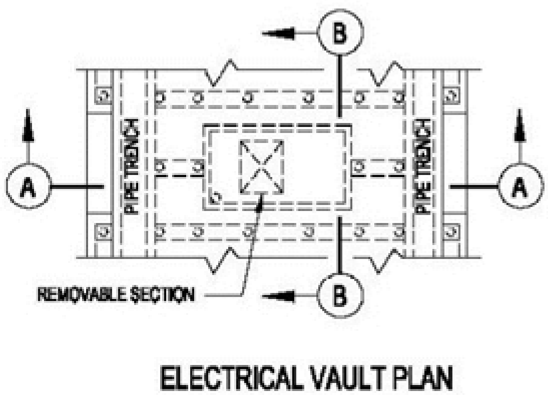
LIGHTING AND SMALL POWER PLAN



ELECTRICAL VAULT PLAN

Figure D-2 (c) Pier Electrical Distribution: Typical Vault System (3 of 5)





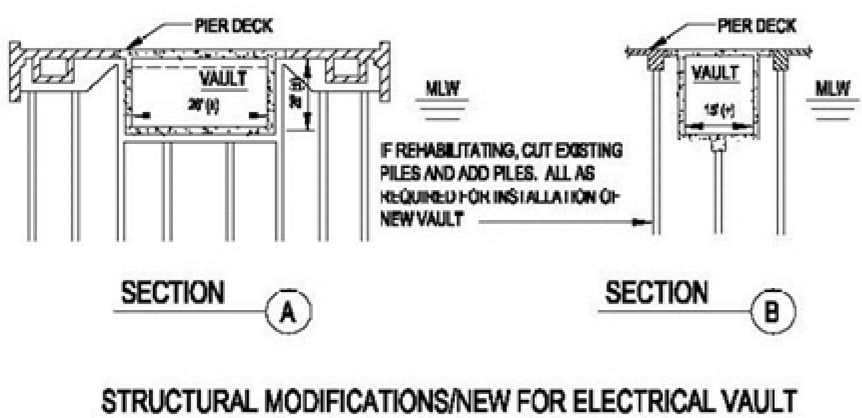


Figure D-2 (d) Pier Electrical Distribution: Typical Vault System (4 of 5)

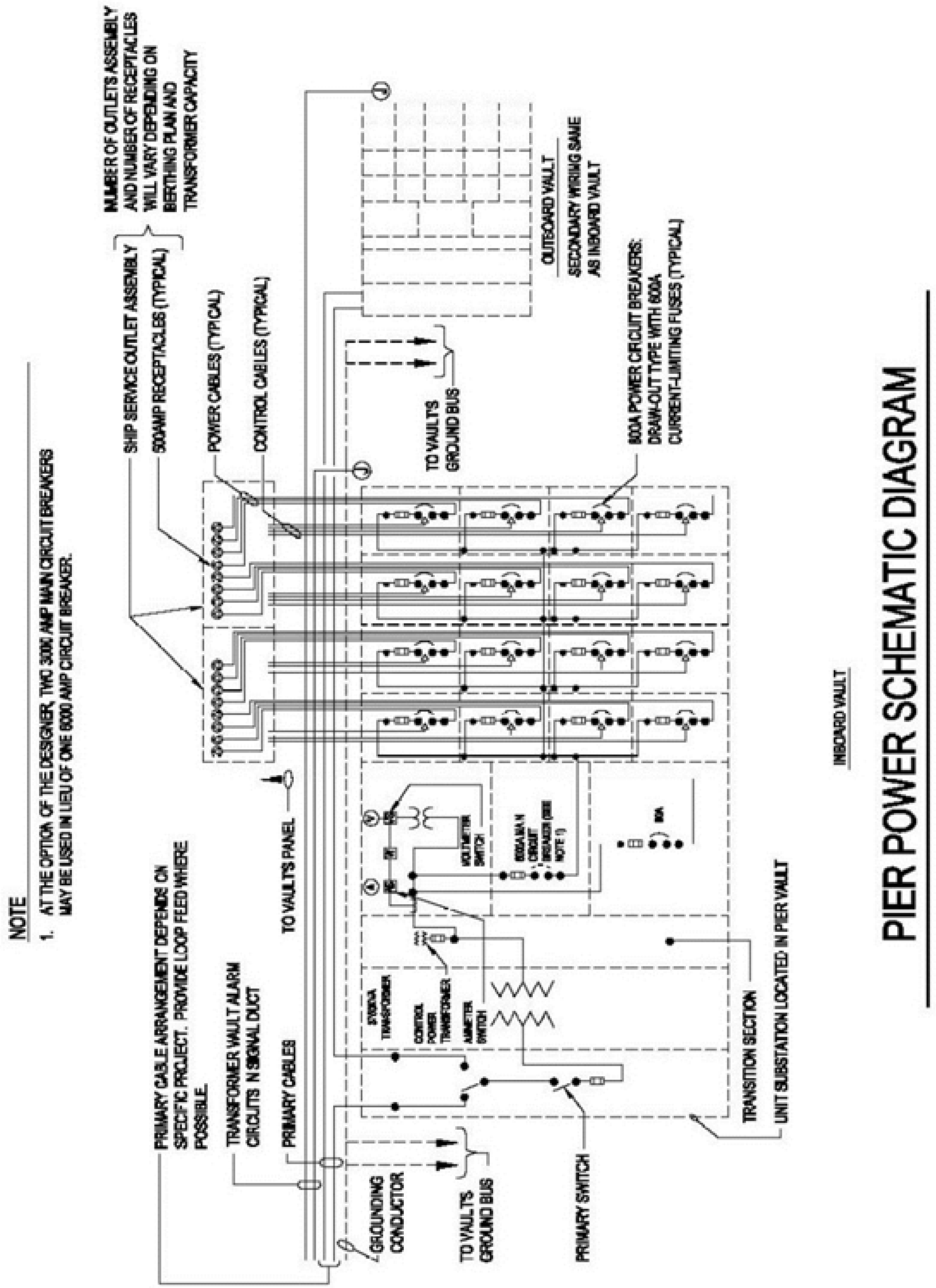


Figure D-2 (e) Pier Electrical Distribution: Typical Vault System (5 of 5)

