NAVFACINST 11300.37A
09 DEC 1993

NAVFAC INSTRUCTION 11300.37A

From: Commander, Naval Facilities Engineering Command

Subj: ENERGY AND UTILITIES POLICY MANUAL

Ref: (a) OPNAVINST 11000.16A

1. Purpose. To provide updated policy and guidance on utilities management and engineering for shore activities.

2. Cancellation. This revision to NAVFACINST 11300.37 will replace in their entirety chapters 1, 2, 3, and 4 of the originating instruction.

3. Discussion. Recent changes to energy and utilities engineering policy has necessitated issuing a revision to NAVFACINST 11300.37. The revisions will be accomplished in two phases; utilities engineering policy changes to be issued as NAVFACINST 11300.37A and energy policy issued in the future as NAVFACINST 11300.37B. The utilities policy revisions include a new emphasis on integrated utility planning, revised clean steam and fuel selection criteria, as well as a more abbreviated utilities management chapter. This revision is designed as a direct substitute for existing chapters 1 - 4.

4. Action. All Naval shore activities shall comply with the policy and guidance contained herein under the authority delegated to NAVFACENGCOM by reference (a).

Signed
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Captain, CEC, U.S. Navy
Director for Public
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CHAPTER 1

POLICY AND GENERAL RESPONSIBILITIES

1000 SCOPE

This manual consolidates CNO and NAVFAC policy and guidance on energy and utilities management and utilities engineering for Naval shore activities.

PART 1

ENERGY AND UTILITIES ASSESSMENT AND PLANNING

1100 GENERAL

Energy and utilities assessment and planning are ongoing functions performed by NAVFAC Engineering Field Divisions (EFDs), activities, claimants, and others. The purpose of NAVFAC energy and utilities programs is to assist activities and claimants to plan, build, modify, operate and maintain energy and utilities systems that satisfy mission requirements at the lowest life cycle cost.

1101 UTILITIES MASTER PLAN

a. PURPOSE The utilities section of an activity's Master Plan is an overview of the information developed in the Utility System Assessment (USA), Computer Assisted Utility System Evaluation (CAUSE), or integrated Utility Development Plan (IUDP) study. It is an important element in developing the Land Use Plan (LUP). It also serves to include important utility projects in an activity's Capital Improvement Plan (CIP). The LUP and the CIP are the key sections of an activity Master Plan.

b. POLICY Activity master plans should include a utility support section. The data, provided by the EFD's Utility Division, is based on USA, CAUSE, or IUDP studies.

IUDPs are long term development plans which, unlike USAs which look at the adequacy of the existing system, determine the optimum system which meets the needs of future missions. Our current utility systems were designed in the early 1900s to meet different mission requirements than we have today. Technologies have changed and our bases have become more spread out. Central, oil fired steam distribution systems may no longer be the most efficient and cost effective way to provide thermal energy to our buildings. Cogeneration, heat pumps, hot water heating systems in lieu of steam, and satellite or individual heating boilers may be the preferred way of providing electrical and thermal energy to our facilities. An IUDP will provide a roadmap for an activity's development which will enable the activity to tailor infrastructure projects towards this more economical configuration rather than replacing old technology in kind.

c. GUIDANCE Since the USA, CAUSE, and IUDP programs are the primary sources for identifying utility requirements and deficiencies, the schedules for these studies and Master Plans need to be coordinated to ensure timely transfer of utility information into the activity Master Plan.

d. ACTION

(1) The Engineering Field Divisions shall use the USA, CAUSE, and IUDP programs to develop utilities data to support the activity Master Plan.

(2) Schedules for USAs, CAUSE, and IUDP studies and Master Plans shall be coordinated to ensure a timely transfer of utility information.

(3) Utility data shall be provided in the form of a utility support section for insertion into the Master Plan.

(4) Utility projects included in an activity Capital Improvement Plan shall include utility data provided for the Master Plan.

PART 2

ENERGY AND UTILITIES MANAGEMENT

1200 POLICY

Energy and utilities systems shall be operated and maintained at the lowest life cycle cost. To accomplish this, data on energy and utilities equipment performance, operation and maintenance costs, and other information must be collected and analyzed. The frequency of analysis depends on the cost of ownership of the system. In general, systems costing over $1 million a year to own and operate should be analyzed monthly. The purpose of the analysis is to determine areas where annual and life cycle costs can be reduced by capital improvement and changes in operation and maintenance procedures. Chapter 4 provides detailed guidance on utilities management. OPNAVINST 4100.5 provides guidance on energy management.

PART 3

ENERGY GOALS AND AWARENESS

1300 ENERGY GOALS

The following Navy energy goals were established by OPNAVINST 4100.5D. Fiscal year 1985 is used as the baseline year for comparison.

a. Existing buildings. Reduce adjusted energy consumption per thousand gross square feet (KSF) by 6 percent by the end of FY 1990, 12 percent by the end of FY 1995, and 20 percent by the end of FY 2000.

b. New buildings. Reduce the estimated annual design energy usage per gross square foot by 1 percent per year for new buildings, thereby achieving a 10 percent reduction for those buildings to be designed in FY 1995 over comparable buildings designed in FY 1985.

c. All shore activities. Support the following overall Navy FY 1995 goals to the extent that it is cost-effective and practical:

(1)Obtain 10 percent of total Navy shore facility energy from coal, solid fuels, and renewable energy sources; and

(2)Increase the miles per gallon efficiency of administrative vehicles (CESE A-N) by 12 percent, and increase the usage of alternative vehicle fuels.

OPNAVINST 4100.5C also established energy management standards for all shore activities. Chapter 5 provides detailed policy and guidance on Energy Goals and Reporting System. Chapter 7 provides additional detail on energy management standards for facilities.

1301 ENERGY AWARENESS

All Navy, Marine Corps, and civilian personnel in the Naval shore establishment use energy. All hands must be made aware of the significant cost of energy to the government and the significant cost reductions possible when energy is used efficiently.

PART 4

CNO, CLAIMANT AND PUBLIC WORKS SUPPORT

1400 POLICY

Reference (d) provides claimant support assignments for EFDs. In addition to these assignments, CHESNAVFACENGCOM will provide support for Headquarters Marine Corps. Geographic EFDs will provide support for activities within their geographic areas and support CNO through NAVFACENGCOM Headquarters.

PART 5

ECONOMIC ANALYSIS

1500 POLICY

Economic analysis for all energy and utilities projects shall be based on methods outlined in NAVFAC P-442, Economic Analysis Handbook.

PART 6

RENEWABLE ENERGY

1600 SCOPE

The renewable energy program in the Navy was established to encourage the development of other than conventional or fossil fuel energy sources for the Navy and to reduce our dependence on foreign energy sources. The concept is not a new one, but due to the politics of energy within the last two decades renewable energy resources have gained new attention. The concept is that of using the supply of energy that surrounds us in the form of light, fluid motion, and renewable resources.

1601 GENERAL

a. Navy Funds. Renewable energy resources that are not able to be developed using Public/Private Venture contracts shall be developed using Navy funds where life cycle costs are effective.

b. Renewable Energy Resources. Renewable energy includes solar, wind, photovoltaics, wave power, biomass, trash, land-fill methane, geothermal, etc.

c. Payback. When renewable energy facilities are constructed using Navy funds, the project shall pay back within its life-cycle. Life-cycle cost analysis shall be conducted using the current discount rate and latest differential escalation rates for energy published by the Department of Energy.

d. Savings to Investment Ratio. Renewable energy projects must compete for Navy funds with other conservation technologies. The basis for project selection will be the Savings to Investment Ratio (SIR) described in Chapter 8, Part 1.

e. Solar Analysis. A solar analysis for a military construction project is not needed if:

(1)a solar analysis was conducted for a similar facility and location;

(2)that analysis shows solar is not cost effective; and

(3)energy costs have not substantially increased since the solar analysis was completed.

CHAPTER 2

UTILITIES ENGINEERING PROGRAMS

PART 1

UTILITY SYSTEMS ASSESSMENTS (USAs), UTILITY TECHNICAL STUDIES (UTSs) AND INTEGRATED UTILITY DEVELOPMENT PLANS (IUDPs)

2100 PURPOSE

Utility Systems Assessments (USA) and Utility Technical Studies (UTS) identify utility deficiencies and recommend corrective actions to ensure that adequate utilities will be available to meet current and future mission requirements. Integrated Utility Development Plans are basewide studies which examine the most life cycle cost effective way to provide utilities in the future.

2101 POLICY

Commanding Officers are responsible for the adequacy of facilities in relation to readiness, effectiveness and responsiveness. Activity utilities engineering resources, however, are often not sufficient to maintain and upgrade the Navy's shore utility systems. As a result, many systems have deteriorated, are approaching capacity limits or are of questionable reliability. The EFDs, through the USA and UTS programs, in conjunction with the Utility Master Plan outlined in Chapter 1, Section 1101, provide utility engineering support to correct these deficiencies.

Certain activities have experienced major changes to their utility load distribution since the activity was constructed. These changes could include major changes in the size or density of the installation, mission changes with resultant changes in utility requirements, or the availability of new technology or fuel source. In these cases, evaluating the utility system for condition, capacity, and reliability may not be sufficient. In these limited cases an IUDP should be conducted to determine the most life cycle cost effective way to supply and distribute utilities. For example, an IUDP could determine that a base should ultimately convert from a steam system to a hot water system supplemented by individual building boilers.

An IUDP would evaluate new technology, and available fuels in determining the best system. The results would be a roadmap which an activity could follow in repairing and replacing its system. Following an IUDP, an installation can move from a utility system designed in the 1940s to one designed for the year 2000.

2102 GUIDANCE

a. In accordance with OPNAVINST 11000.16, EFDs provide USAs for Naval activities on a reoccurring cycle. UTSs are accomplished by contracts funded by the activity, sub-claimant, or claimant and are administered by the geographic EFD.

b. A Utility System Assessment is an engineering evaluation of the condition, reliability, and quality of a utility system and of its capability to meet present and future requirements. It provides utility data for inclusion in an activity Master Plan. EFDs should schedule USAs to coordinate with Master Plan schedules. EFDs should identify not only utility systems that are deficient, but also utility systems or major components that have exceeded their useful life or are experiencing increasing maintenance costs or inefficiency. Specific deficiencies are identified and documented in sufficient detail to initiate corrective actions. Utility input into the Annual Inspection Summary (AIS) is reviewed to ensure that the AIS reflects all utility deficiencies. Utility systems include but are not limited to:

(1) Electricity generation and distribution
(2) Steam production and distribution
(3) High temperature hot water production and distribution
(4) Chilled water production and distribution
(5) Compressed air production and distribution
(6) Natural gas supply and distribution
(7) Potable water supply and distribution
(8) Sewage collection and disposal
(9) Salt water supply and distribution

c. Utility Technical Studies are investigations that focus on utility system deficiencies. Alternatives to correct the deficiencies are examined in enough detail to select and develop projects needed to implement the optimum solution. Funding for the UTS is provided by the claimant.

The UTS provides an investigation of each deficiency and an analysis, including life-cycle cost, for each alternative considered and the recommended alternative. Complete justification and project documentation is included.

d. An IUDP is not conducted on a regular cycle like a USA or UTS. Neither are all naval activities justified in requesting a IUDP. Because IUDPs are expensive and time consuming they should be limited to those installations who have experienced major changes to their load distribution and who will be budgeting for extensive utility system improvements.

e. NAVFACENGCOM encourages the use of Computer Aided Drafting & Design (CAD 2) in all areas of facilities engineering.

(1)The mapping capabilities of CAD 2 have particular application in support of USAs and UTSs. Current and complete drawings of utility systems are a major requirement of engineering investigations.

(2)Expanded use of CAD 2 by utilities engineers is expected in the coming years. To assist in converting the shore establishment to CAD 2, USAs should include recommendations for UTSs to convert utility system drawings to digital format.

2103 RESPONSIBILITIES

a. NAVFACENGCOM. Provide policy and guidance for the USA/UTS and IUDP programs in accordance with OPNAVINST 11000.16.

b. Engineering Field Divisions.

(1)Accomplish USAs and IUDPs in accordance with OPNAVINST 11000.16 and this instruction.

(2)Provide the results of each study to the appropriate claimant via the activity.

(3)Use the study to develop a utility support section for incorporation into the activity Master Plan.

(4)Develop scope(s) of work and administer contracts to perform UTSs.

(5)Geographical EFDs shall provide claimant EFDs, by 1 December of each year, the status of recommended UTSs and a 6 year USA schedule for the claimant's activities. The USA schedule should be coordinated with the Master Plan schedule. Claimant EFDs shall provide a consolidated status report of these requirements to the claimants prior to 1 January of each year.

c. Major Claimants.

(1)Prioritize and approve the six-year USA schedule by 1 March of each year in accordance with OPNAVINST 11000.16.

d. Shore Activities. Provide assistance to EFDs and contractors in accomplishing USAs, UTSs, and IUDPs.

PART 2

COMPUTER AIDED LOGISTICS SUPPORT

2200 PURPOSE

Computer Aided Logistics Support (CALS) standardization will require that data prepared for CAD 2 and Computer Assisted Utility System Evaluation (CAUSE) be compatible with automatic machine to machine transfers and electronic telecommunications. The following CALS definition, scope and objectives were presented at a "SYMPOSIUM ON AUTOMATION OF THE NAVY" on 26 August 1986.

a. Definition. CALS is an integrating mechanism for a modernization process that is underway in the Navy today from design engineering to acquisition, to operational employment and support.

b. Scope.

(1)Mandated by Congress for DOD-wide implementation.

(2)Applies to all new major acquisitions advertising in 1990 and beyond.

(3)Development and implementation is a joint Industry-DOD process.

(4)Requires integration of existing "Islands of Automation" through standardization and coordinated architectures.

c. Objectives.

(1)Design more supportable facilities.

(2)Foster "Near Paperless" system of acquisition and support functions.

(3)Transition from paper based to digital logistics and technical information.

(4)Routinely acquire and distribute logistics and technical information in digital form for new facilities.

(5)Shorten the leadtime for more effective logistics support to the operating forces.