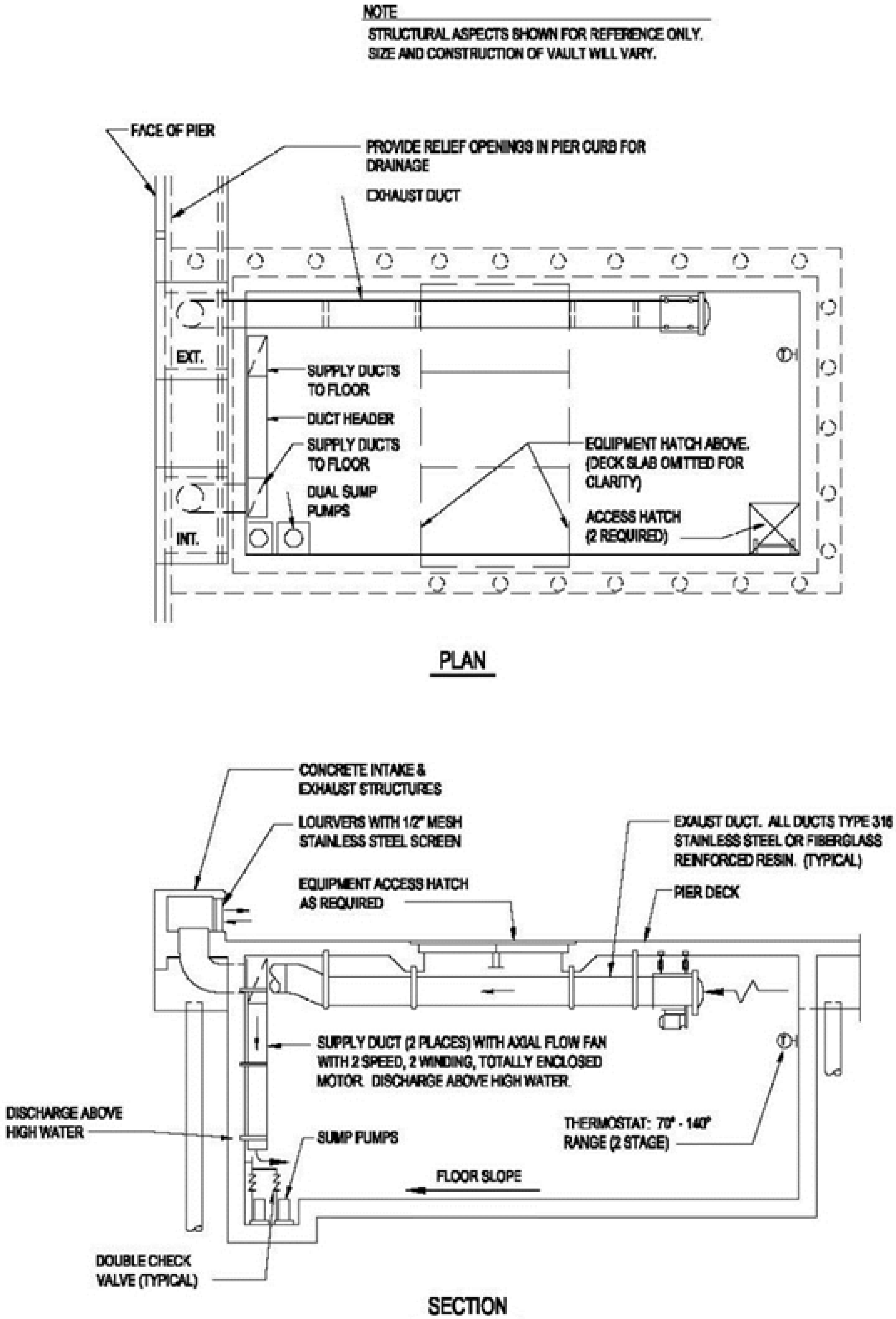
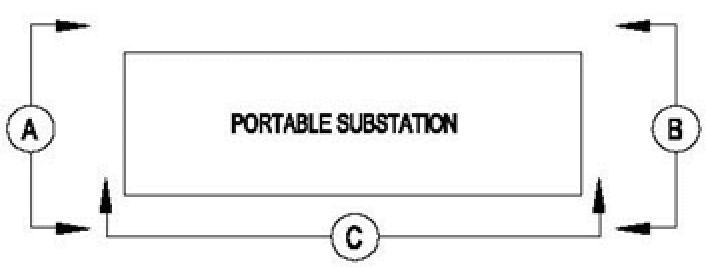


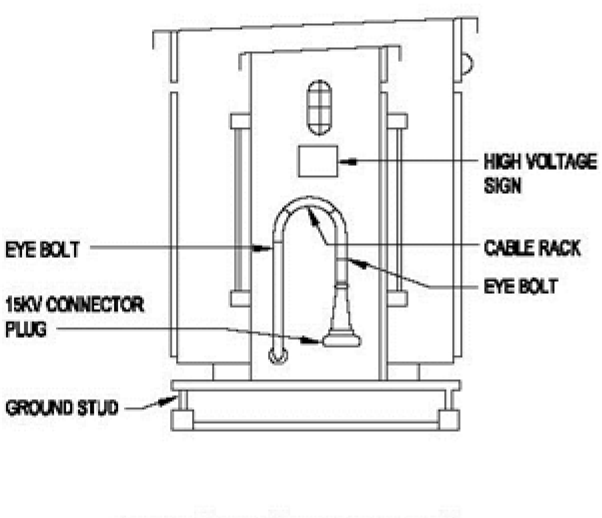
Figure D-3 (a) Portable Substation (1 of 3)

NOTES

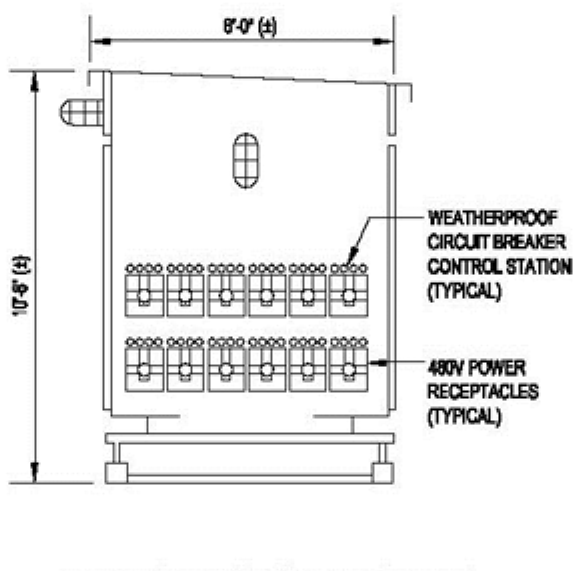
1. DRAWING IS FOR REFERENCE, PLANNING AND ESTIMATING PURPOSES ONLY.
2. DRAWING IS DESIGNED FOR A 3 PHASE, 13.2KV GROUNDED NEUTRAL SYSTEM. THE CONNECTORS ARE NOT AVAILABLE FOR UNGROUNDED NEUTRAL SYSTEMS ABOVE 8.32KV.
3. THE NUMBER OF CIRCUIT BREAKERS AND RECEPTACLES AND THE LENGTH AND WEIGHT OF THE SUBSTATION WILL VARY DEPENDING ON THE TRANSFORMER KVA SIZE. THE TRANSFORMER SIZE WILL NORMALLY VARY FROM 1000KVA TO 2500KVA, THE NUMBER OF CIRCUIT BREAKERS AND RECEPTACLES FROM 6 TO 12, THE SUBSTATION LENGTH FROM 22' TO 28', AND THE SUBSTATION WEIGHT FROM APPROXIMATELY 22,500 POUNDS TO 33,500 POUNDS.