2201 GUIDANCE

a. The CAUSE program contains two major sub-programs, Computer Assisted Power Systems Engineering (CAPSE) and Computer Assisted Fluids Engineering (CAFE). In-depth analyses of shore facility utility systems are needed to ensure that utility systems safely, adequately and reliably meet mission requirements. Additionally, good management practice dictates that optimum benefits be obtained from system improvements and that all utility systems work in concert at their optimum efficiencies. Computer assistance in performing time consuming, complex calculations enables engineers to evaluate more alternatives and select the best overall solution. By freeing engineers of cumbersome calculations, the computer makes utilities engineers more productive. CAUSE studies provide utility data for inclusion in an activity Master Plan. EFDs should schedule CAUSE studies to coordinate with Master Plan schedules.

(1)The CAPSE series of computer programs permit the engineer to model the operation of electric power systems. Evaluations include: voltage, power factor, capacity, short-circuit, component characteristic and efficiency studies.

(2)The CAFE programs model the operation of mechanical utility systems, e.g., steam and water. They enable engineers to determine optimum configuration, system capacities, system efficiencies and improvements to system operation to optimize the effectiveness of these systems.

c. EFD Utilities Divisions use the CAUSE program to evaluate activities' utility systems.

(1)They conduct in-depth analyses on activities' utility systems in their geographic area to ascertain present and future operating conditions and identify deficiencies. These analyses evaluate utility system safety, reliability and efficiency. Immediate, short-term and long-term utility needs of the fleet can be met efficiently and effectively with maximum utilization of existing and planned resources. The data from this evaluation shall be summarized for inclusion in the utilities support section of an activity Master Plan.

(2)They coordinate analyses with planning for ship requirements using existing databases to model the future requirements. This ensures that activities can plan their utility system improvements to provide optimum benefits within existing funding constraints for time phased improvements.

(3)Computer aided analyses help to develop optimum system resolution for deficiencies identified by the Utility Systems Assessment Program, Energy Engineering Program Surveys and the activities Annual Inspection Summary.

d. Contractors are used to assist activities in their collection and preparation of data. The use of standardized (near paperless) electronic data handling will simplify gathering and transferring equipment characteristics, inventory and future load data. Improved activity utilization of mapping, one line diagrams and impedance diagrams will make the task of the utility analyst easier and will result in more effective use of the recommendations by the activity.

2202 RESPONSIBILITIES

a. NAVFACENGCOM. Provide policy and guidance for the CAUSE and Utilities CAD 2.

b. Engineering Field Divisions. Use the CAUSE program to assist activities in evaluating utility systems under their cognizance by developing a utility support section for incorporation into the activity Master Plan.

(1)Collect all necessary system data, including equipment characteristics and inventory and present and future loads, to conduct a thorough analysis and prepare system component connection (one-line) diagrams. Activity and A&E resources shall be used to augment EFD efforts to collect and prepare system data.

(2)Conduct periodic in-depth analyses of utility systems to ascertain present and future operating conditions and identify deficiencies. Analyses shall evaluate utility system safety, reliability and efficiency. They shall ensure that utility systems provide the quantity and quality of service necessary to meet all mission requirements. Coordinate analyses with planning, ship requirements, and MILCON Program development to ensure shore facilities have adequate utilities to meet requirements ten years into the future. Immediate, short-term and long-term needs shall be met efficiently and effectively with maximum utilization of existing and planned resources.

(3)Recommend actions necessary to ensure that system improvements provide optimum benefits and are time phased with system requirements. Also, provide recommendations regarding changes to O&M procedures and system configurations.

(4)Initiate follow-up action to ensure that all recommendations involving system capacity, reliability, and/or safety are being implemented.

(5)Coordinate a continuing education program for their utility system analysts.

(6)Work closely with activities to have utility maps, diagrams and site survey drawings converted to CAD 2.

c. Atlantic Division, Naval Facilities Engineering Command, Code 16. Responsible for the technical management of the CAUSE program. Specific duties include:

(1)Maintain existing computer programs/software supporting CAUSE.

(2)Optimize the operation of computer programs/software including all computer instructions needed by engineers using the programs.

(3)Develop and/or adapt new computer programs (software) to enhance the capabilities of CAUSE.

(4)Train EFD personnel in the use and application of the program packages and necessary time-sharing computer operating instructions.

(5)Ensure hardware and software requirements are inc consonance with program objectives.

(6)Prepare and publish technical documentation required to support CAUSE.

(7)Provide technical advice to the NAVFAC program manager of the impact of any proposed hardware, software or central processor changes.

(8)Coordinate all technical problems directly with the EFDs and government or commercial time-sharing service organizations.

d. Activities

(1)Assist EFDs in collecting and preparing data for studies.

(2)Use CAUSE to monitor and plan changes for utility systems.

PART 3

WATERFRONT UTILITIES

2300 SHORE-TO-SHIP POWER

2301 PURPOSE

OPNAVINST 11310.3A provides minimum operation and maintenance procedures for electrical systems which provide shore-to-ship power.

2302 POLICY

Applies to all Navy-owned components of electrical distribution systems between each power source (commercial utility metering point or Government owned generator) and each shore power connection point on board ships. Electrical components that are not directly involved in supplying power to ships, but can affect the reliability of these circuits, are also included. This instruction does not apply to electrical components aboard ships or components used exclusively to deliver 400 Hertz, supershore, or direct current power or any other power for major ship repair or overhaul. All shipyards are excluded.

2303 GUIDANCE

The safe and reliable operation of shipboard electrical equipment is critical in port as well as at sea. A malfunction or misapplication of shore-to-ship power equipment could cause at least an inconvenient interruption of electrical service to a ship at berth; at worst, it could threaten the lives of personnel, damage critical shipboard and shore power equipment, or completely disable a ship. Problems with shore-to-ship power systems are frequent and may become more common as ships' power requirements increase in the future. Investigations by NAVSEASYSCOM and NAVFACENGCOM have shown that improperly trained ship and shore personnel and inadequately maintained shore-to-ship power equipment are the major causes of problems. Because the requirements are critical and the waterfront environment is harsh for electrical equipment, it is imperative to apply the highest standards to the operation and maintenance of electrical distribution systems that supply shore-to-ship power to the fleet.

a. Training. Training programs should be developed by each ship and shore activity for all ship and shore based personnel involved in the operation and maintenance of shore-to-ship power systems. The program should include the installation, fabrication, assembly and testing of low and medium voltage cable, splices, terminations, connectors, portable substations, switchgear and receptacles, where applicable. NFPA 70B, Electrical Equipment Maintenance, can be used as a guide for local training programs. NFPA 70B may be obtained from: National Fire Protection Association, Battery March Park, Quincy, MA 02269. Navy sponsored training courses and manufacturers' training shall be used to the maximum extent possible to supplement local training. Activities and Fleet Commanders should establish standards for personnel working on shore-to-ship power systems. Activities should maintain training records and conduct periodic refresher training programs.

b. Shore-to-Ship Power System Operating Procedures. Basic power system operating guidelines are published in NAVFAC MO-201, Operation of Electric Power Distribution Systems. The following additional procedures shall be applied to all shore-to-ship power systems.

(1) Standard Operating Procedures (SOPs). SOPs shall be prepared by each activity and distributed to all personnel involved with the operation and maintenance of shore-to-ship power systems. These SOPs shall address, as a minimum, the following areas:

(a) Organization
(b) Responsibilities
(c) Priorities
(d) Normal Procedures
(e) Emergency Procedures
(f) Safety and Health Requirements and Considerations

(2) Critical Component Identification. Activities shall identify as critical components of shore-to-ship power systems, all electrical components whose failure could effect the reliability of the electrical distribution system supplying power to the ships. Critical components shall be placed under the maintenance program defined in this section.

(3) One-Line Diagrams. One-line diagrams illustrating the equipment ratings and system configuration of all critical components shall be prepared and kept current by the activities. Plot plans shall be annotated to show the location of all shore-to-to-ship power system components. See NAVFAC MO-204, Electric Power System Analysis, for additional information.

(4) Power System Study. An activity power system study, including load flow, fault current analysis and coordination of protective devices, shall be reviewed and updated at least once every 5 years of sooner, if required

by major modifications to the activity's or utility company's electrical distribution system. The study evaluates the adequacy of all critical components of the shore-to-ship power system.

(a)All protective devices which could directly or indirectly cause a ship power failure shall be evaluated to determine compliance with the American National Standards Institute (ANSI) standards and the National Electrical Code.

(b)EFDs shall perform USAs to assist activities in evaluation changes to the shore-to-ship power systems and recommend, as appropriate, a power system load flow, fault current and/or protective device coordination study to be performed either by the EFD, using their Computer Assisted Utility Systems Engineering (CAUSE) facilities, or by contract.

(5)Voltage Requirements. Voltages available at the ship's shore-to-ship power receptacles shall be within +/-15 percent of rated voltage under full load conditions.

(6)Transportable Substations. Transportable substations or other portable equipment used to supply power to ships are included in the maintenance program defined in this section.

(7)Paralleling Transformers. If a ship is supplied by two or more shore transformers, the ship's operating forced should 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 and on shore.

(8)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 to or from shore power.

c. Shore-to-Ship Power System Maintenance Standards

(1)General. The basic electrical equipment maintenance guidelines, as outlined in National Fire Protection Association (NFPA) Publication 70B, Electrical Equipment Maintenance, shall be used as minimum maintenance standards. Additionally, NAVFAC MO-200, Facilities Engineering, Electrical, Exterior Facilities, NAVFAC MO-322, Inspection of Shore Facilities and manufacturers maintenance recommendations shall be used as supporting guidelines for all shore-to-ship power system equipment. Maintenance schedules listed shall be adjusted so as not to interfere with normal waterfront operations, e.g., schedule maintenance when critical components are not required for ship support.

(2)Continuous Inspection Schedules

(a)Inspection checklists shall be prepared by each activity and used for all shore-to-ship power system critical components. A checklist shall be prepared for each type of preventive maintenance if there is more than one type, e.g., semi-annual, annual, etc. These checklists shall include everything that is to be done during the scheduled maintenance. Signed off copies of checklists shall be filed with maintenance records.

(b)Inspection schedules shall be prepared and followed for all shore-to-ship power system critical components. Maintenance intervals published in NFPA 70B, NAVFAC MO-200 and NAVFAC MO-322 may be adjusted based upon local conditions and experience. However, maintenance intervals shall not exceed the times listed in NFPA 70B.

(3)Maintenance Records

(a)Maintenance records shall be established and maintained covering each shore to ship power system. Critical component records must indicate completed work and by whom. Testing and test records shall be part of each critical component's maintenance record.

(b)Maintenance records shall also be used to identify excessive unscheduled maintenance so that problems may be diagnosed and corrected.

(4) Switchgear Operations. Switchgear devices included on the critical component list which operate because of an overload, overcurrent, or short-circuit shall be evaluated for damage. Air circuit breakers shall be carefully inspected for damage to contacts, arc chutes frame and operating mechanism and oil circuit breakers shall be inspected and maintained as outlined in MO-322. Shipboard operational requirements may require that maintenance other than visual inspections be temporarily deferred but deferrals shall not exceed the times listed in NFPA 70B for maintenance intervals.

(5) Testing. Critical components shall be tested during regular maintenance intervals in accordance with the requirements of NFPA 70B.

d. Portable Shore-to-Ship Electric Power Cables

(1) Low Voltage Cables (Rated 600 Volts and Below). Portable cables used in the shore-to-ship power system shall be supplied in accordance with MIL-C-915E and MIL-C-915/6. Cable shall be three conductor, flexible, unshielded type THOF-500 construction. Cable shall be rated for at least 600 volt service and should be ordered from the Defense Industrial Supply Center, Philadelphia, Pennsylvania. The stock number for the cable is THOF-500 NSN 6145-01-008-5468.

(2) Medium Voltage Cables (Rated 601 Volts to 5000 Volts). The portable cables used for the 4160 volt shore-to-ship power system shall be three conductor, flexible, braided shield type SHD-350GC, 8,000 volt insulated, with PVC jacket. Insulation shall conform with Insulated Power Cable Engineers Association (IPCEA) S-66-524. Jacket materials shall comply with IPCEA S-19-81. Medium voltage cables are available only from commercial sources.

(3) Low Voltage Cable Overcurrent Protection. Shore-to-ship cables are rated to carry maximum continuous load of 400 amperes. The 450 volt pier substation circuit breaker long time overcurrent protection shall be adjusted to trip at continuous loads of 440 amperes to prevent overload damage to the cables of ship's electrical system.

(4) Medium Voltage Cable Overcurrent Protection. 4160 volt ship-to-shore cables are rated to carry a maximum continuous load of 360 amperes. The 4160 volt pier

substation circuit breaker long time overcurrent protection shall be set to trip at a maximum of 400 amperes to prevent overload damage to the cable or ship's electrical system.

(5) Standard Cable Lengths. Activities should maintain an inventory of portable shore-to-ship electric power cables in lengths required for serving the ships. Lengths are selected and constructed to minimize the requirements for in-line connections. All of the cables serving a ship from a pier mounted 450 volt turtleback must be of equal length to minimize the unequal sharing of loads.

(6) Cable Storage. Cables not in use should be stored in a dry, weatherproof location. Covered off pier storage locations are highly desirable. Cable ends, terminations and plugs shall be protected against contamination and moisture when not in use.

(7) Number of Shore-to-Ship Circuits

(a) The number of shore-to-ship circuits using three conductor cables required to supply power to a particular ship depends on the estimated power requirements of the ship. Power requirements vary depending on the ship's activity while in port. MIL-HDBK-1025/2, table 10, gives the Shore Power Requirements for various classes of ships. Each low voltage cable is limited to 400 amps steady state at 450 volts. The medium voltage cables are limited to 360 amps at 4.16 KV.

(b) The ship's force should provide estimated ampere load requirements to the shore operators. When the available shore power is less than the estimated ship load, the ship's force shall be notified of the available capacity of shore-to-ship power system. When more than one circuit is required all cables shall be the same length and conductor sizes shall be matched to minimize unequal load distribution in accordance with OPNAVINST 11310.3A. Shore power mounds should have sufficient number of receptacles so that splice boxes, which negate the safety features built into the shore power system, are not used in paralleling widely separated power mounds.

(8) Cable Terminations

(a)All low voltage cables should be terminated with a MIL-C-24368/1 plug at each end of the cable. The connectors are assembled onto the cable using approved methods as detailed in NAVSEA drawing 803-5001027, section 2, group E, sheet 15, which is available from Naval Sea Systems Command, SEA 563Z, Washington, DC 20362. This drawing is also available in hardbound copy as publication number S9300-AW-EDG-010/EPISM from the Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

(b)Portable shore power cable jumpers, supplied by the ship, may be used only where piers do not have MIL-C-24368/2 type receptacle and plug assemblies.