KEY PLAN

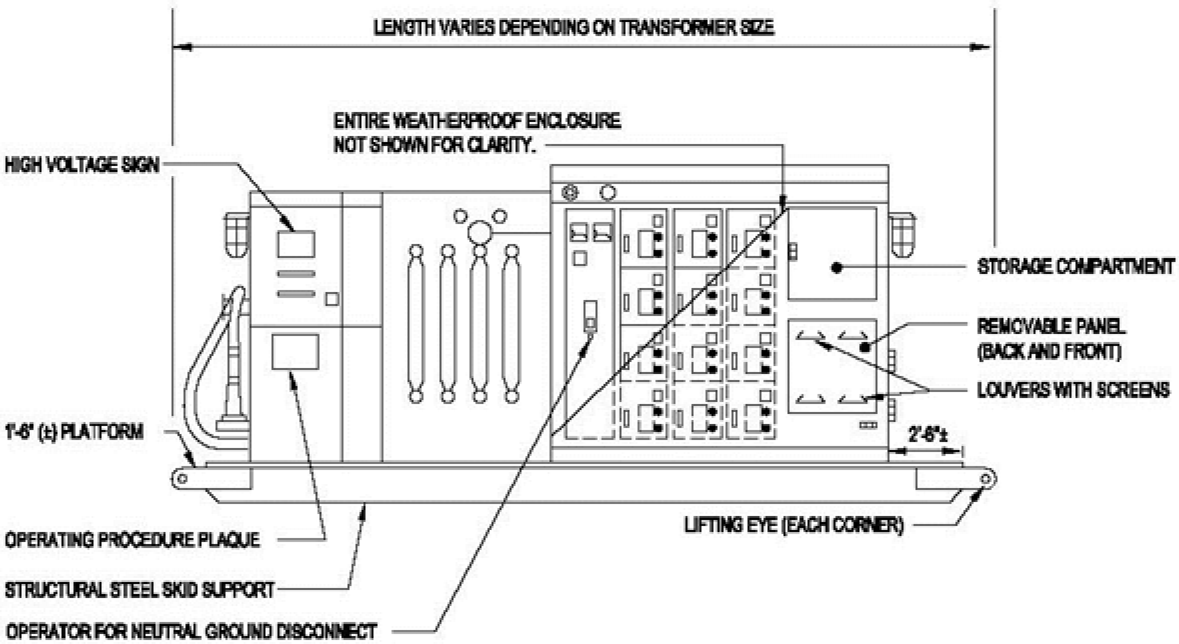


ELEVATION A-A (PRIMARY INPUT)

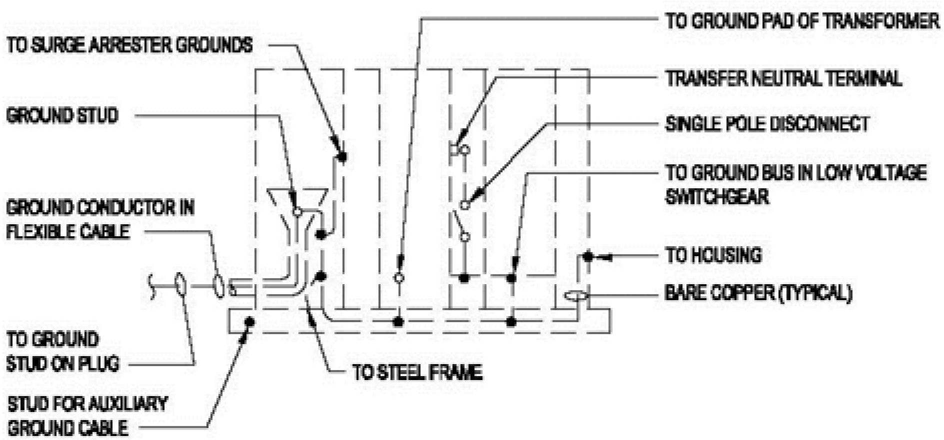


ELEVATION B-B (SECONDARY OUTPUT)

Figure D-3 (b) Portable Substation (2 of 3)



ELEVATION C-C (FRONT VIEW)



GROUNDING SCHEMATIC

Figure D-3 (c) Portable Substation (3 of 3)

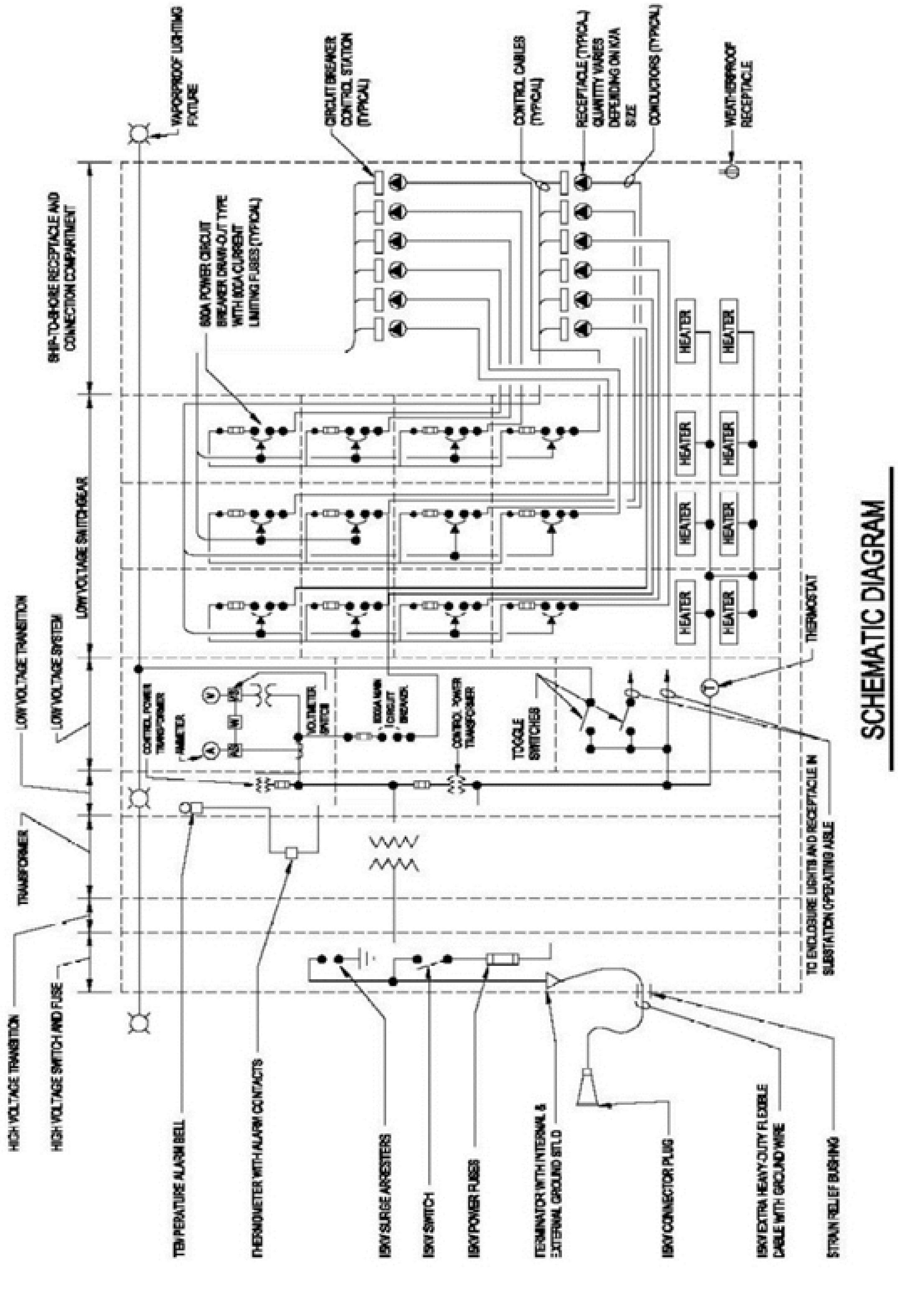
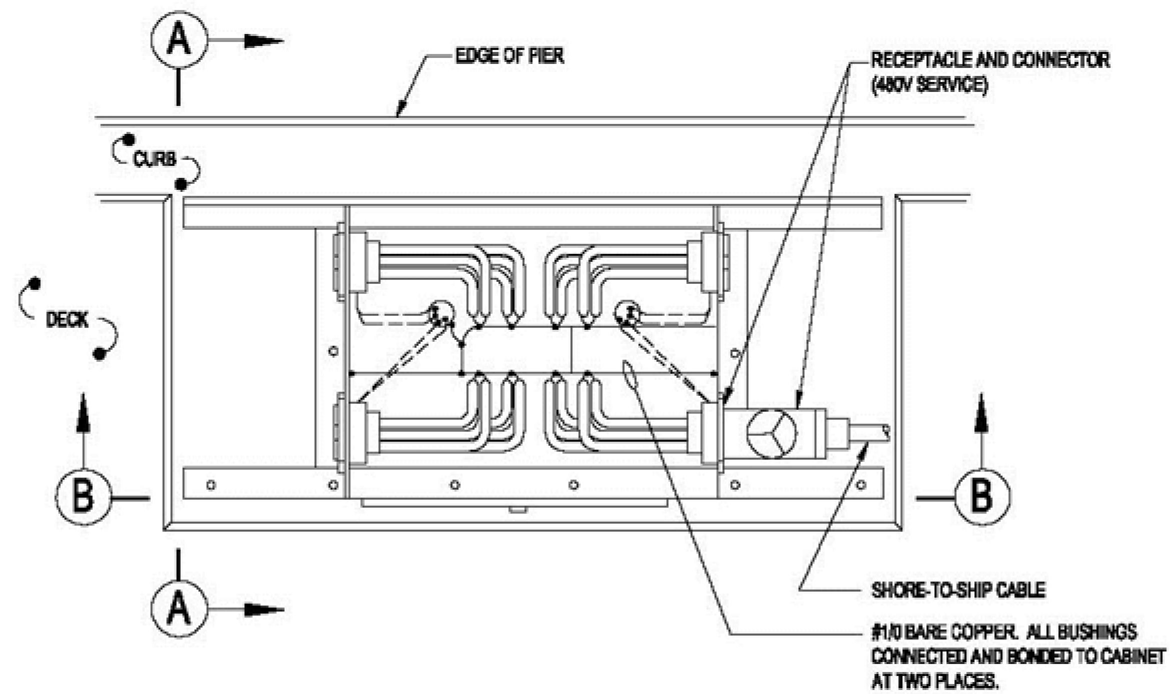
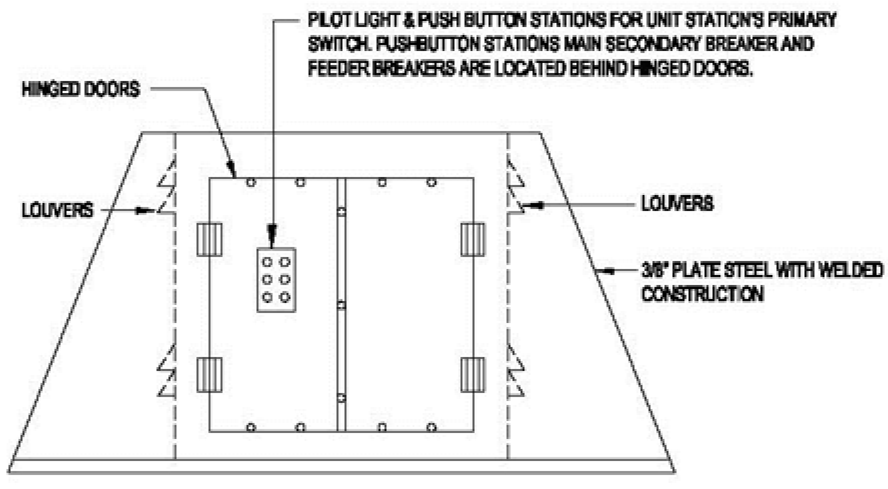