(c)Cables serving submarines shall have a MIL-C-24368/5 outboard plug connection permanently attached to the shipboard end.

(d)All medium voltage cables shall be terminated at the shore end with a three phase 5000 volt, 400 ampere plug. The shipboard end of the cables shall be terminated with MIL-E-16366, 2 hole bolted lug type terminals.

(9)Low Voltage System In-Line Connections. In-line connections are used only if operationally necessary. The in-line connection shall use MIL-C-24368/4 connectors or an equivalent method of connection that is watertight, oil resistant and ensures proper phase orientation. The following three pole connectors may also be used:

CAGE	CONNECTOR ASSEMBLY	COG	FED SUPPLY CLASS
90129	X 8998-1 Male	1H	0099-LL-H28-0067
90129	X 8998-2 Female	1H	0099-LL-H28-0067

(10)Shore-to-Ship Power System Service Connections

(a)Connecting the shore-to-ship power system cables to the pier receptacles shall be accomplished only by qualified shore electricians in direct coordination with an electrical supervisor from the serviced ship. A checklist with detailed, sequential step-by-step connection procedures shall be developed by the activity providing the cold iron electrical service. The checklist shall show the date, ship, pier and outlet number and shall be signed by both the shore electrician and the shipboard electrician in charge when the hookup is completed. This checklist should be retained by the Public Works Department or Center for at least one year.

(b)This checklist shall address at least the following items:

- Visual inspection of the cable terminations to insure they are clean, free from salt, moisture, and corrosion, and are undamaged.

- Inspection of the cable terminations to insure they are clean, free from salt, moisture, and corrosion, and are undamaged.

- Electrical insulation resistance tests of each cable assembly showing actual values measured. Cables having insulation readings below 1,000,000 ohms for 450 volt cables and 5,000,000 ohms for 4160 volt cables shall not be placed in service; shop testing and repair shall be initiated.

- Shore power outlets are de-energized before connecting the cables.

- Connect the cables to the pier shore power outlets.

- If the ship is supplied by more than one shore transformer, the electrician shall instruct the ship's operating force that paralleling of shore transformers through the ship's bus is prohibited unless authorized by the cognizant activity based on a fault current analysis.

- Energize the cables only after the ship grants permission to transfer to shore power.

- Ship's forces are responsible for rigging the cables on board the ship, verifying phase rotation on each cable and for completing the connection on board the ship. The shore activity will assist in rigging cable in some cases.

(11)<u>Maintenance of Portable Shore-to-Ship Power Cable</u>

(a)Shop Tests. The shop test procedures given in NAVFAC MO-200 shall be performed on all cables and connectors which fail insulation resistance tests or pre-installation inspections. These tests can be used to locate cable faults and to verify cable integrity after repairs are completed. Cables which fail shop tests and cannot be economically repaired shall be removed from service permanently.

(b)Repair. Insulation repairs entailing damage to outer cable jacket with conductor insulation intact should use approved materials only. An approved materials or kit will provide abrasion resistance and will remain flexible over a wide range of temperature. The completed insulation repair must have a moisture seal and the seal must be permanently bonded to the cable insulation. Repair kits and materials which carry a Bureau of Mines approval number or use a vulcanized rubber molding for insulating are the only materials which are approved for use on portable shore-to-ship power cables. Procedures for repairs to cables with damage outer jacket and conductor insulation shall be as required for cable splicing.

(c)Splicing. Splicing of portable shore-to-ship power cables is not recommended. However, if splices cannot be avoided, low voltage cables may be spliced when the spliced connections are insulated with an insulating material which conforms to the requirements of paragraph 11(b) above and NCEL Technical Note N-1503, copies of which may be obtained from the Commanding Officer, Naval Civil Engineering Laboratory, Code L07, Port Hueneme, CA 93043. Medium voltage power cables shall not be spliced under any conditions.

2304 RESPONSIBILITIES

a. NAVFACENGCOM Public Works Centers and Engineering Field Divisions

(1)Issue shore-to-ship power operation and maintenance policy and procedures.

(2)Evaluate shore-to-ship electrical power outages and recommend corrective actions for design, operation and maintenance of shore-to-ship power systems.

(3)Provide support to NAVSEASYSCOM for the identification and solution of interface problems between ships' electrical distribution systems and shore-to-ship power systems.

b. Major Claimants and Sub Claimants

(1)Ensure that subordinate shore activities and applicable fleet units develop shore-to-ship power operation and maintenance programs.

(2)Ensure that projects necessary to correct identified waterfront deficiencies involving shore-to-ship power support are submitted.

c. Commanders of Forces Afloat

(1)Establish standards for shipboard personnel for the checkout and connection of the power cables on board ship and ensure that subordinate units apply these standards.

(2)Develop required changes to shipboard operating procedures in support of the shore-to-ship power operating procedures established by this instruction.

d. Activities. The following apply to shore activities and Public Works Centers providing electrical cold iron power:

(1)Establish shore-to-ship power operation and maintenance program.

(2)Assess waterfront facilities as they relate to shore-to-ship power, and submit projects to correct identified deficiencies.

2305 STEAM AND FEEDWATER

2306 DISCUSSION

a. Background. The Navy spends millions of dollars annually to repair ship boiler corrosion and damage. Part of this damage is the result of impurities found in steam and feedwater supplied to ships for "cold iron" support and steam blanketing of ships' boilers. To ensure that impurities do not enter ships NAVSEASYSCOM has prohibited ships from accepting shore-to-ship steam and feedwater unless the supplying activity certifies that the steam and feedwater meet NAVSEASYSCOM standards.

b. Standards. Shore-to-ship steam and feedwater sampling and testing shall be conducted in accordance with Naval Ships Technical Manual, NAVSEA S9086-GX-STM-020/CH-220 V2. PACNAVFACENGCOM Manual P-200, Shore to Ship Steam and Feedwater Manual for Naval Facilities, provides further guidance and information.

2307 CRITERIA

Shore-to-ship 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. When shore steam condensate or feedwater is provided, a 100 mesh Y type strainer shall be installed in the feed line to the ship to preclude resin contamination of the ship's system. The quality requirements are:

a. Shore Steam and Condensed Steam

Constituent or Property	Requirement
pH	8.0 to 9.5
Conductivity	25 uS/cm max
Dissolved Silica	0.2 ppm max
Hardness	0.10 epm max

b. Feedwater Supplied to Ships

Constituent or Property	Requirement
Conductivity	2.5 umho/cm max
Silica	0.20 ppm max

Facilities providing shore steam to Navy ships are required to sample and test shore steam and provide certification to the ships as follows:

(1)Sampling and analysis requirements:

(a)Shore boiler discharge shall be sampled daily.

(b)Each pier and quay shall be sampled quarterly.

(2)Shore steam certification requirements:

(a) Documentation of the most recent daily and quarterly analysis results shall be provided to each ship prior to shore steam hookup.

(b) Daily steam analysis results shall be made available to each ship by telephone. Telephone numbers shall be provided to each ship at the time of shore steam hookup.

(c)Each ship shall be notified any time shore steam does not meet the specified requirements.

2308 RESPONSIBILITIES

a. Engineering Field Divisions

(1)Assist activities to ensure that shore-to-ship steam requirements and feedwater requirements are met and maintained. Shore-to-ship steam meeting the NAVSEASYSCOM quality requirements is known as Clean Steam.

(2)Monitor the success of activities in meeting the NAVSEASYSCOM quality standards and report such monitoring to NAVFACENGCOM biannually. Activities meeting the NAVSEASYSCOM Clean Steam and feedwater standards at the time of the biannual report are considered "certified".

(3)Provide periodic assessments of Clean Steam production and distribution facilities to insure the quality requirements are met and maintained; and to recommend improvements to equipment and procedures.

b. NAVFEC. Provide as requested:

(1)Troubleshooting, metering and equipment testing services on a reimbursable basis.

(2)MUSE steam plants as required to support cold iron services.

c. Activities. The supplying activity is responsible for providing steam and feedwater of sufficient quality to meet NAVSEASYSCOM requirements. Activities are advised of the following:

(1)Daily laboratory tests to certify that steam purity at the shore boiler discharge and quarterly laboratory tests to certify that steam quality at each pier/or quay meet the purity requirements are required by NAVSEASYSCOM. Continuous automatic isokinetic sampling is recommended in order to conserve manpower. A summary of the test results should be sent to the geographical EFD at least biannually.

(2)When a laboratory test indicates that shore-to-ship steam quality does not meet the quality requirements, all ships receiving the suspect steam and the cognizant type commander(s) must be notified by message with a copy to the Geographical EFD. Immediate corrective action is required by the supplying activity.

(3)When the supplying activity cannot correct the deficiency within a 30 day period, then a waiver request and POA&M to accomplish corrective actions must be sent to NAVSEASYSCOM with a copy to the Geographic EFD within the next 30 day period.

(4)Feedwater for ships which is processed from shore water should be continuously monitored for conductivity and tested for silica before delivery to each ship. When any test result does not meet the requirements, the supplying activity shall test the water in the feed tanks of all ships which received the water and provide the ship with copies of all test results.

(5)MUSE steam generators and boilers loaned or rented to an activity for the purpose of providing Clean Steam service must have feedwater supplied to them of sufficient purity to produce steam that meets the requirements of Naval Ships Technical Manual, NAVSEA S9086-GX-STM-020/CH-220 V2.

PART 4

ENERGY/FUEL SOURCE

2400 GENERAL

a. Facilities shall be connected to base-wide heat distribution systems only when it has been determined to be life cycle cost effective to do so. OPNAVINST 4100.6B provides the criteria for source selection apply to base-wide and to individual facility heating and power boilers of the sizes indicated in the specific paragraphs. In all cases the fuel selection shall be based upon the life cycle cost analysis.

b. All Navy heating and power plants must be designed, operated, maintained and monitored to conform to applicable environmental standards. In addition, installation contingency plans should include a fuel conversion capability detailing the mechanical systems alterations and changes in operation and maintenance required to use alternative fuels.

c. When planning the construction of a major heating or power plant, cooperation is required with other federal, state and local agencies that are considering regional or district utility systems. In addition, coordination with the local utility company is required when planning a major Navy plant which may affect the local utility.

2401 ENERGY SOURCE SELECTION

a. Coal

(1) New Boilers. All new boilers over 100 MBTUH input and plants over 300 MBTUH input shall be designed to be converted to burn coal and/or a solid fuel such as refuse derived fuel (RDF) or biomass. A coal convertible design utilizes boilers increased in size to accommodate future coal combustion but is arranged to burn oil and/or natural gas, and space is provided for future particulate collectors, flue gas sulfur removal equipment and solid fuel and ash handling and storage facilities. Coal convertibility, however, shall not take precedence over the life cycle cost effectiveness. Space for 90 days coal storage capacity shall be provided.

(2) Replacement Boilers or Additional Boilers for existing plants will continue to burn the present fuel. All boilers over 100 MBTUH input, installed to burn fuels other than coal, shall be designed to be coal convertible and space shall be provided for a minimum of 90 days coal storage. Coal convertibility, however, shall not take precedence over the life cycle cost effectiveness.

b. Fuel Oil and Natural Gas

(1) New Oil Fired Boilers Replacements or Additions (5 MBTUH up to 100 MBTUH). All new oil fired boilers of 5 MBTUH and up to 20 MBTUH input must be capable of burning all grades of fuel oil through No. 5. All new boilers 20 MBTUH through 100 MBTUH shall be capable of burning all grades of fuel oil through No. 6. This requirement does not apply where oil is the alternate fuel in a dual fuel plant. Replacements and additional boilers shall be capable of burning the widest range of fuels presently provided in the existing facility. Fuel oil standby capability of 30 days shall be provided.

(2) New Gas Fired Boilers Replacements, or additions (5 MBTUH up to 100 MBTUH). These boilers shall have the capability to burn oil as a dual fuel. Fuel oil standby capability of 30 days shall be provided for boilers with interruptible or spot gas service. Boilers with firm gas service shall consider the fuel vulnerability requirements, as outlined in OPNAVINST 11300.6; however, a minimum of 7 days shall be provided.

c. Liquified Petroleum Gas (LPG)

(1) Due to uncertain availability in times of fuel shortages use of LPG is not encouraged.

(2) Use of LPG (1 MBTUH and above). Any use of LPG in a plant of this size will require approval from NAVFAC.

d. Electric Power

Combined with the poor energy efficiency in generation and distribution of electric power, the use of electricity consumes the greatest BTU equivalent and highest cost of common energy forms. Accordingly, in the planning of energy use, electricity will be given careful scrutiny to minimize and conserve its use. Cogeneration, heat pump applications, and heat recovery techniques are encouraged where economically justified. Lighting systems shall use energy efficient electronic ballasts and lamps designed for use with the ballast. Programmable controllers shall be used to limit lighting use during unoccupied hours.

e. Renewable, Geothermal, Solar, Biomass, and Synthetic Fuel

Renewable energy sources should be used wherever they are life cycle cost effective and where there is confidence in the ability of technology to provide adequate mission support reliability.

f. Refuse Fuel

Cooperation with other federal, state and local agencies considering refuse burning schemes in the vicinity of Naval installations shall be given within the bounds of legal authority, with primary consideration to continued timely, reliable and economical mission support. Mass burning of raw refuse or purchased refuse derived fuel may be utilized wherever life cycle cost effective and practical in comparison with other available solid waste disposal and energy source alternatives. Utilization of third party financing is preferred over Navy construction of refuse burning plants.

g. Waste Oils

Wherever a significant source of waste oil exists, it should be considered as a potential fuel source for activity boilers. Care must be exercised to comply with environmental regulations and restrictions on segregating hazardous wastes and chlorinated solvents from waste oil fuels. The geographical Engineering Field Division of NAVFAC must be consulted prior to utilization of waste oil as an energy source. In addition, activities should contact the nearest Naval Supply Center or Depot to determine the cost effectiveness of utilizing fuel oil reclaimed (FOR) as an energy source. For additional information on burning waste oil refer to NAVFAC MO-911, Utilization of Navy Generated Waste Oil as Burner Fuel.

PART 5

UTILITIES VULNERABILITY

2500 SCOPE

a. Energy is a key ingredient of national security. An adequate, reliable supply of energy is essential to the performance of military missions. OPNAVINST 11300.6A, Policy for the Security of Energy and Utilities at Naval Activities, updates energy security policy for Department of Navy organizations and activities. This update is based on experiences gained during recent disasters, including the Loma Prieta earthquake and Hurricane Hugo of 1989. This memorandum reemphasizes the need for energy security plans at the activity level.

b. It is a basic responsibility of major claimants and commanders to know the vulnerability of their missions and facilities to energy disruptions and the risk of such disruptions, whether the energy source is internal or external to the command. It is essential to take action to eliminate critical energy support vulnerabilities.

c. Major Claimants will: (1) conduct energy vulnerability analyses and review them for currency annually; (2) assist activities in establishing energy emergency preparedness and operation plans; and (3) develop and execute remedial action plans to remove unacceptable energy security risks.

d. Activities will establish and maintain: (1) a technically accurate data base on its portable emergency generators and (2) a method for employing or transferring these assets within their organizations or across Service/Agency lines in an energy emergency.

2501 RESPONSIBILITIES

a. Activities will establish schedules and procedures for their organizations to perform the analyses and develop energy emergency preparedness and operation and remedial action plans using definitions in enclosure (1) of OPNAVINST 11300.6A. Analyses will be performed at the lowest organizational activity feasible, consistent with capabilities. Vulnerability analyses, energy emergency preparedness and operation plans, and remedial action plans will address the factors in enclosure (2) of OPNAVINST 11300.6A. Analyses will include liaison with public utilities and other off-base service providers to ensure critical base missions are recognized in the service restoration plans of those providers.

COGENERATION

2600 SCOPE

a. In general, this section emphasizes technical aspects of cogeneration; however, utilities are now negotiating with independent suppliers for capacity in the 1990s. We should encourage third party cogeneration investment offering Government owned land and a steam market.

b. Cogeneration produces two forms of energy from one primary fuel - electrical or mechanical and useful thermal energy simultaneously. The thermal energy (e.g. recovered waste heat from the generation of electricity) can be tapped for space and water heating and/or air conditioning. Alternatively, it can also be used to produce steam for industrial purposes or to produce additional electricity.

c. Cogeneration, as a concept, has been around for more than 100 years. The efficient use of otherwise wasted thermal energy as a cogenerated by-product can mean substantial energy and cost savings. The Department of Energy has estimated a 10-30 percent reduction in fuel requirements through cogeneration, which is a significant energy savings potential. A return on investment (ROI) of 20 percent or more without depreciation or tax credits can be expected. For cogeneration systems an average simple pay-back (time to recoup an investment outlay) is about two to four years. Given these attractive features, it comes as no surprise that nationwide investments in cogeneration are projected to reach $60 billion by the end of the century. Recent advances in boiler and turbine technology have made possible the shift from primary premium fuels, oil and natural gas, to solid fuels such as biomass and coal to produce electricity. The use of abundant domestic coal alleviates the dependence on insecure foreign oil and gas imports. Further, it helps reduce the current trade and budget deficits.

d. Third party financed cogeneration also promises the deferral or elimination of capital investment for power plant construction in the Navy. See paragraph 8301 for third party contracting.

2601 APPLICATIONS

a. Typically, cogeneration applications are divided into two categories. Those that fall below 500 KW capacity are generally small cogenerations, or packaged cogeneration systems (PCS), and those larger than 500 KW are considered large cogeneration systems (LCS). Based on this separation, the small cogeneration systems find applications in enlisted personnel housing (BEQs), officer personnel housing (BOQs), mess halls, hospitals, commissaries, administration buildings, light manufacturing shops, laundries, etc. Large cogeneration systems, which are a proven technology, are applicable to base-wide installations to provide both electricity and steam.

b. Cogeneration offers several important advantages over conventional approaches: energy efficiency, fuel flexibility, economics, power reliability, and survivability.

2602 BASIC CONCEPTS/DEFINITIONS

Some basic technical concepts and definitions are provided for a better understanding of cogeneration.

a. Topping cogeneration is defined as the process of using a primary fuel, such as natural gas, to produce mechanical or electrical power. Residual thermal energy is recovered and used for heating, air conditioning, or various manufacturing processes. The primary fuel is used to "fire" a boiler, for example, which produces steam to drive a turbine which then provides mechanical energy that is converted to electrical energy by means of a generator. Exhaust heat is used to supply thermal loads. A combined cycle is realized when additional electricity is created by the captured thermal energy.

b. Bottoming cogeneration is when waste heat, such as occurring in a steel reheat furnace, a glass kiln, or a diesel engine power plant, is extracted from the hot exhaust waste steam and transferred to a fluid (generally through a waste heat recovery boiler) which is then vaporized. The vapor is used to drive a turbine which produces electrical or mechanical energy. A Rankine cycle is a bottoming system using a "phase-change" fluid which can be either water or an organic fluid such a toluene, fluorinol, or Freon II. Organic fluids provide greater flexibility because their properties permit operation at temperatures lower than those at which water vaporizes; moreover, they operate with greater efficiency at high temperatures, Such systems using organic fluids are called Organic Rankine Cycle (ORC) systems.

c. Prime Mover is equipment that converts thermal to electrical (or mechanical) power. Three types of prime movers are commonly used: steam turbines, gas turbines, and diesel engines.

d. Wheeling is the transmission of power from one utility to another, or from one site to another, by interconnection with a utility-grid.

e. Avoided Cost or buy-back is what, under the provisions of the Public Utility Regulatory Policies Act (PURPA), the utility must pay for cogenerated power which the utility avoids generating or buying elsewhere. Capacity credit is part of avoided cost structures.

f. Capacity Credit is an additional payment the utility makes to the cogenerator to pay for additional generating capacity added to the utility's systems, thereby avoiding or deferring the utility's investment in additional generating capacity.

2603 TECHNOLOGY SYSTEMS OVERVIEW

a. The technology for large cogeneration systems (LCS) is proven and commercially available. The LCS is normally a site-specific design using off-the-shelf prime movers such as gas turbines, diesel engines, and steam turbines. PCS is a pre-engineered, pre-packaged module with electric capacity of 500 KW or less using a prime mover such as a reciprocating engine or gas turbine. Heat recovery from a small PCS can be used for hot water, heating and cooling, and for industrial processes. These modular units are mounted on skids and can be quickly placed in position and put on line.

b. The choice of a primary fuel depends on relative prices as well as supply, storage, environmental, and local geographical factors. The selection of a prime mover is influenced by the choice of primary fuel in addition to required generating capacity and investment costs for a particular application.

c. The range of primary fuels has also expanded from oil and gas to include solid fuels. Oil and gas are premium fuels and are more subject to external market fluctuations in price and supply. Solid fuels, such as coal and biomass, are more abundant and with recent these fuels have become more acceptable from a environmental standpoint. Besides, solid fuels typically cost 50-70 percent less than natural gas and long-term supply contracts at fixed prices are easier to obtain. However, handling costs are higher.

d. The type of system (topping, bottoming, or combined cycle) and the choice of primary fuel depend on the unique characteristics and requirements of a particular cogeneration facility. There is a large array of suppliers of equipment and services, but what is important is the careful planning required to select a system tailored to the user's needs that will maximize energy savings for 15 to 25 years of operation.

2604 PLANNING/EVALUATION

a. In most cases a cogeneration study first determines the largest heat requirement which can be thermal following. This is the most common approach because the most efficient cogeneration alternative is thermal following. In thermal following systems all the heat produced as a result of cogeneration is consumed for a useful purpose.

b. The most efficient operation of the central heating system has not been established at many of our activities. This should be our goal prior to considering congeneration. Cogeneration should be considered only after the most efficient operation this and the net result is that energy continues to be wasted in support of cogeneration.

c. The following actions should be taken to determine the most efficient operation prior to determining the heat load for a thermal following cogeneration system:

(1) Consider decentralization to eliminate distribution losses.

(2)Activities should secure the steam plant or portions of the distribution system during the non-heating season.

(3)Consider hot water heating plant/distribution system in lieu of steam.

(4)Consider "clean steam" for "cold iron" services only.

(5)Optimize boiler operations.

(6)Minimize the steam trap maintenance program.

(7)Implement a steam trap maintenance program.

(8)Operate the steam distribution system at the minimum pressure, as most steam loads require far less than typical distribution pressures.

(9)Consider replacing all steam absorption chillers with centrifugal chillers.

(10)Do not install steam absorption chillers to increase the non-heating season heat load.

(11)Reduce building steam loads.

d. Other considerations that will have a significant impact on a cogeneration study are:

(1)Electric peak shaving may not be cost effective unless ratchet charges are considered and accounted for.

(2)Incremental utility rates must be used in the analysis.

e. For small cogeneration, there should be a $15/MBTU differential between gas and electric rates, and electric rates should be greater than $.065/KWH. BOQs must have greater than 300 occupants/day and mess halls must serve more than 1300 meals/day to provide minimum thermal load.

(1)Consistent year-round thermal load and at least 4000 hours of operation.

(2)An electrical to thermal cost differential of $10/MBTU or higher (Based on a conversion factor of one MWH = 3.413 MBTUs).

(3)Electrical demand up to 1200 kw.

f. The complexity of a cogeneration system varies generally with the size of the system. Large cogeneration systems might involve economics of scale not available for small cogeneration systems. A feasibility analysis must be performed to carefully appraise the benefits, costs, and risks. As a basic prerequisite, the following items must be considered for cogeneration projects, both large and small.

(1)Energy requirements, both thermal and electricity (thermal to electrical ratio).

(2)Large scale cogeneration is generally cost effective if electric rates are greater than $.05/kWh and the differential between natural gas and electric rates is $15/MBTU. However, even when this differential does not exist, other factors, such as utility company incentives, may make cogeneration worth pursuing.

(3)As a general rule, plants should be sized to follow the thermal load.

(4)Fuel costs and supply options.

(5)Ownership (Navy or third party ownership, operation, and maintenance).

(6)Qualifying for cogeneration status.

(7)Power supply criteria (reliability, mobilization, survivability, and vulnerability).

(8)Cogeneration system performance characteristics.

g. The primary parameters of a cogeneration system are the site's steam (thermal) and electric power usage. These parameters are used in engineering and economic models that compare various systems and determine the revenue streams. Computer based analysis makes life cycle coating analysis more flexible because changes to the system and various equipment options can be easily accommodated.

PART 7

COAL

2700 GENERAL

The Defense Fuel Supply Center (DFSC) is responsible for the procurement of coal (FSC 9110, Fuels, Solid). Coal is not centrally stored and issued, but is bought for direct delivery and ordered by the activity as required.

2701 REQUISITION PROCEDURES

a. DD Form 416, Purchase Request for Coal, Coke, or Briguettes, will be to requisition coal, coke, or briguettes by the requiring activity in requesting coal purchases.

b. DD Form 416 is prepared at the activity level by the individual activity and forwarded to the appropriate Military Service Control Point (MSCP) listed in Paragraph 2702 in accordance with instructions prescribed by NAVFACINST 10340.4E. DD Forms 416 will be submitted to DFSC by the MSCPs by the date set forth in DFSCR 4220.2, Requirements Submission Schedule for Coal. Requisitions must be complete as to specifications, quantities, estimated monthly consumption and mode of delivery desired. A separate requisition is prepared for each kind of coal, such as bituminous, anthracite, or lignite. The purchase program number should be entered in the upper right-hand block of the form.

Coal contracts will no longer include a provision for payment of premiums for higher quality coal. Consequently, please state only the minimum specification requirements. By specifying only the minimum needs, we allow maximum participation in the bidding. If double screen coal is required, be sure to indicate on the purchase maximum percent passing through the smaller screen.

2702 MILITARY SERVICE CONTROL POINTS

a. Director, U. S. Army General Material and Petroleum Activity, New Cumberland Army Depot, New Cumberland, Pennsylvania 17070.

b. Commanding Officer, Naval Facilities Engineering Center (NAVFEC), Port Hueneme, CA 93043.

c. Commander, San Antonio Air Logistics Center (SFR), Kelly AFB, Texas 78241.

d. Commanding General, Marine Corps Logistics Support Base, Albany, Georgia 31704.

2703 REQUIREMENTS

a. Routine requirements submitted in accordance with the requisition schedule are normally covered by requirements contracts resulting from formal advertising or negotiation. Accounting and appropriation data will be shown on the Purchase Orders issued under the contract. DFSC prepares a DD Form 350, Individual Procurement Action Report, at the time the contract is issued. Therefore, the activity preparing the Purchase Orders will not prepare a DD Form 350.

b. Emergency procurements must be approved by the MSCPs as shown in Paragraph 2702 and will be bought as quickly as possible. The requiring Military Service will furnish DFSC with details giving rise to the emergency requirement, the quantity of coal on hand and estimated consumption for the next 30 days.

c. Local purchase by individual activities is authorized, subject to Military Service regulations, where the annual requirements per line item does not exceed $10,000.

2704 COAL CONTRACTS

Coal contracts are administered by DFSC. Source inspection functions are assigned to Defense Contracts Administration Services (DCAS).

2705 INSPECTION AND ACCEPTANCE

a. Specification requirements are established by the Military Services in collaboration with DFSC for each item purchase. Quality requirements are developed by DFSC Directorate of Technical Operations (DFSC-T) and contractually invoked.

b. Inspection normally is performed in two steps as follows:

(1)Source inspection of coal is performed by the DCAS Quality Assurance Representative (QAR). The contractor is contractually required to provide and maintain an acceptable inspection system. The contractor is contractually required to sample and test east shipment of coal and submit to the receiving activity a test analysis report. The contractor's inspection system, including operations directly related thereto, is subject to review and surveillance by the DCAS QAR. When the contractor has established a history of reliability, he is allowed (at the option of the Contracting Officer) to ship on a Certificate of Conformance (COC) with an attached analytical test report identified to that shipment.

(2)A visual inspection of each delivery is made by the receiving activity to determine that coal is reasonably free of slate, dirt, water, fines, undersize and oversize coal. the analytical test report accompanying the shipment is reviewed to verify that the test analysis results substantiate specification conformance. Samples are taken in accordance with the "Quality Assurance Procedures for Receipt of Coal" (Available from DFSC). The samples are forwarded to the Department of Army East or West Laboratory for analysis and preparation of an Analysis Report. This Analysis Report is final and binding and is used for the purpose of price adjustment in accordance with the provisions of the contract.

The Laboratories will forward the Analysis Report to the Coal consuming activity, one copy to NAVFEC and two copies to DFSC. The activity will retain the original and forward a copy to plant operation management, a copy to the respective EFD for technical review and forward a copy to the appropriate finance office with the necessary price adjustments.