Figure D-4 (a) Ship Service Outlet Assembly (1 of 2)

NOTE:
SEE NEXT PAGE FOR SECTION CUTS.



PLAN



FRONT ELEVATION (REAR SIMILAR)

Figure D-4 (b) Ship Service Outlet Assembly (2 of 2)

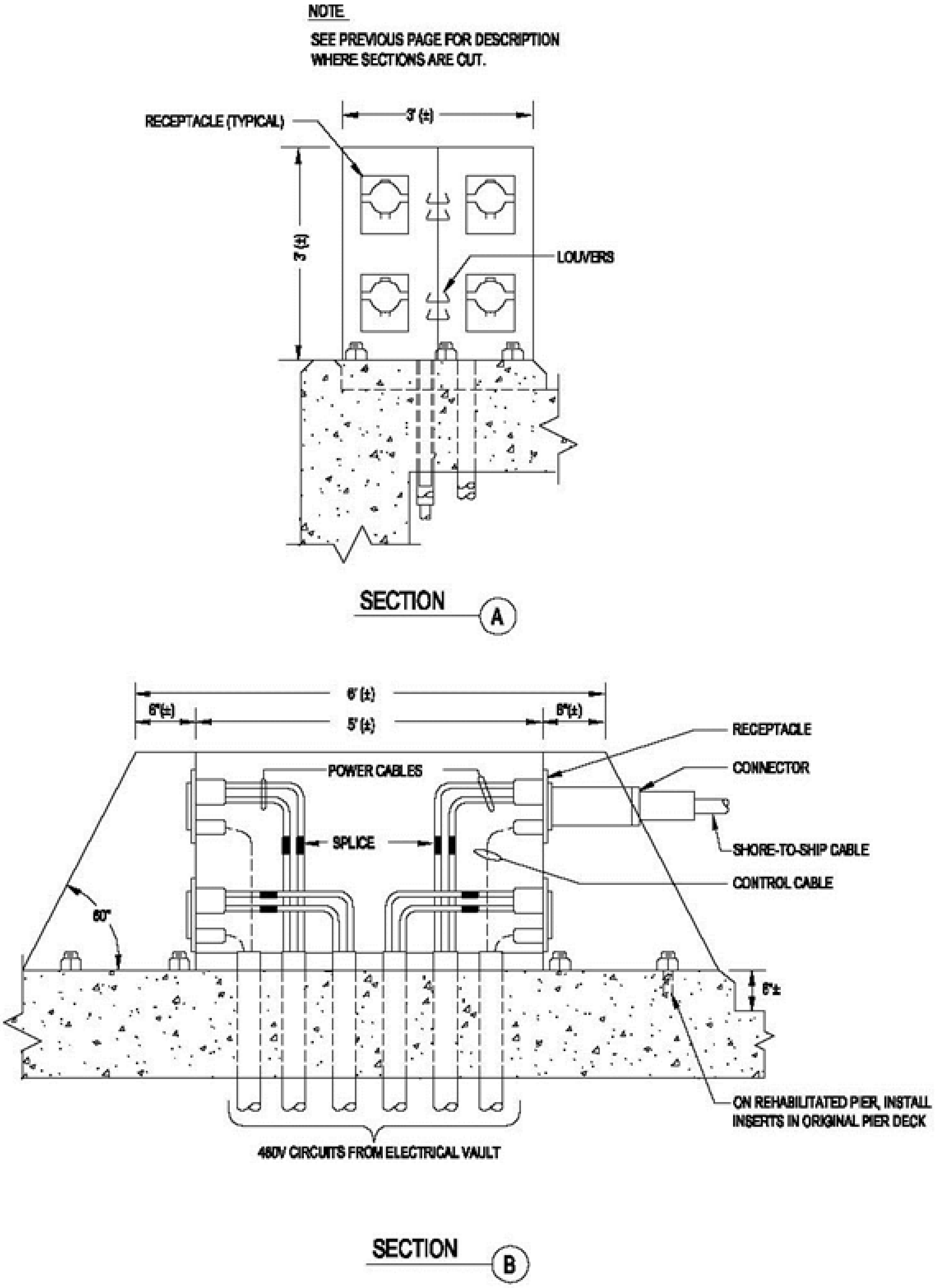


Figure D-5 (a) Single Pole Connector Details

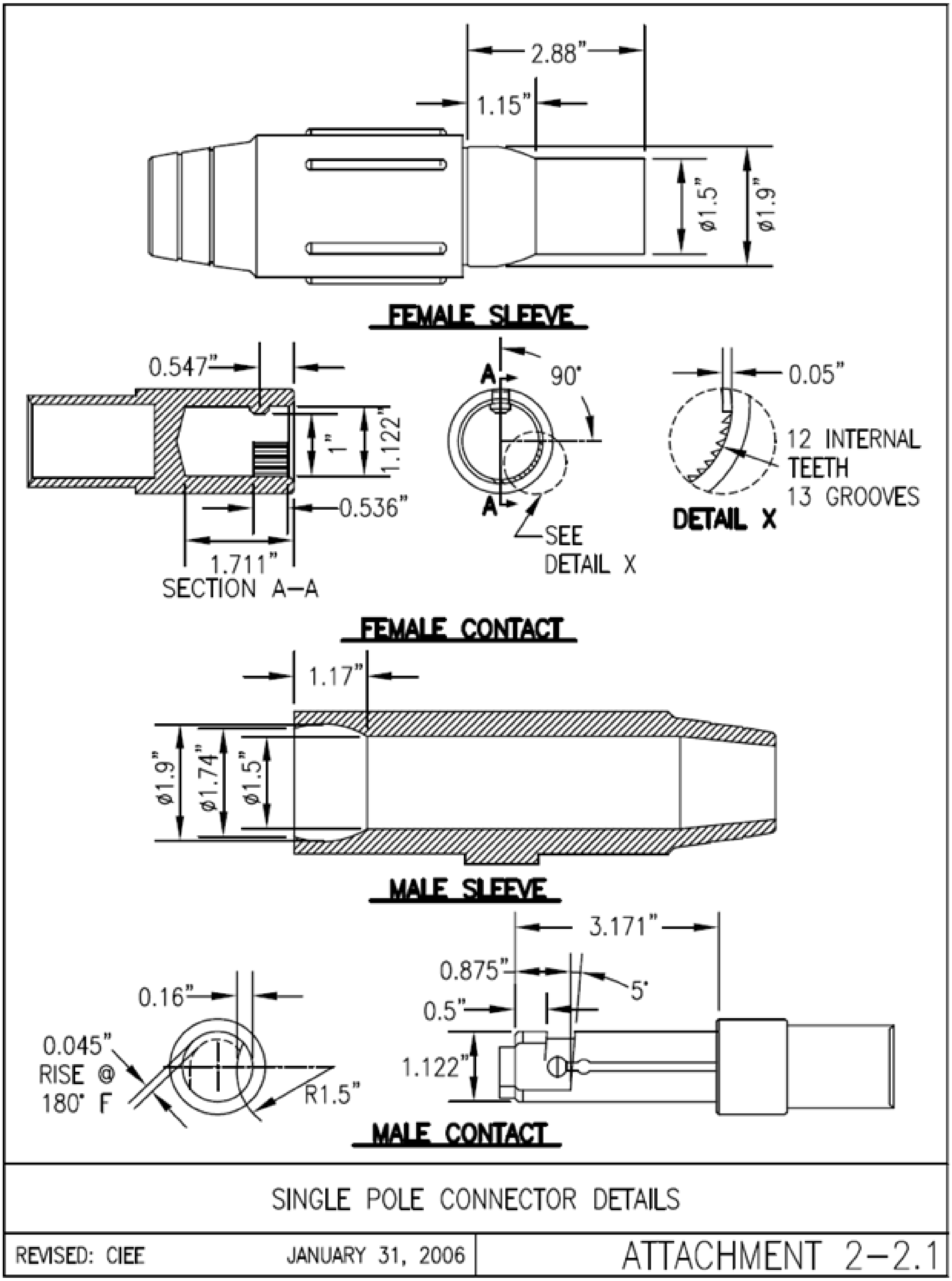


Figure D-5 (b) Single Pole Connector Specification

1. RATED FOR 600 VOLTS, 690 AMPERE MAX, 60 HERTZ, SINGLE POLE CAM, CONTINUOUS DUTY OPERATION.
2. INLINE CONNECTORS SHALL LOCK TOGETHER SO THAT THEY CAN NOT TWIST OR TURN LOOSE UNLESS A PUSH–BUTTON RELEASE MECHANISM IS ENGAGED.
3. POWER CABLE TERMINATION TO THE CONNECTOR CONTACTS SHALL BE VIA A CRIMP CONNECTOR.
4. THE INSULATED SLEEVES SHALL BE MECHANICALLY SECURED TO THE CONNECTOR CONTACTS TO GIVE A MINIMUM OF 700 LBS SHEAR FORCE.
5. BALL NOSE INSULATED SLEEVES SHALL BE MOLDED OF AN ETHYLENE PROPYLENE THERMOPLASTIC RUBBER (EPTR) COLORED BLACK PHASE A, WHITE PHASE B, AND RED PHASE C.
6. THE EPTR SLEEVES SHALL HAVE THE FOLLOWING MINIMUM REQUIREMENTS:
   - CONSTANT SERVICE TEMPERATURE RANGE: –60°C TO +135°C (–81°F TO +275°F)
   - FLAMMABILITY: UL 94 HB RATED
   - ELECTRICAL: UL RELATIVE THERMAL INDEX (RTI): 100°C (212°F)

SINGLE POLE CONNECTOR SPECIFICATION

REVISED: CIEE	JANUARY 31, 2006	ATTACHMENT 2–2.2

Figure D-6 (a) Pier Electrical Distribution for Temporary Services (1 of 3)

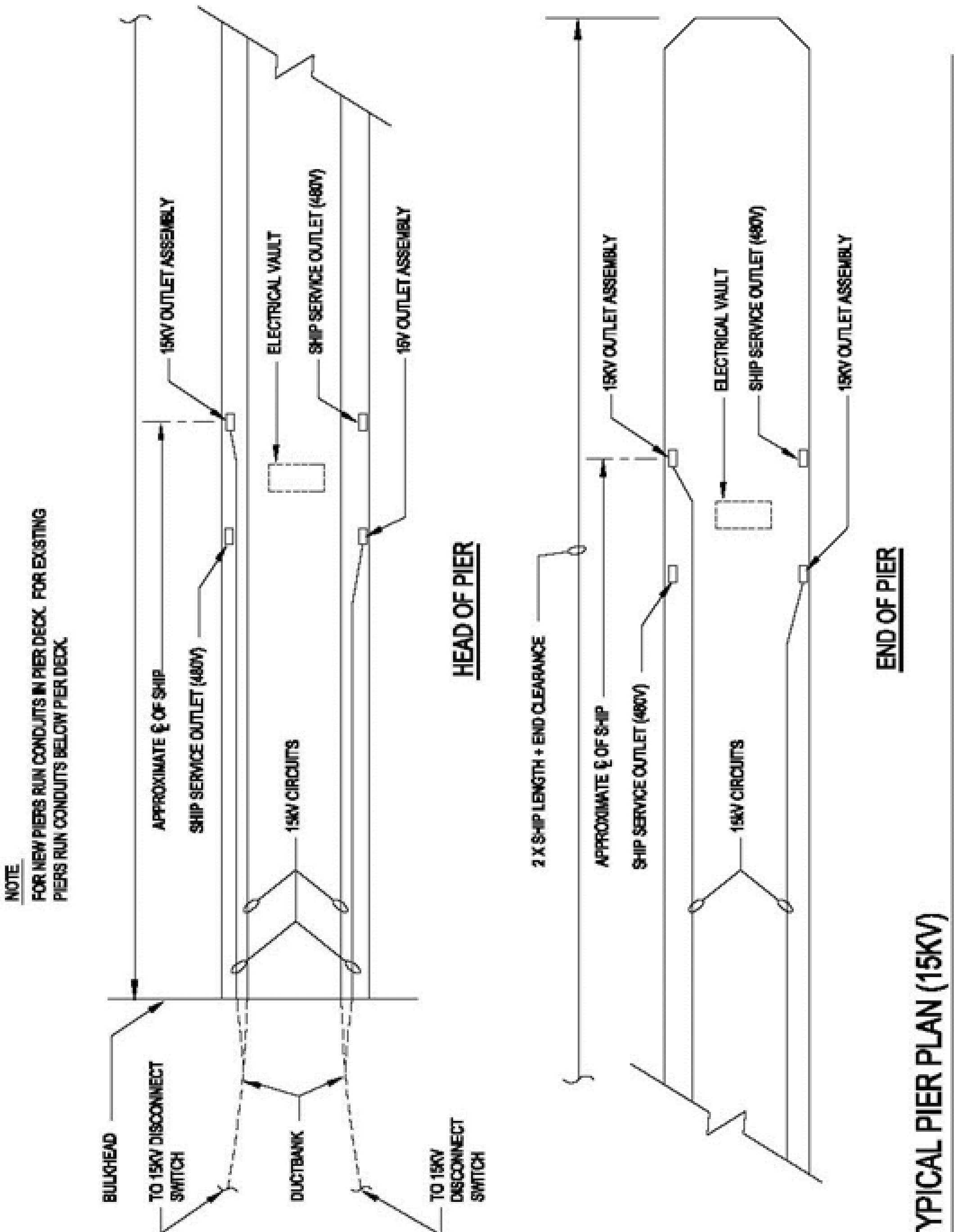


Figure D-6 (b) Pier Electrical Distribution for Temporary Services (2 of 3)

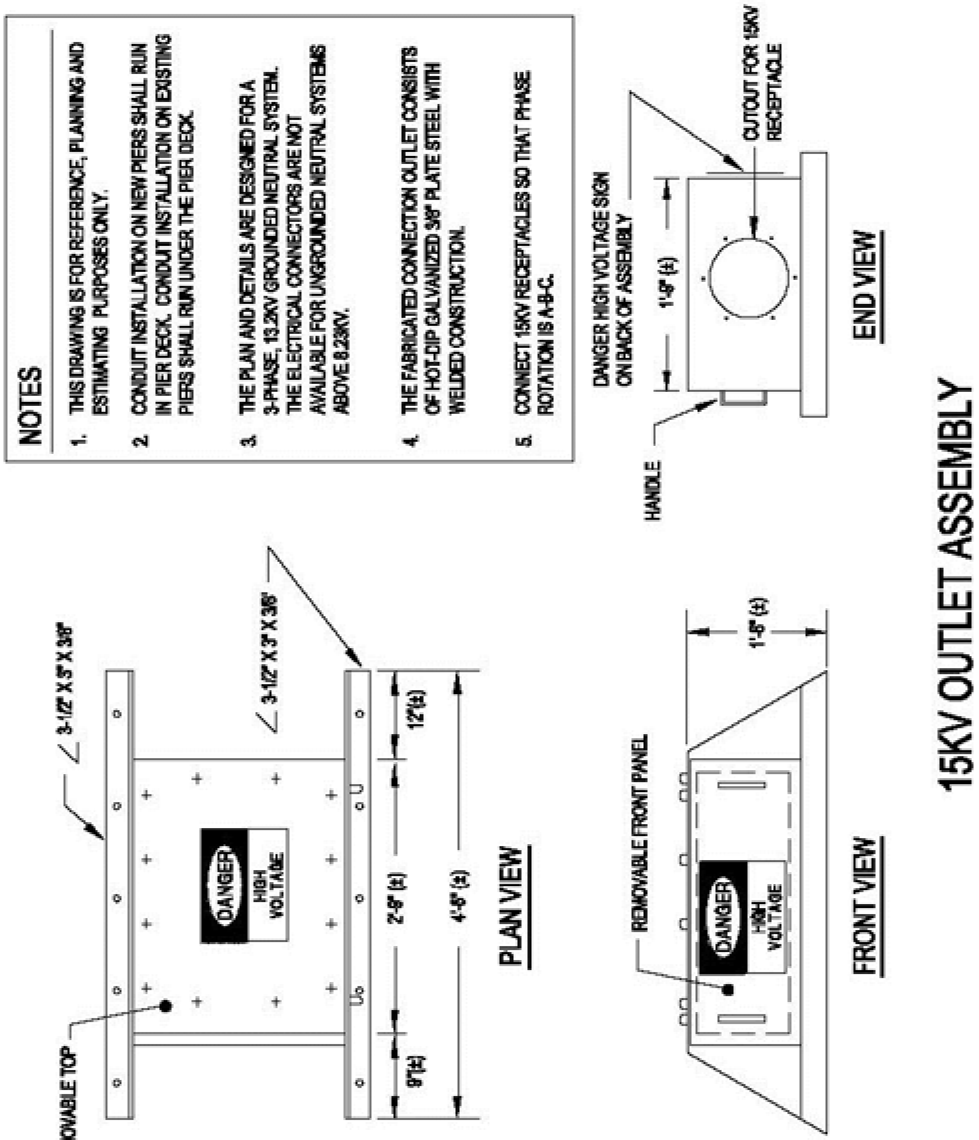
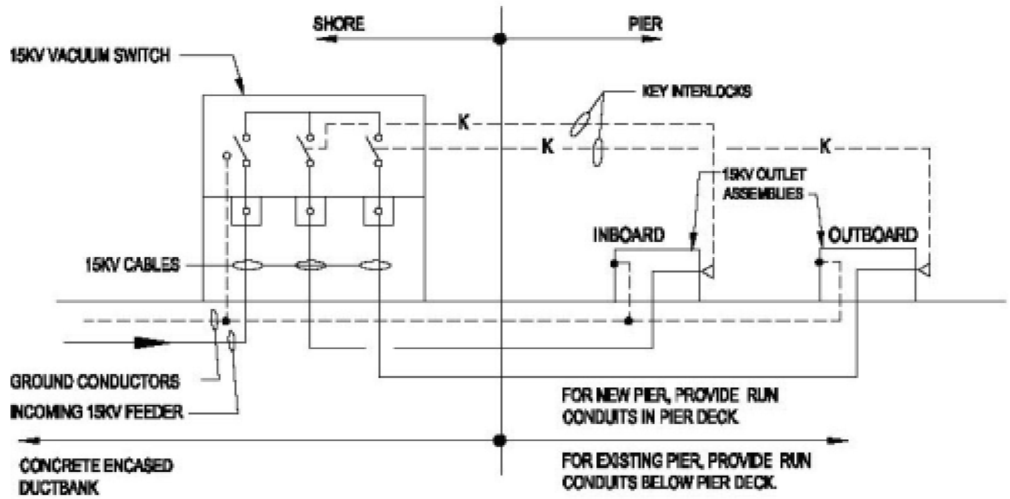
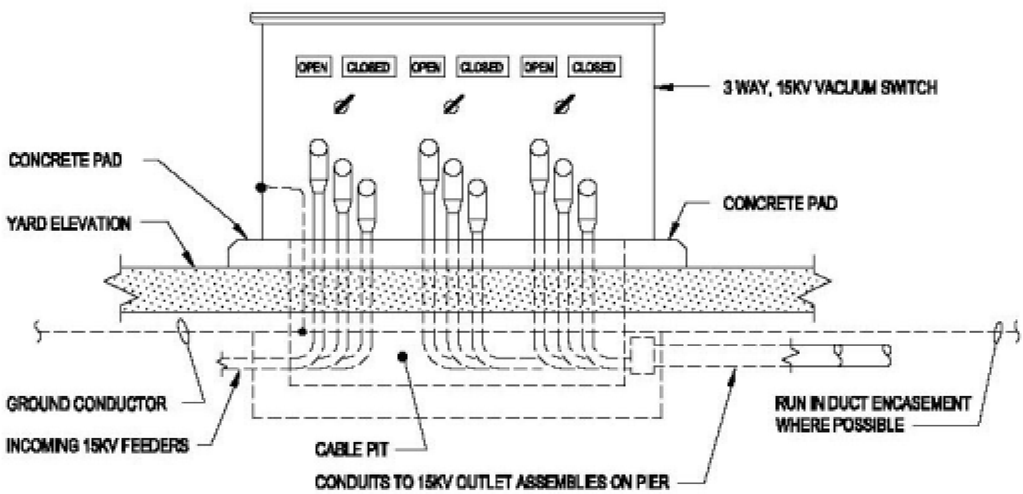