2706 ACCEPTANCE/REJECTION

a. Acceptance or rejection of deliveries is based on visual inspection (in accordance with contract provisions covering such inspection) upon receipt at the using activity and prior to unloading. When visual inspection discloses that a shipment does not meet the quality or other conditions required by the contract, the DFSC Contracting Officer should be notified immediately by message or telephone prior to any action to accept and unload the coal. If the product is unacceptable, a request for rejection, together with sufficient data to support such action, will be submitted promptly to the Contracting Officer.

b. Product may be rejected (source or destination) if it is not in conformance with contractual requirements.

2707 CONTRACT WAIVERS

a. Product and services supplied on DFSC contracts will conform to all of the requirements of the contract. The Defense Acquisition Regulations (DAR) provides that where for reasons of urgency or economy, and when acceptable to the activity responsible for technical requirements, exceptions may be granted subject to equitable adjustment of the contract price or other consideration. Contract specification waivers can only be authorized by the cognizant contracting officer. It is in the best interest of the Government for the contractor to submit requests for waivers directly to the contracting officer. When a waiver is requested it will be handled in the following manner. First, the contracting officer will contract the DFSC-T for their recommendation as to acceptance or rejection of the contractor's waiver request. DFSC-T will assure the approval of the applicable Military Department in order to render their recommendation.

b. Based upon the DFSC-T recommendation, the contracting officer will either grant or deny the waiver request. It should be noted that in emergencies, DFSC-T may recommend minor deviations without approval by the quality office of the Military Department, if they cannot be contacted during non-duty hours. Should this occur, DFSC-T will advise the Military Department quality office of the full facts during the next working day.

2708 TRANSPORTATION

Contracts providing for rail movement are normally awarded on the basis of delivery FOB carrier at the mine. DFSC obtains rail routings from the Military Traffic Management Command (MTMC) and furnishes the rail routings to contractors. Contractors ship on a Commercial Bill of Lading (CBL), to be converted to a Government Bill of Lading (GBL) in accordance with rail route orders provided by DFSC. Contracts providing for truck movement are normally awarded on the basis of delivery FOB destination.

2709 STANDARDIZATION

Coal is an organic heterogeneous material, the basic characteristics of which are not changed during the mining and preparation for market. There are many types and kinds of bituminous coal produced in the United States, most of which are included in the DOD purchases. Chemical and physical characteristics vary with type and kind; therefore, the bituminous coal industry has no standardization either as to quality or size. Specifications for each line item requisition are based on the design of the handling and burning equipment at a given activity.

This design, in turn is based on the kind and type of coal available at the most economical delivered cost to a given location. Anthracite coal, on the other hand, is produced from a relatively small area in northeastern Pennsylvania. The industry, together with the Pennsylvania Department of Commerce, has standardized the marketing of anthracite, both as to size, nomenclature and the allowable minimum quality and size.

CHAPTER 3

UTILITIES SYSTEM OPERATION AND MAINTENANCE

PART 1
HEATING AND POWER PLANTS

3100 PURPOSE

Part 1 provides information and guidance on the operation, maintenance and inspection of heating and power plants.

3101 DISCUSSION

a. Definitions

(1) Boiler. An electrical/mechanical device containing a heat transfer fluid under pressure designed to convert chemical (or electrical) energy to thermal energy. The thermal energy may then be used for a variety of purposes such as space heating or the production of a electricity. Steam generators and hot water generators are considered boilers, while steam and hot water converters are not. The discernable feature of a boiler is that the heat source is applied directly to that water or other heat transfer fluid.

(2) Power Plant. A plant producing electricity.

(3) Heating Plant. Any plant producing steam, hot water, or other medium for the purpose of space or process heating.

(4) Cogeneration Plant. A plant producing a heated medium for the purpose of space or process heating and electricity.

(5) Central (Heating or Power) Plant. A plant that exports a heated medium and/or electricity to more than one user.

b. Applicability. Part 1 applies to all boiler plants containing one or more boilers with input capacities greater than 0.40 million British Thermal Units per hour (MBTUH). Residential units with capacities less than 0.40 MBTUH are excluded.

3110 OPERATIONS AND MAINTENANCE MANUALS

3111 DISCUSSION

a. Background. Rapid degradation of a boiler's material condition and performance will occur if careful attention is not given to its operation and maintenance. If the degradation continues failure of the equipment will inevitably occur.

b. Standards. Written maintenance and operational records in the form of a log are necessary for each boiler. Each attendance to the boiler for observation and maintenance shall be recorded in a log along with observations made and maintenance performed. In addition, all central heating plants shall have written operating and maintenance procedures compiled into an O&M manual. For plants with capacities up to 50 million British Thermal Units per hour (MBTUH) the O&M manual should consist of plant drawings and manufacturer's maintenance and operations catalogs containing trouble shooting guides, maintenance procedures and equipment operating procedures including start-up, shutdown, emergency and lay-up procedures. Central heating plants with capacities of 50 MBTUH and larger and electrical generating plants 750 KW and larger shall have systems oriented O&M manuals. As a minimum, manuals for existing plants should include items (1) through (8) below. The costs and benefits of the remaining items should be evaluated for each plant based on the remaining economic life, condition, complexity and availability of information. Existing O&M manuals should be reviewed and updated every five years, or earlier in the event of a major system change.

(1)Plant systems and equipment operating procedures including start-up, shutdown, emergency and lay-up procedures.

(2)Plant systems and equipment maintenance procedures.

(3)Performance test records for major equipment.

(4)Sample operator logs.

(5)Preventive maintenance schedules and log format for all equipment and systems.

(6)Minimum spare parts inventory.

(7)Trouble shooting procedures for major equipment and systems.

(8)Clearly defined duties, responsibilities, and qualifications for all O&M positions.

(9)File of manufacturer's equipment data and drawings.

(10)File of manufacturer's equipment O&M procedures.

(11)File of plant design and construction drawings.

(12)Performance test procedures for major equipment and systems.

(13)A Plant Equipment Manual including equipment ID or account numbers, manufacturer's name, model number, capacity, and performance data.

(14)Outline of training program for all positions.

3112 RESPONSIBILITIES

a. Naval Facilities Engineering Command. EFDs shall assist activities in reviewing, updating and establishing O&M manuals.

b. Activities. Maintain O&M manuals for systems and major equipment. Review adequacy and update the manuals at least once every 5 years.

3120 BOILER WATER TREATMENT

3121 DISCUSSION

a. Background. One of the major causes of boiler failures is the lack of or ineffective boiler water treatment. In addition, the formation of scale on boiler heat transfer surfaces increases fuel costs to the Navy. In order to combat failures and promote efficiency all activities should have boiler water treatment programs in effect.

b. Safety. Many of the chemicals used in water treatment are hazardous to the health of personnel when handled improperly. These chemicals include caustic, acids, and others. NAVOSH and industry safety regulations, including the use of gloves, goggles, and respirators where appropriate, should be strictly adhered to whenever handling boiler water treatment chemicals.

c. Standards. The extent of the boiler water treatment program will depend on the type of boiler and its application, with low pressure hot water boilers needing the least attention and higher pressure boilers used for the generation of steam to ships or for electrical generation requiring the most attention. Periodic testing of feedwater, boiler water, condensate return, necessary for assessing the effectiveness of the program. Hot water boilers with capacities greater than .40 MBTU shall have monthly raw water, boiler water and condensate samples tested by a laboratory independent of the boiler plant for comparison to an activity analysis prepared at the same time at the plant. Significant discrepancies between the two analyses may indicate problems with either the equipment, treatment chemicals, test reagents, or procedures. The activity shall take steps immediately to determine the cause of the problem and correct the situation. If an equipment problem is indicated, prompt attention should be given to the equipment involved. Since a boiler will necessarily deteriorate without adequate water treatment, repair to the boiler. NAVFAC MO-225, Industrial Water Treatment, contains further guidance and information.

GUIDELINES

a. Frequency of Sampling. The following sampling frequency is recommended:

Boiler Type	Capacity	Function	Frequency
Hot Water	Less than .40 MBTUH	Heating	at installation

Hot Water	.40 to 1 MBTUH	Heating	once/year
Hot Water	1 MBTUH to 5 MBTUH	Heating	once/6 months
Hot Water	5 MBTUH to 20 MBTUH	Heating	once/month
Hot Water	20 MBTUH and greater	Heating	Once/week
Steam	Less than 5 MBTUH	Heating	once/week
Steam	5 MBTUH and greater	Heating	once/day
Steam	5 MBTUH and greater	Electrical Generation	once/8 hrs
Steam	All	Steam to ships	see Ch. 2

b. Control Limits

(1) For boilers not producing shore-to-ship steam or feedwater, the limits on boiler water quality will vary according to the type of boiler and the nature of its service. the recommended water and steam quality limits for steam boilers and those of the American Society of Mechanical Engineers (ASME) "Consensus on Operating Practices For the Control of Feedwater and Boiler Water Quality in Modern Industrial Boilers".

(2) The extent of treatment for hot water boilers depends on the temperature and pressure of the water and the service.

Hot water boilers heating domestic water do not require water treatment unless an unusually hard water is used in which case a water softener is necessary. The recommended treatment for hot water boilers used for space heating with water temperatures below 250 F at pressures of 160 psig or less is to fill the boiler and system with softened water at the time of installation. No further treatment is usually required as long as the system does not leak excessively. The recommended feedwater limits for hot water boilers used for space heating and industrial processes with water temperatures of 250° or more at pressures greater than 160 psig are:

Constituent or Property	Upper Limits
hardness	10 ppm (as CaCO3)
oxygen	.01 ppm
carbon dioxide	.01 ppm
bicarbonate alkalinity	0 ppm
silica	1 ppm

In addition, the pH of the boiler and system should be kept within the 8.5 to 9.5 range.

3123 PROHIBITIONS AND RECOMMENDATIONS

The use of filming amines is prohibited. Filming amines are difficult to control and have been found to obstruct distribution as a sludge conditioner is recommended. Tannin interferes with the testing of other boiler water chemicals and has largely been replaced by polymers as a sludge conditioner.

The dosage of some boiler water additives such as volatile amines is restricted by the U. S. Code of Federal Regulations Title 21, Section 173.310 for steam used for food processing or humidification. NAVFAC policy is to prohibit for all new construction and building renovations the use of steam which contains amines for food processing, space humidification, and medical instrument sterilization. To ensure that boiler water additives do not come in contact with food or are contained in steam used to contain the additive laden steam within the primary distribution system.

3124 RECORDS

A record log of sampling results, adjustment to chemical levels, and adjustment to equipment is considered essential for management of an effective treatment program. NAVFAC Form 11330/2 (11-75), Boiler Water Test and Treatment Record, and NAVFAC Form 2566 (4-59), External Boiler Feedwater Treatment Record are recommended. Activities should retain water treatment logs and reports for at least one year.

3125 RESPONSIBILITIES

a. Naval Facilities Engineering Command. EFDs shall assist activities by providing consultation services and by monitoring activity water treatment programs for effectiveness.

b. Activities.

(1)The activity is responsible for establishing and maintaining an effective water treatment program. Copies of monthly water treatment logs and records shall be made available to the EFDs upon request. The activity shall direct independent laboratories and water treatment vendors to forward copies of monthly check sample analyses to its EFD for review.

(2)The activity is authorized to have monthly check samples analyses for boilers performed by the Army Engineer and Housing Support Center Industrial Water Treatment Laboratory, (CEHSC-FU-W), Fort Belvoir, VA 22060-5580. Contact the geographic EFD to begin this service and for details.

3130 PROPRIETARY DEVICES AND CHEMICALS

3131 DISCUSSION

Shore activities are requested by various representatives of industry to procure and test new devices and chemicals to treat the waterside, clean the firesides, or improve the combustion efficiency of boilers. These devices and chemicals claim to treat boiler water in such a way as to eliminate the formation of burner devices and fuel oil additives claim to prohibit fireside deposits and enhance burning of the fuel. Some of these devices chemicals shall be evaluated and approved by Naval Facilities Engineering Command (NAVFACENGCOM) prior to procurement and installation.

3132 GENERAL

On line installation and testing of any product that could cause operational or maintenance problems is prohibited. Proprietary devices and chemicals often have generic counterparts which are less expensive and as effective. The purchase of generic chemicals and chemicals from Government Services Administration or Navy stock schedule is encouraged.

3133 ACTIONS

1. NAVFACENGCOM shall evaluate and approve new devices and chemicals prior to their use.

2. The geographic Engineering Field Division (EFD) shall provide technical comments as to the validity of new devices or chemical prior to submittal to NAVFACENGCOM for approval.

3. Activities shall request evaluation and approval of new devices chemicals from NAVFACENGCOM via the geographic EFD. Activities shall obtain the following information from the manufacturer or sponsor:

a. A statement defining the intended purpose and functions of the device or product.

b. A complete description of the device or chemical, including information on its application, method of operation, and the environmental conditions under which it is designed to function.

c. Detailed result of an exhaustive research and testing program by an independent agency in good standing and high repute in the engineering profession.

3140 EFFICIENCY

3141 DISCUSSION

a. Background. Boiler plants account for about one third of the Navy's shore energy costs. Therefore, it is imperative to ensure that boiler plants are operated efficiently. Many of the larger boilers in the inventory are 20 years old or older. Close monitoring of these boilers is necessary to ensure efficient and reliable service.

b. Objective. The objective of Navy boiler plant operations is to ensure that the plants are operated at the highest level of reliability, efficiency and safety possible. To accomplish that objective, all heating and power plants shall be operated at optimum efficiency at all loads.

c. Standards. The ASME PTC 4.1, Power Test Code for Steam Generating Units, provides a means for measuring the performance of boilers. The test requires an accurate fuel analysis. Combustion efficiency is often used to assess boiler performance because fuel analysis is not rapid enough to influence real time operations. The information required for determining the combustion efficiency should be recorded in the boiler log. This information includes O_2, CO_2, CO, stack temperature, and ambient air temperature measurements. Combustion efficiencies defined for different fuels are:

Fuel	Combustion Efficiency
Natural Gas	$-0.165(CO_2)-0.8303\ (T_s-T_a+8) + 90.8$
L.P. Gas	$-0.191(CO_2)-0.8767\ (T_s-T_a+18) + 92.8$
Oil	$-0.250(CO_2)-0.9009\ (T_s-T_a+7.5) +94.3$
Bituminous Coal	$-.272(CO_2)-0.8587\ (T_s-T_a+14) +96.6$
Anthracite Coal	$-0.350(CO_2)-0.9920\ (T_s-T_a+75) +98.4$

Ambient air temperature (Ta) should be taken before the first heat transfer device. Flue gas temperature (Ts), O_2, CO_2, and CO readings should be taken after the last heat recovery device. Since a single CO_2 value may have more than one O_2 value and air infiltration can be a problem, O_2 versus CO_2 needs to be plotted on an Oswald chart. Temperatures are in degrees Fahrenheit. CO_2 and O_2 readings are in % by volume. The CO reading should not exceed 200 ppm.

Boilers must be tested periodically to maintain optimum efficiency. Operating boilers that are continually manned require combustion efficiency checks and may require adjustments to combustion efficiency checks and require adjustments to combustion equipment at least once a shift. All other operating boilers with input capacities of 0.40 MBTUH or greater require combustion efficiency measurements at least monthly.

In addition to the combustion efficiency tests outlined above, large boilers require periodic testing according to the heat loss method of ASME PTC 4.1. Boilers with input capacities greater than 150 MBTUH require ASME PTC 4.1 heat loss method tests annually. Boilers with input capacities from 75 to 150 MBTUH require ASME PTC 4.1 tests at least once every two years. When computing efficiencies, the ASME PTC 4.1 values for unaccountable losses should be 0.50%, 0.75%, and 1.00% for gas, oil and coal, respectively. If efficiencies are to be maintained annual assessments of operations, maintenance, and equipment adequacy must be made and any deficiencies corrected.

3142 CRITERIA

a. Acceptable limits for combustion testing of continuously manned boiler plants are as follows:

(1) Natural Gas

	Load			
	25%	50%	75%	100%
Min. Combustion Efficiency %	81	82	82	83

(2) Light oils such as Grade 2, Diesel Fuel, JP-5, and Naval Distillate:

	Load			
	25%	50%	75%	100%
Min. Combustion Efficiency %	84	85	85	86

(3) Medium Oils such as Grade 4 and NSFO:

	Load			
	25%	50%	75%	100%
Min. Combustion Efficiency %	84	85	85	86

(4)Heavy oils such as Grade 5 or 6. Multiple burner boilers without positive air register seals may not meet the efficiency standard below 50% load.

	Load			
	25%	50%	75%	100%
Min. Combustion Efficiency %	83	84	85	86

(5)Coal (bituminous). The design characteristics of some coal fired boilers may not allow for operation at loads less than 50%.

	Load			
	25%	50%	75%	100%
Min. Combustion Efficiency %	83	84	85	86

When combustion efficiencies are less than those presented above, an effort should be made to identify and correct the cause of the deficiency. Particular attention should be directed to air heaters, economizers, viscosity controls, air trim systems, and combustion controls. Correction of deficiencies which entail large capital expenditures should be based on an economic life cycle cost analysis.

(6)Other fuels. Operate boilers or incinerators burning wood, refuse derived fuel, peat and other fuels at efficiencies not less than one percent below the predicted performance curve. If predicted performance curves are not available, develop performance curves using the ASME PTC 4.1, heat loss method.

b. The acceptable limits for boilers not continuously manned measured at steady state conditions and at high fire are:

	Fuel	
Flue Gas Constituent	Gas	Oil

CO_2	(%) min.	9.0	11.0
O_2	(%) max.	5.0	5.0
CO	ppm max.	0.0	0.0
Bacharach # max.		0.0	1.0

Stack temperatures on the boilers shall be no more than 550°F upstream of any heat recovery devices.

3143 RESPONSIBILITIES

a. Naval Facilities Engineering Command

(1)EFDs shall assist activities by:

(a)Providing training opportunities on a reimbursable basis.
(b)Reviewing operations and maintenance practices.
(c)Field testing boilers where appropriate.
(d)Conducting or administering studies for the purpose of improving operations and maintenance efficiency.
(e)Providing information on boiler monitoring and other PC technology to better manage boiler plants.

(2)The Naval Facilities Engineering Center (NAVFEC) shall assist NAVFACENGCOM and the EFDs. NAVFEC shall provide on a reimbursable basis:

(a)Thermal plant design criteria and review.
(b)Testing, trouble shooting and investigative engineering services.
(c)Efficiency improvement training.
(d)Provide boiler and UPV inspection services.

b. Activities. The owning activity is responsible for:

(1)Establishing optimum efficiency curves for all boilers.
(2)Ensuring that the boiler plant is operated efficiently and that the prescribed efficiency tests are performed.

(3)Accomplishing tune ups and repair/replacement of equipment to ensure that the Navy's heating and power plants are efficiently operated and maintained.

3150 MINIMUM ATTENDANCE

3151 DISCUSSION

a. Definitions

(1)Fully automatic boiler. A fully automatic boiler is a boiler with controls that automatically regulate and maintain proper water level within the boiler, regulate the rate of combustion in the boiler in response to heat output requirements and cut off the fuel supply when a predetermined condition is reached, cut off the fuel supply in the event of low water in the boiler or loss of ignition or other predetermined emergency conditions, and turn on the fuel supply and start combustion when additional heat input to the boiler is required. Fully automatic boilers shall lock out on safety in case of failure to light off, lock out on safety in case of loss of ignition, provide pilot proving before opening main fuel valve on boilers with gas or oil pilots, prevent attempt to light off if the gas pressure is below a predetermined minimum on boilers with a gas pilot and provide pre-ignition and post-ignition purging on shut down on boilers with heat input in excess of 750,000 BTUH.

(2)Semiautomatic boiler. A semiautomatic boiler is a boiler equipped so that the water level in the boilers is regulated automatically, the fire is regulated automatically by the pressure and demand for steam, and the fuel supply is automatically shut off in the event of low water in the boiler or loss of ignition or other predetermined emergency conditions. Start up is not automatic. Semiautomatic boilers shall have pilot ignition with pilot proving devices. Each burner of a multi-burner semiautomatic boiler shall be manually activated to restart following any shut-down.

(3)Heating Boiler. A boiler operated at pressures not exceeding 15 psig for steam, or at pressures not exceeding 160 psig and temperatures not exceeding 250°F for water.

(4)Power Boiler. A boiler operated at a pressure of more than 15 psig (but not more than 300 psig) for steam, or pressure of more than 160 psig and a temperature of more than 250°F for hot water.

(5)High Pressure Power Boiler. A power boiler operated at pressures exceeding 300 psig for steam or hot water or at temperatures exceeding 400°F for hot water.

b. Standards. To reduce the possibility of property losses, personnel injuries and unnecessary fuel and maintenance costs, boiler plants must be operated in a safe and efficient manner. To ensure safe and efficient boiler operation all heating and power boilers shall receive operational attendance by qualified operators on a constant or periodic basis. The frequency and degree of attendance can vary depending on plant capacity, operating pressure, extent of automatic controls employed, and the application of central monitoring systems.

Central alarm and monitoring systems (remote surveillance) should be used whenever feasible to reduce the frequency of visits to boiler plants using fully automatic controls. The alarm devices must include flame failure, low water or insufficient water flow, excessive pressure or temperature and insufficient pressure or temperature, and may also include low wind box-furnace differential pressure, low fuel pressure, low fuel temperature, and other pertinent items which directly effect the combustion process or safety of operation. Transmittal of one signal to the central, continually manned operating point to indicate whether or not unsafe conditions exist at a boiler may be sufficient to permit operation of that boiler. Alarms should be processed at the boiler location at frequencies not less than required for ignition and flame proving and transferred to the central monitoring location as the alarm occurs.

The use of computer monitoring/control of boilers, which are not continuously manned, can increase the time interval between attendance frequencies if the monitoring is continuous and quantitative in addition to providing alarms for upset conditions. The frequency of acquiring data from the unit being monitored should be no less than required for attendance without central monitoring. When computer monitoring is used to justify decreased attendance frequencies, the central monitoring station shall be continuously manned. Remote energizing of boiler controls is prohibited without an operator or mechanic in attendance at the boiler. Any control should be such that no flame safeguard or burner management component is remotely controlled.

3152 CRITERIA

a. Heating and Power Boilers. The required minimum attendance(1) for oil and gas fired boiler plants using fully automatic controls is:

Output of Heating Boiler Plant(2)	Without Central Monitoring	With Central Monitoring
Up to 400,000 BTUH	Once/month	At time of service
400,000 to 1,700,000 BTUH	Once/week	Once/month
1,700,000 to 5,000,000 BTUH	Once/day	Once/day
5,000,000 to 14,000,000 BTUH	Once/8 hrs	Once/12 hrs
Over 14,000,000 BTUH	Once/hour	Once/4 hrs
Output of Power Boiler Plant		
Up to 1,400,000 BTUH	Once/day	Once/week
1,400,000 to 3,500,000 BTUH	Once/8 hrs	Once/12 hrs
3,500,000 to 14,000,000 BTUH	Once/4 hrs	Once/8 hrs
Over 14,000,000 BTUH	Once/hour	Once/4 hrs
High Pressure Power Boilers Plant	Continuous	Continuous

The following explanations apply to the above table:

NOTES: (1)Where two or more boilers are operating in a single plant, the minimum attendance shall be based on the capacity of the largest operating boiler or one half of the sum of the combined capacities of all operating boilers, whichever is greater.

(2)The minimum attendance specified in the 0 to 1,700,000 BTUH range from this group applies only to hot water boilers and to steam boilers connected to a closed circuit gravity return system requiring no boiler feed pumps. For small boilers supplying open circuit distribution systems and thus requiring boiler feed pumps, minimum attendance requirements shall in no case be less than twice per week.

b. Minimum attendance. The minimum attendance required for all high pressure power boilers and non-fully automatic boilers is:

Gas-Fired Boilers

No. of Operating Boilers in Plant	1	2	3	4	5	6
Output Capacity(1) of Plant	**Boiler Room Personnel/Shift(2)**					
up to 14,000,000 BTUH & under	1	1	1	1	1	1
" 25,000,000 BTUH	1	1	1	1	1	1
" 40,000,000 BTUH	1	1	1	1	1	1
" 60,000,000 BTUH	1	1	1	1	1	1
" 80,000,000 BTUH	1	1	1	2	2	2
" 100,000,000 BTUH	1	1	1	2	2	2
" 125,000,000 BTUH	1	1	1	2	2	2
" 150,000,000 BTUH	1	1	1	2	2	2
" 200,000,000 BTUH & over	1	1	1	2	2	2

Oil-Fired Boilers

up to 14,000,000 BTUH & under	1	1	1	1	1	2
" 25,000,000 BTUH	1	1	1	1	2	2
" 40,000,000 BTUH	1	1	1	2	2	2
" 60,000,000 BTUH	1	1	1	2	2	2
" 80,000,000 BTUH	1	1	1	2	2	2
" 100,000,000 BTUH	1	1	2	2	3	3
" 125,000,000 BTUH	1	2	2	3	3	3
" 150,000,000 BTUH	2	2	2	3	3	3
" 200,000,000 BTUH & over	2	2	2	3	3	3

The following explanations apply to the above table:

NOTES:

(1)The Output Capacity is the average peak demand, not the peak capacity. This average should be taken over the last five year period of the plant's operation. The minimum staffing listed pertains only to boiler operator attendance. It does not include additional staffing which may be required for maintenance and repair of the boiler and auxiliary equipment or tasks such as boiler water treatment.

(2)For high pressure power boiler plants with central monitoring, attendance may be reduced by one but will never be less than one.

c. Coal Fired Plants. Due to the unique operation and maintenance requirements of individual coal-fired plants and their relative small number, minimum staffing will be determined on a site specific basis with the assistance of the geographic EFD.

3153 RESPONSIBILITIES

a. Naval Facilities Engineering Command. NAVFACENGCOM shall monitor compliance with the minimum attendance and staffing requirements via the EFDs. The EFDs shall assist the activities in attaining compliance with the requirements.

b. Activities. To ensure safe and efficient boiler plant operation, activities are advised of the following:

(1)An operator should be in continuous attendance when boilers without fully automatic controls are in operation.

(2)The attendance for oil and gas fired boilers using fully automatic controls should be less than the criteria of paragraph 3152a unless continuously manned computer monitoring is employed.

(3)The staffing for continuously manned boiler plants with either automatic or semiautomatic controls should not be less than what is contained in paragraph 3152b.

(4)A set of standard operating procedures including safety practices should be established for and posted at each boiler plant. Automatic controls and safety devices should be checked only by competent personnel when periodic visits are made. This should include operation of flame failure devices and observing normal programming controls for proper sequence, timing, scavenging, etc. Attendance visits should be of sufficient duration to observe a complete operational cycle and perform preventive maintenance on the equipment. An operational log should be kept on the boiler containing the name of the attendant, date, time, observations made, checks of programming, flame failure and low water cut off devices, meter reading, operational changes and maintenance performed during each visit.

(5)Requests for waivers for boilers that have controls not meeting the definition of a fully automatic or a semiautomatic boiler shall be made to the geographic EFD. Requests should state the condition of the boiler, corrective action planned and the time-frame necessary to comply with the criteria. No steaming boiler shall be operated unattended without low water and loss of ignition cut off devices.

(6)Although the minimum attendance required should ensure satisfactory operation, it may be necessary to check some boilers more frequently. The necessity for more frequent attendance will depend on the reliability of the equipment, operational conditions and quality of maintenance as determined by the operational log and the boiler inspection records.

(7)No boiler with a capacity greater than 400,000 BTUH shall operate without a Valid Inspection Certificate, NAVFAC Form 11014/32. If unsafe conditions are found the activity shall notify the geographic EFD of the nature of the unsafe condition and corrective action planned.

3160 SAFETY INSPECTION OF BOILERS AND UNFIRED PRESSURE VESSELS

3161 DISCUSSION

a. Standards. Boilers and pressure vessels require periodic inspection because of the severity of the service which they are subjected. In extreme cases, the lack of periodic or proper inspection can result in catastrophic mission impairment. To prevent the failure of boilers and pressure vessels, the NAVFAC Boiler and Pressure Vessel Safety Inspection Program requires periodic inspection of boilers and pressure vessels by qualified inspectors. Qualified inspectors can diagnose conditions during the periodic inspection which, if not detected and corrected, would contribute to the failure of the vessel. NAVFAC MO-324, Inspection and Certification of Boilers and Unfired Pressure Vessels, contains the guidelines for the inspection program. MO-324 includes the criteria for frequency of inspection and qualifications for inspectors as well as an outline conduct inspections according to MO-324 and the referenced National Codes. Where a conflict occurs between MO-324 and the referenced codes, MO-324 governs.