Figure D-6 (c) Pier Electrical Distribution for Temporary Services (3 of 3)



ONE-LINE DIAGRAM



SHORE INSTALLATION OF 15KV DISCONNECT SWITCH

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APPENDIX E GLOSSARY

E-1 ACRONYMS

AC	Alternating Current
A/E	Architect-Engineer
AFCEC	Air Force Civil Engineer Center
ANSI	American National Standards Institute
APTS	Activity Providing Telephone Service
ASME	American Society of Mechanical Engineers
ATFP	Anti-terrorism / Force Protection
ATS	Acceptance Testing Specification
AWS	American Welding Society
BAN	Base Area Network
BIA	Bilateral Infrastructure Agreement
BLII	Base Level Information Infrastructure
BOD	Biochemical Oxygen Demand
CBC	Naval Construction Battalion Center
CFR	Code of Federal Regulations
CHT	Collection-Holding-Transfer
CO	Commanding Officer
CPE	Chlorinated Polyethylene
CPS	Cathodic Protection System
CSF	Commander Submarine Forces
CSL	Commander Submarine Forces Atlantic
CSP	Commander Submarine Forces Pacific
DC	Direct Current

DLA	Defense Logistics Agency
DoD	Department of Defense
EDC	Environmental Distribution Center
EDM	Electronic Distance Measurement
EIC	Engineer-in-Charge
EPA	Environmental Protection Agency
EXWC	NAVFAC Engineering and Expeditionary Warfare Center
FAA	Federal Aviation Administration
FEC	NAVFAC Facilities Engineering Command
FPC	Facilities Planning Criteria
FPR	Fiberglass Polyester Resin
FRP	Fiber Reinforced Polymer
FSW	Feet Sea Water
FWD	Forward
GPS	Global Positioning System
HDPE	High Density Polyethylene
HMPE	High Modulus Polyethylene
HNFA	Host Nation Funded Construction Agreements
HPA	High Pressure Compressed Air
HQUSACE	Headquarters, U.S. Army Corps of Engineers
IAW	In Accordance With
ICAP	Infrastructure Condition Assessment Program
ICEA	Insulated Cable Engineers Association
IEEE	Institute of Electrical and Electronics Engineers
ISDN	Integrated Services Digital Network

IT	Information Technology
ITN	Information Technology Node
LCC	Life-cycle Cost
LPA	Low Pressure Compressed Air
MDF	Main Distribution Frame
MIL	Military
MPM	Mooring Program Manager
MS	Maintenance Standard
MTS	Maintenance Testing Specification
NACE	National Association of Corrosion Engineers
NAD	North American Datum
NAVSEA	Naval Sea Systems Command
NCC	Navy Crane Center
NFESC	Naval Facilities Engineering Service Center
NFPA	National Fire Protection Association
NIPRNET	Non-classified Internet Protocol Router Network
NMCI	Navy-Marine Corps Intranet
NNB	Norfolk Naval Base
NSN	Naval Station Norfolk
NSTM	Naval Ship’s Technical Manual
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OIC	Officer In Charge
OSHA	Occupational Safety and Health Administration
OWWO	Oily Waste / Waste Oil

PC	Personal Computer
PEA	Propellant Embedment Anchors
PEO	Program Executive Office
PEP	Preliminary Engineering Plan
POC	Point Of Contact
POL	Petroleum, Oil, and Lubricants
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment
PPMS	Pier Power Monitoring System
PVC	Polyvinyl Chloride
PWO	Public Works Office
QA/QC	Quality Assurance/Quality Control
QPL	Qualified Products List
ROV	Remotely Operated Vehicle
RTD	Resistance Temperature Detector
RTRC	Reinforced Thermosetting Resin Conduit
SIPRNET	Secret Internet Protocol Router Network
SPM	Single Point Mooring
SOFA	Status of Forces Agreements
SOPS	Standard Operating Procedure
SPS	Shore Power Station
SSPC	Steel Structures Painting Council
SWOB	Ship Waste Oily Barge
TBD/TBP	To Be Determined, or Provided
TOU	Time-of-Use

UCT	Underwater Construction Team
UFC	Unified Facilities Criteria
USCG	U.S. Coast Guard
UTM	Universal Transverse Mercator
UUV	Unmanned Underwater Vehicle
VPM	Vertical Payload Module
WEF	Water Environment Federation
WGS84	World Geodetic System 1984

E-2 ABBREVIATIONS AND SYMBOLS

A	ampere
ABL	above baseline
abv.	above
AVG	average
C	center
CL	centerline
DWL	design waterline
ea	each
fps	foot per second
ft	foot
FR	frame
fwd	forward
g	gravity
gpd	gallon per day
gpd/person	gallon per day per person
gpm	gallon per minute
hp	horsepower
H	height
Hz	hertz
in	inch
k	kips (1,000 lb)
kcmil	area in thousands of circular mils
kg	kilogram
kg/h	kilogram per hour

kg/m^3	kilogram per cubic meter
km/h	kilometer per hour
kN	kilonewton
kN/m	kilonewton per meter
kN/m^2	kilonewton per square meter
kPa	kilopascal
ksf	kips per square foot
kV	kilovolt
kVA	kilovolt ampere
kW	kilowatt
L	length, distance
L/d	liter per day
L/s	liter per second
L/m	liter per minute
lb	pound
lb/ft	pound per foot
lb/ft^2	pound per square foot
lb/ft^3	pound per cubic foot
lb/h	pound per hour
lb/in^2	pound per square Inch
m	meter
m^2	square meter
mg/L	milligram per liter
mg/L/h	milligram per liter per hour
mil	0.001 inch

mm	millimeter
mm^2	square millimeter
MPa	megapascal
MPa/m	megapascal per meter
mph	miles per hour
m/s	meter per second
MVA	megavolt ampere
MW	megawatts
N	number
P	port side (left side of vessel when facing forward)
pci	pound per cubic inch
pcf	pound per cubic foot
plf	pound per linear foot
ppm	part per million
psf	pound per square foot
psi	pound per square inch
psig	pound per square inch gauge
S	starboard side (right side of vessel when facing forward)
scfm	standard cubic feet per minute
V	volt
VAC	volt alternating current
W/ft	watts per foot
W/m	watts per meter
w/o	without
WL	waterline

E-3 DEFINITIONS OF TERMS

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.