3162 RESPONSIBILITIES

a. NAVFACENGCOM. The NAVFAC Boiler and Pressure Vessel Inspection Certification Board (NBICB) shall:

(1)Certify the competency of qualified Navy shore inspectors

(2)Establish uniform inspection program guidelines and criteria

(3)Resolve inspection issues arising from disagreements between inspectors and activities or EFDs

b. Engineering Field Divisions. The EFDs are responsible for providing quality assurance for the inspection program and assistance to Navy shore facilities. The Navy realizes quality assurance through EFD monitoring of inspections and inspectors. Inspectors must have a Certificate of Competency from NAVFAC or a state/municipality which is a member of the National Board of Boiler and Pressure Vessel Inspectors (NBBI).

In addition, inspectors must have a NBBI commission or a written license/authorization to inspect from the geographic EFD before they are authorized to sign the inspection report, NAVFAC Form 9-11014/41 or NAVFAC inspection certificate, NAVFAC Form 9-11014/32. EFD licensing is contingent upon inspectors maintaining their qualifications according to the provisions of MO-324. The EFDs monitor inspections by keeping records of inspections. The EFDs shall:

(1)Establish and maintain an inspection organization in compliance with mo-324, including a Licensing Board for the purpose of:

(a)Monitoring inspectors by endorsing the credentials of inspector candidates, licensing, and reissuing licenses to NAVFAC certified inspectors every two years.

(b)Verifying and endorsing the credentials, experience, and qualifications of Navy employed inspector candidates prior to forwarding this information to the NBICB.

(c)Monitoring inspections to ensure compliance with MO-324. The EFD's Senior Inspector should perform the actual monitoring.

(d)Acting on and maintaining a record of all boiler and pressure vessel inspection matters brought to the Licensing Board's attention by the Senior Boiler Inspector or the EFD's inspection program manager.

(e)Maintaining an active liaison with the NBICB and notifying the NBICB of non-renewal or revocation of licenses to inspect boiler and pressure vessel failures and their causes and other inspection difficulties of a technical or administrative nature as they occur.

(f)Notifying major claimants of situations where a boiler or pressure vessel fails to meet inspection certification requirements or where they are delinquent by three or more months in their inspection schedule. The Public Works Officer and Commanding Officer of the owning activity should be made aware of the deficiency prior to notifying the major claimant. Major claimants need not be notified if the activity is in the process of repairing the boiler or pressure vessel or has removed it from service.

(2)Assist in providing training to EFD and activity employed inspectors.

(3)Review all inspection contracts.

(4)Provide inspection services on a reimbursable basis either by Navy employed inspectors or by contract.

(5)Provide consultation services concerning the installation and repair of boilers and pressure vessels.

(6)Ensure that boilers and pressure vessels procured by EFD administered contracts are designed, constructed and installed according to the ASME Boiler and Pressure Vessel Code and other applicable Codes as referenced in MO-324.

(7)Inspecting all newly constructed or installed boilers and pressure vessels before final acceptance to ensure that the vessel is certifiable. A NAVFAC certified inspector, preferably the EFD's Senior Inspector, should perform the final inspection.

c. Activities. Navy shore activities are responsible for ensuring that their boilers and pressure vessels are inspected according to the frequency and provision of MO-324. The NAVFAC inspection certificate, NAVFAC Form 9-11014/32, becomes void whenever a boiler or pressure vessel fails any part of an inspection whether internal, external, or operational; or when alterations or repairs are made which impact upon the safety of the boiler or pressure vessel; or upon the discovery of a safety deficiency, regardless of the expiration date on the certificate. The certificate will again be valid after the deficiency has been corrected and the boiler or pressure vessel is inspected by an authorized boiler inspector. No boilers or pressure vessels shall be operated without a valid NAVFAC inspection certificate. Activities are requested to:

(1)Ensure that boilers and pressure vessels procured meet the design, construction, and installation requirements of the ASME Boiler and Pressure Vessel Code and other applicable Codes referenced in MO-324.

(2)Ensure that boilers and pressure vessels are inspected at the frequencies and by the procedures specified in MO-324. Activities shall forward activity administered inspection contracts to the EFD for review prior to enactment of the contract.

(3)Provide the EFD with up-to-date boiler and pressure vessel inventories before the end of each calendar year.

(4)Provide the EFD with a copy of inspection reports within 30 calendar days of an inspection whenever the inspection is performed by an activity administered contract or an activity inspector.

(5)Request assistance from the EFD whenever changes and repairs are contemplated or equipment malfunctions occur which impact upon the safety of their boilers and pressure vessels.

(6)Provide NAVFAC-certified activity inspectors with the tools, including applicable code books, required to conduct a proper inspection.

(7)Provide training for activity inspector candidates and forward their credentials and qualifications to the EFD Licensing Board. Activities are encouraged to maintain a NAVFAC certified inspector on their staff.

(8)Ensure that activity inspectors receive supplementary training regarding the activity's flame safeguard and control systems. Maintenance of inspector qualifications and proper performance of inspection is essential for continued renewal of the EFD license to inspect.

(9)Notify the EFD promptly of any boiler or pressure vessel failures or catastrophes. Prompt notification is necessary to identify the causes of failure and prevent failures from similar causes in the future.

3170 TRAINING

3171 DISCUSSION

a. Background. The Navy requires skilled manpower to operate and maintain utilities. Millions of dollars can be saved through the diligent operation of a single piece of equipment such as a large boiler. Conversely, improper operation can lead to the rapid deterioration of equipment and mission impairment. Modern utility systems employ complicated control systems, sophisticated mechanical devices, and novel instrumentation. The scope and range of knowledge needed to be effective on the job is staggering. The ever increasing advance of technology has made skilled manpower a necessity. On-the-job training is insufficient and must be supplemented by a more formal training program.

b. Standards. Navy personnel have several avenues for training available. One of these is a semi-formal program consisting of four courses made up of a series of topics. The program is designed to be used at the activity in conjunction with hands-on training. Each topic has an associated videotape, a student workbook and instructor guides. The Navy has the right to reproduce the videotapes but must purchase the workbooks and instructor's guides from the contractor, NUS Training Corporation, 910 Clopper Road, Gaithersburg, Maryland 20878, ATTN: Marketing Department. Activities can obtain the videotapes at a nominal cost from the Army Joint Visual Information Activity, Tobyhanna Army Deport, Pennsylvania 18466-1502, ATTN: ASNV-O-D. Activities must submit a Military Interdepartmental Purchase Request, DD Form 448, or NAVCOMPT Form 2275 with each request for tapes. The following courses are available:

(1) Power Principles-Power Plant Operator Training. The course consists of 80 one-hour videotapes with associated workbooks and instructor's guides. Activities may select the tapes that they need, although all personnel operating a boiler plant should at least review the first 40 tapes.

(2) General and Mechanical Maintenance Training. A comprehensive program for plant maintenance personnel consisting of 44 one-hour videotapes and workbooks arranged into ten subject areas.

(3) Electrical Maintenance Training. Provides training to new personnel. The course consists of 28 one-hour videotapes with associated workbooks divided into six subject areas.

(4) Instrumentation and Control Technician Training. This program applies to technicians involved in the repair of electronic and pneumatic controls. The program has 49 topic areas with associated one-hour videotapes and workbooks.

In addition to the videotape program, correspondence courses in the areas of mechanical systems inspection, operations and maintenance are also available from the Navy Public Works Training Center, 1220 Pacific Highway, San Diego, California 92132-5190.

More specialized on-site hands-on efficiency improvement training is available from the Naval Energy and Environment Support Activity or from various contractors.

The Civil Engineering Corps Officer School provides managers with an Energy Management course at various sites throughout the U.S. each year.

3172 RESPONSIBILITIES

a. Engineering Field Divisions. The responsibilities of the EFDs include:

(1)Establishing and maintaining videotape lending libraries.

(2)Providing other training assistance on a reimbursable basis as needed.

b. Naval Facilities Engineering Center shall provide efficiency improvement training on a reimbursable basis as scheduling allows.

c. Activities. The activity is responsible for:

(1)Developing training programs for operations and maintenance personnel.

(2)Establishing training requirements for all positions.

(3)Charging immediate supervisors, extending to utilities and maintenance superintendents, with the training of their subordinates.

(4)Providing resources for the accomplishment of training requirements.

PART 2

STEAM DISTRIBUTION SYSTEMS

3200 SCOPE

NAVFAC MO-209, Chapter 3, provides detailed information and guidance on proper operation and maintenance of steam distribution systems. Direct buried conduit systems shall be installed, maintained, and repaired in accordance with the Manufacturer's Approved Brochure and NAVFAC Guide Specifications NFGS-02964, Exterior Underground Heat Distribution Systems. Systems shall have a Letter of Acceptability issued by Federal Agency Committee on Underground Heat Distribution Systems. The Letter of Acceptability is signed by representatives of federal agencies participating in the committee and stating that the supplier's system is approved for use for the site ground-water conditions, operating temperature, and soil classification(s) indicated. Shallow concrete trench systems shall be installed in accordance with NFGS-02963, Exterior Shallow Trench Heat Distribution System. As energy costs continue to rise, proper operation, maintenance and repair becomes more and more cost effective to implement in an expeditious manner. Engineering Field Divisions shall assist and activities shall assure that efficient operation and timely maintenance of steam distribution systems are performed. If technically and economically feasible, steam distribution systems shall be secured during the non-heating season. The Power Principles Video Training Program shall provide further assistance to all concerned.

3201 APPLICATIONS AND SYSTEMS

a. Steam Distribution System. A steam distribution system consists of steam and condensate return piping, equipment, instrumentation, and related facilities.

b. Supply Pressure. Steam supply system are categorized as either low-pressure systems or high-pressure systems.

(1) Low-Pressure Steam. Low-Pressure steam, 0 to 15 psig, is used for space heating (unit heaters, radiators convectors, heating coils, or other steam heating devices), snow melting, cooking, and domestic hot water heating. It is distributed from a central plant or mechanical room to a multiple building installation.

(2) High-Pressure Steam. High-pressure steam, above 15 psig, is used for industrial purposes, process work, hospital uses, laundry machinery, and dry cleaning. For extensive outside distribution, high-pressure steam at or above 100 psig is commonly employed.

3202 STEAM DISTRIBUTION METHODS

a. Policy

Above-ground Distribution Systems shall be selected whenever practical. Due to the ease in detecting leaks and the lower cost of installation, above-ground distribution lines are normally more life cycle cost effective. There are instances though, where due to mission requirements or esthetics, that above-ground distribution lines are not the system of choice. System designers should consider quality of life as well as life cycle costs when choosing a mode of installation. Often a designer can choose to reroute a line or screen it from view as an alternative to burying it.

3203 OPERATION AND MAINTENANCE OF STEAM DISTRIBUTION SYSTEMS

NAVFAC MO-209, Chapter 3, sections 3 and 4, provides detailed information and guidance on proper operation and maintenance of steam distribution systems.

3204 OPERATION AND MAINTENANCE OF STEAM TRAPS AND PRESSURE REDUCING STATIONS

NAVFAC MO-209, Chapter 3, sections 5 and 6, provides detailed information and guidance on proper operation and maintenance of steam traps and pressure reducing stations.

3205 BUILDING HEATING SYSTEMS

The use of steam for building heat is hard to control and requires more maintenance than hot water systems. Buildings that are heated with steam are often overheated and this excess energy consumption is blamed on the central distribution system. Steam systems require the use of many steam traps which also contribute to the building's energy consumption. Circulating hot water systems require less maintenance and are easier to control.

Buildings that undergo a heating system major repair or replacement should be converted to a hot water system versus a steam system. Exceptions would be industrial type buildings that require steam and where it can be shown that a steam system has the lowest life cycle cost.

PART 3

HOT WATER DISTRIBUTION SYSTEMS

3300 SCOPE

NAVFAC MO-209, Chapter 4 provides information and guidance on proper operation and maintenance of hot water distribution systems. Direct buried conduit systems shall be installed, maintained, and repaired in accordance with the Manufacturer's Approved Brochure and NAVFAC Guide Specifications NFGS-15705, Underground Heat Distribution Systems (Prefabricated or Pre-Engineered Types). Systems shall have a Letter of Acceptability issued by Federal Agency Committee on Underground Heat Distribution Systems. The Letter of Acceptability is signed by representatives of federal agencies participating in the committee and stating that the supplier's system is approved for use for the site ground-water conditions, operating temperature, and soil classification(s) indicated. Shallow concrete trench systems shall be installed in accordance with NFGS-15751, Heat Distribution System Outside of Buildings (Concrete Shallow Trench Type). Hot water can be distributed more efficiently and cost effectively than steam. For this reason hot water should be utilized over steam wherever feasible. EFDs shall assist and activities shall assure that operation and maintenance of hot water distribution systems are properly performed. The Power Principles Video Training Program shall provide further assistance to all concerned.

3301 APPLICATIONS AND SYSTEMS

a. Hot Water Heat Transmission. Hot water is an alternate medium to steam for conveying heat to customers. Hot water can be efficiently generated and distributed, easily controlled and accurately measured. The system suffers little energy loss if properly insulated except for line heat losses of 3°F to 8°F per mile of distribution piping.

b. Types of Hot Water Distribution Systems

(1) Low Temperature Water System (LTW). A hot water heating system operating with a pressure of approximately 30 psig and a maximum temperature of 250°F.

(2) Medium Temperature Water System (MTW). A hot water heating system operating at temperatures of 350°F or less, with pressures not exceeding 150 psig. The usual supply temperature is approximately 250 to 325°F.

(3) High Temperature Water System (HTW). A hot water heating system operating at temperature over 350°F and pressure of approximately 300 psig. The usual maximum supply water temperature is 400 to 450°F.

(4) Selecting Type of Hot Water Distribution System. System must maintain adequate pressure and temperature and assure uniform flow of water to customers.