Activity: The organization (or organizations) that is responsible for the daily and routine operation and maintenance of the associated waterfront facility.

APTS: Activity providing telephone service. The organization responsible for the daily and routine operation and maintenance of the waterfront's telecommunication system (or systems).

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 dry dock.

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 Dry Dock: 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 semi-permanent 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 berth side 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.

Quay Wall: 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, dry docks, 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.

APPENDIX F REFERENCES

F-1 GOVERNMENT PUBLICATIONS

UNIFIED FACILITIES CRITERIA (UFC)

https://www.wbdg.org/ffc/dod

UFC 1-200-01, *DoD Building Code*

UFC 3-190-06, *Protective Coatings and Paints*

UFC 3-220-10N, *Soil Mechanics*

UFC 3-230-01, *Water Storage and Distribution*

UFC 3-400-02, *Design: Engineering Weather Data*

UFC 3-430-09, *Exterior Mechanical Utility Distribution*

UFC 3-460-01, *Design: Petroleum Fuel Facilities*

UFC 3-501-01, *Electrical Engineering*

UFC 3-520-01, *Interior Electrical Systems*

UFC 3-550-01, *Exterior Electrical Power Distribution*

UFC 3-560-01, *Electrical Safety Operation and Maintenance*

UFC 3-570-01, *Cathodic Protection*

UFC 3-575-01, *Lightning and Static Electricity Protection Systems*

UFC 3-600-01, *Fire Protection Engineering for Facilities*

UFC 4-010-06, *Cybersecurity of Facility-Related Control Systems*

UFC 4-152-01, *Piers and Wharves*

UFC 4-213-10, *Graving Dry Docks*

UFC 4-832-01N, *Design: Industrial and Oily Wastewater Control*

UNIFIED FACILITIES GUIDE SPECIFICATIONS (UFGS)

http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs

UFGS 26 05 13.00 40, *Medium-Voltage Cables*

UFGS 26 05 33, *Dockside Power Connection Stations*

UFGS 26 11 16, *Secondary Unit Substations*

UFGS 26 12 19.10, *Three-Phase, Liquid-Filled Pad-Mounted Transformers*

UFGS 26 13 00, *SF6/High-Firepoint Fluids Insulated Pad-Mounted Switchgear*

UFGS 26 18 23.00 40, *Medium-Voltage Surge Arresters*

UFGS 26 23 00.00 40, *Switchboards and Switchgear*

UFGS 26 27 13.10 30, *Electric Meters*

UFGS 26 27 14.00 20, *Electricity Metering*

UFGS 26 32 13.00 20, *Single Operation Generator Sets*

UFGS 26 36 23.00 20, *Automatic Transfer Switches*

UFGS 26 42 13.00 20, *Cathodic Protection by Galvanic Anodes*

UFGS 26 42 15.00 10, *Cathodic Protection System (Steel Water Tanks)*

UFGS 26 42 17.00 10, *Cathodic Protection System (Impressed Current)*

UFGS 33 30 00, *Sanitary Sewerage*

DOD SINGLE STOCK POINT FOR MILITARY SPECIFICATIONS, STANDARDS AND RELATED PUBLICATIONS

http://dodssp.daps.dla.mil/

CID A-A-59326, *Coupling Halves, Quick-Disconnect, Cam-Locking Type*

FED-STD-595, *Colors Used in Government Procurement*

MIL-C-24368/1, *Connector Assemblies, Plug, Power Transfer, Shore-to-Ship and Ship-to-Ship, 500 Volts, 500 Amperes, 60 Hertz, Symbol Number 1160*

MIL-C-24368/4, *Connector Assemblies, Plugs and Receptacles, Electric, Power Transfer, Shore to Ship and Ship to Ship, 500 Volts, 500 Amperes, 60 Hertz, Symbol Numbers 1162.1, 1162.2, 1162.3*

MIL-C-24368/5, *Connector Assemblies, Plug, Submarine Shore Power Transfer, Shore to Ship and Ship to Ship, 500 Volts, 400 Amperes, 60 Hertz, Three-Phase, Symbol Number 1149*

MIL-C-52404, *Connection Hose, Fire and Water*

MIL-DTL-915, *Cable, Electrical, for Shipboard Use*

MIL-DTL-24643, *Cables, Electric, Low Smoke Halogen-Free, for Shipboard Use*

MIL-S-12165, *Strainer Suction, Fire Hose, and Strainers Suction, Hose*

MIL-STD-101, *Color Code for Pipelines and for Compressed Gas Cylinders*

MIL-STD-767, *Control of Hardware Cleanliness (NOFORN)*

MIL-STD-1399, *Interface Standard for Shipboard Systems*

MIL-STD-2041, *Control of Detrimental Materials (NOFORN)*

NAVFAC ATLANTIC

P-442, *Economic Analysis Handbook*

MO-201, *Electric Power Distribution Systems*

MO-340, *Ship-to-Shore Hose Handling Operations Manual*

NAVAL FACILITIES ENGINEERING SERVICE CENTER (NFESC)

TN-1586, *Steam Separator Test and Evaluation*

Bilge and Oily Wastewater Treatment System

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

https://www.osha.gov

29 CFR 1910, Occupational Safety and Health Administration, Department of Labor: *Occupational Safety and Health Standards*

ENVIRONMENTAL PROTECTION AGENCY (EPA)

https://www.epa.gov/laws-regulations/regulations

40 CFR 141, U.S. Environmental Protection Agency: *National Primary Drinking Water Regulations National Secondary Drinking Water Regulations*

40 CFR 1700, U.S. Environmental Protection Agency, Department of Defense: *Uniform National Discharge Standards for Vessels of the Armed Forces*

NAVAL SEA SYSTEMS COMMAND (NAVSEASYSCOM)

www.navsea.navy.mil

S0570-AC-CCM-010/8010, *Industrial Ship Safety Manual for Fire Prevention and Response*

S9086-AB-ROM-010, *Naval Ship's Technical Manual (NSTM)*

S9593-BF-DDT-010, *Oil Pollution Abatement System*

362-2333, *Air Circuit Breakers (Fused), Navy Type AQB-FL400*

NAVAL SHIP WEAPONS SYSTEMS ENGINEERING STATION

59300-AW-EDG-010/EPISM, *Electrical Plant Installation Standards Methods (EPISM)*

SUBMARINE MAINTENANCE ENGINEERING, PLANNING AND PROCUREMENT ACTIVITY (SUBMEPP)

Maintenance Standard (MS) Number 3240-081-089, *Inspect and Repair Shore Power Cables*

F-2 NON-GOVERNMENT PUBLICATIONS

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

http://www.ansi.org/

ANSI/NEMA C57.12.29, *Pad-Mounted Equipment—Enclosure Integrity for Coastal Environments*

ANSI/NEMA C84.1, *Electric Power Systems and Equipment—Voltage Ratings (60 Hertz)*

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