Hot water generators consist of natural circulation boilers or forced circulation boilers. Since hot water distribution systems are more efficient than steam distribution systems, they should be selected whenever practical. The lower the temperature required the more efficient the system should operate due to the lower temperature differential between the hot water and piping's external temperature. Lower temperature systems are less costly to construct as well. All projects calling for the replacement or new installation of a heating system shall include a life cycle economic analysis of steam versus LTW, MTW, and HTW distribution systems and justification stating the conditions which prohibit the use of above-ground systems on all MCON and special projects. This includes repair by replacement projects where the existing distribution systems are steam and/or underground. The following factors will be among those considered in the analysis:

(a) Economic advantage of thermal storage of the hot water system in sizing of equipment such as boilers, pumps, and piping.

(b) Operation and maintenance costs of hot water versus steam distribution system.

(c) Customer requirements of temperature or pressure served more economically by steam or hot water.

(d) Replacement or renovation of existing plant and system compared with construction of new plant and/or system. Comparison to be on a life cycle basis.

(e) Prevalence of skilled steam plant or hot water plant operators in area, especially in remote locations.

(f) Complexity of controls and ability of steam to maintain varying or constant temperature conditions through the assigned or existing heat transfer equipment.

c. Pumping Systems. There are two main pumping systems: (1) the combined pumping system and (2) the separate pumping system. In the combined pumping system the same pumps are used to circulate water through both the hot water generators and the system.

In the separate pumping system water is circulated through the boiler by individual boiler recirculation pumps, while separate circulating pumps circulate the water through the distribution system.

3302 HIGH TEMPERATURE WATER DISTRIBUTION METHODS

a. Types of Distribution Methods. Hot water distribution methods are similar to those described for steam distribution systems. In hot water distribution circuits, the circulating pumps maintain positive circulation in the closed piping system at all elevations.

3303 OPERATION AND MAINTENANCE OF HOT WATER DISTRIBUTION SYSTEMS

NAVFAC MO-209, Chapter 4, sections 3 and 4, provides detailed information and guidance on proper operation and maintenance of hot water distribution systems.

3304 PUMPS

NAVFAC MO-209, Chapter 4, section 5, provides detailed information and guidance on proper operation and maintenance of pumps.

PART 4

ELECTRICAL DISTRIBUTION

3401 PURPOSE

This section provides minimum operation and maintenance procedures and criteria for electrical distribution systems.

3402 GUIDANCE

a. Operation and maintenance procedures of electrical distribution systems should comply with national standards and Navy codes including the publications listed below. The first two codes listed contain rules (both mandatory and advisory) for the safe installation, maintenance and operation of electrical systems. Other publications contain requirements applicable to the Navy.

(1) National Electrical Code (NEC), NFPA 70, and related pamphlets.

(2) National Electrical Safety Code, ANSI C2.

(3) NAVFAC MIL-HDBK-1004. The electrical engineering design manuals are a series from 1004.1 to

1004.7. The use national professional society, association and institute standards in accordance with NAVFACENGCOM policy to provide basic design guidance.

(4)NAVFAC MO-200, 201. Contain specific operation and maintenance criteria for electrical systems.

b. Multiple Transformation. The inefficient operation that results from multiple transformations of distribution voltages should be avoided. For every transformer that is energized in a system, approximately 1% of the energy equivalent to the transformer KVA rating will be dissipated as heat and losses. A rule of thumb to determine if you have too many transformers energized is to divide the total KVA ratings of all the transformers currently energized by the peak KW demand from your electric bill. The ratio should be approximately 2.5. In practice the ratio is normally around 4. If this is the case for your activity, two alternatives that should be considered are (1) consolidate transformer loads and (2) convert intermediate voltage electrical distribution system to a higher voltage level.

c. Consolidation of Transformer Loads. Loads on lightly loaded transformers should be consolidated whenever possible. Those transformers that are unloaded should be disconnected on the primary side of the transformer. Two advantages accrue to the activity when doing this: (1) they acquire a spare transformer for use and (2) they eliminate the cost of the transformer no load losses. When replacing transformers, the use of low loss transformers should be considered using a life cycle cost comparison.

d. Distribution Voltages. Due to the excessive cost and energy consumption of low voltage systems (5KV or less), projects supporting the widespread expansion of electrical distribution systems below 15 KV rating will require justification including an economic comparison between voltage levels. MIL-HDBK-1004.1, provides general criteria for selection of voltage levels. The following additional guidance should be used for utilities master planning:

(1)Activities should have a long-range plan for converting to a single distribution voltage above 12KV.

(2)Projects creating major loads near the fence line should consider the economics and reliability of supplying the electric loads at high voltage directly from the utility company. Savings in equipment and line transformers and circuits on the base for other purposes makes this alternative attractive. This major load center at high voltage is often the first step in converting the entire base's voltage level.

e. Inspection of Equipment. MO-322 includes maintenance and inspection/service checklists for electrical systems. An infra red (IR) camera ia a good inspection tool for electrical distribution systems and equipment. Abnormal conditions will generate excess heat. An IR camera allows the inspector to locate problem areas without shutting the system down.

f. PCB. Congress directed EPA to regulate PCBs in the Toxic Substances Control Act of 1976. They began issuing a series of rules in 1978 including:

(1)The Marking and Disposal rule in 1978 required the identification, marking and record keeping of PCB containing equipment through disposal.

(2)The PCB Ban Rule in 1979 prohibited some uses.

(3)The Electrical Use Rule in 1982 required additional inspections and records.

(4)The Fire Hazard Rule in 1985 addressed problems involving toxic products of PCB combustion referred to as furans and dioxins.

(5)EPA rulings on transformers: According to EPA rulings on PCB transformers (500 ppm and above) installed in or near commercial buildings, the following EPA regulations should be adhered to:

(a)Prohibit the use of higher secondary voltage (480 volts and above) network PCB transformers in or near commercial buildings after October 1, 1990.

(b)Prohibit the use of lower secondary voltage network PCB transformers located in sidewalk vaults near commercial buildings as of October 1, 1993.

(c)Require by October 1, 1990, the installation of enhanced electrical protection on all radial PCB transformers in use in or near commercial buildings.

(d)Require by October 1, 1990, the installation of enhanced electrical protection on all lower voltage network PCB transformers o removal by October 1, 1990.

(6)Major manufacturers now offer liquid-filled transformers containing less than 1 ppm of PCB.

g. Load Shedding Plans. Load shedding may be required during shortages of electrical supply. A load shedding plan should be prepared in advance to minimize the impact and ensure the lowest possible impact of power shortages on fleet readiness. The plan should identify the priority order in which circuits should be de-energized and re-energized to meet any given restriction in power supply or voltage reduction. The plan should identify who is responsible to implement the plan as well as locations of critical switches that have to be operated. The load shedding plan should be developed in conjunction with the utility vulnerability plan.

h. Computer Assisted Power Systems Engineering (CAPSE) is discussed additionally in paragraph 2201, Computer Aided Logistics Support. EFDs are working on a six-year cycle to establish and update the CAPSE data base for each activity. The CAPSE program can be an effective tool in evaluating a system for operational problems.

(1)Once a CAPSE date base has been developed by the EFD, the activity should provide the EFD any major changes in load or system configuration for use in updating the program.

(2)When an activity plans a new MCON project, a load flow program should be run to calculate the impact of the project on the system.

i. Overhead vs Underground. Overhead distribution costs less to install and maintain than underground. Justification should be included in each MCON projects for going underground in lieu of overhead. MIL-HDBK 1004 provides additional guidance for applications requiring underground distribution. NFGS-16370, Overhead Electrical Work, issued March 1990, provides useful information on wood poles and crossarms. It is available in the design division on Construction Criteria Base (CCB)-CD-ROM.

j. Painting of Equipment. Painters must be required to take care not to paint across insulators or to paint over information tags on equipment. An E. I. du Pont de Nemours report determined that white painted electrical equipment operated 15 degrees cooler than black painted equipment resulting in increased equipment capacity. This information should be considered when planning for your next painting cycle.

k. Power Factor Correction

(1)Activities with low power factor will normally suffer power factor penalty charges, increased distributed losses, and it is economical to improve the power factor level it is important to consider the effects of the low level on system operation. Where it is decided to improve the power factor level, the electric utility rate contract will state the minimum requirement. Power factor correction equipment should be located as close to the load as possible. Capacitors are normally used to correct power factor problems, either wired directly into the starters of large motors or located in banks adjacent to the shop area for large numbers of small motors.

(2)Fixed shunt capacitors are used to reduce peak current levels and switched shunt capacitors to improve voltage regulation.

(3)Capacitors manufactured before 1978 probably contain polychlorinated biphenyls (PCBs) and should be disposed of in accordance with procedures set by the Environmental Protection Agency.

(4)MO-200 provides guidance for the application, maintenance and inspection of distribution systems (power) capacitors.

3403 RESPONSIBILITIES

a. NAVFACENGCOM. NAVFAC is responsible for promulgating operation and maintenance policy and advice to the field regarding electrical power plants and distribution systems. NAVFAC shall also:

(1)Collect and distribute to the field lessons learned and information on new products and procedures.

(2)Update and maintain utility MO manuals.

(3)Utilize NCEL to investigate areas of electrical O$M problems.

b. Engineering Field Divisions. EFDs will provide technical and management support and assistance to activities for effective management, operation and maintenance of their electrical distribution systems.

c. Shore Activities. Activities are responsible for maintaining and operating effective electrical distribution systems for their facilities and tenants.

PART 5

COMPRESSED AIR SYSTEMS

3500 SCOPE

NAVFAC MO-206, Operation and Maintenance of Air Compressor Plants, provides operation and maintenance procedures for compressed air plants. NAVFAC MO-209, Maintenance of Steam, Hot Water and compressed air plants. NAVFAC MO-209, Maintenance of steam, Hot Water and Compressed Air Distribution System, Chapter 5, provides detailed information and guidance on proper operation and maintenance of compressed air distribution systems. These manuals are to be used with the specific equipment manufacturers' manuals, parts list, and drawings. For a safe and economical system, the information contained in these manuals is necessary for handling the daily problems arising during operation and maintenance.

3501 APPLICATIONS AND SYSTEMS

a. Compressed Air Uses. Compressed air is of particular advantage in applications that require intermittent power at some distance from its source, as the air pressure can be maintained nearly constant during should be secured during non-working hours service, process service, or control purposes.

b. Compressed Air Distributions Systems. Compressed air distribution systems consists of piping, equipment, instrumentation, and related facilities required to accomplish the above described purpose safely and efficiently.

c. Supply Pressure. Compressed air is distributed at low, medium, or high pressures. It must be dry and free of oil, dust, or other contaminants. Refer to NAVFAC MO-206 for methods of producing compressed air and removing moisture, oil, dust, and other contaminants.

(1) Low-Pressure Compressed Air Systems. These systems provide compressed air at pressures up to 125 psig. When several air pressures are required within that range, the plant is usually designed for the highest pressure with pressure reducing stations (regulating valves) supplying the lower pressures.

(2) Medium-Pressure Compressed Air Systems. These systems provide compressed air within the range of 126 to 399 psig. Such systems are not extensive and are generally provided with individual compressors located near the load.

(3) High-Pressure Compressed Air Systems. These systems provide compressed air within the range of 400 to 6,000 psig. To minimize the hazards that exist with higher pressures and capacities use separate compressors for each required pressure.

d. Air Receivers. Air receivers are tanks that serve as reservoirs for the storage of compressed air. Air receivers permit meeting peak demands in excess of compressor capacity and act as pulsation dampeners and compressed air storage on reciprocating compressor installations. They also separate, collect, and drain moisture, oil, and dirt from the system air.

(1) Safety Inspection of Air Receivers

(a) Standard Vessels. An unfired pressure vessel is a closed vessel in which internal pressure is above atmospheric pressure, and the pressure is obtained from an external source. Safe operation of these vessels requires adherence to the inspection frequencies and guidelines of MO-324, Inspection and Certification of Boilers and Unfired Pressure Vessels.

(b) Non-Standard Vessels. Vessels not designed and constructed according to the rules of the American Society of Mechanical Engineer's Boiler and Pressure Vessel Code (ASME B&PV Code) are considered non-standard vessels. Because most contract inspectors are licensed to inspect according to the ASME B&PV Code they will not certify non-standard vessels as safe for operation. Therefore, the procurement of non-ASME B&PV Code is discouraged. When certification of non-standard vessels must b accomplished, NAVFAC certified inspectors should be employed. Repair of non-standard vessels is prohibited. The inspection of non-standard vessels shall proceed in the same manner as outlined in MO-324.

3502 COMPRESSED AIR DISTRIBUTION METHODS

a. Types of Air Distribution Systems. Compressed air is delivered to consumers by either aboveground or underground piping systems. In many cases, however, small air compressors at the point of use are much more efficient than a large central system. Activities shall compare the life cycle cost of central and distributed systems in selecting new or replacement systems.

b. Distribution Route. The shortest distance between the central compressor plant and the consumers is the preferred routing for a compressed air distribution system; however, as with heat distribution systems, other factors affect the final selection of a route.

c. Selection of Aboveground or Underground Distribution Systems. The decision whether to use aboveground or underground piping shall be based on life cycle economics. The advantages of each system are as follows:

Aboveground	Underground
Lower first cost	Less vulnerable target
Less maintenance	Less obstruction to aboveground traffic
Easy detection of failure	Less unsightly
Higher continuous operating efficiency	Freeze protected when buried
Longer Life	

d. Type of Distribution System. An economic analysis will, in most instances, demonstrate the advantages of an aboveground system. Other requirements, such as temporary use or certain operating and local restrictions, may dictate their use. Aboveground systems are less costly to operate and maintain.

3503 COMPRESSED AIR PLANTS

NAVFAC MO-209, Chapter 5, section 3, provides detailed information and guidance on proper operation and maintenance of compressed air plants.

3504 MAINTENANCE AND OPERATION OF COMPRESSED AIR DISTRIBUTION SYSTEMS

NAVFAC MO-209, Chapter 5, section 4 and 5, provides detailed information and guidance on proper operation and maintenance of compressed air distribution systems.

3505 EVALUATION OF LOSSES IN COMPRESSED AIR SYSTEMS

Leakage can result from corrosion in underground piping, damaged joints, and defective fittings and valves. A relatively simple test has been devised which will rapidly and economically determine whether a distribution line is leaking and if so, the magnitude of the losses. this testing procedure is described in detail in NAVFAC MO-209, Chapter 5, section 6. NAVFEC has an inventory of leak detection equipment and can provide additional technical assistance in detecting, pin-pointing and quantifying leaks.

CHAPTER 4

UTILITIES MANAGEMENT

4000 SCOPE

This chapter provides guidance for utilities management at shore activities. At the activity level, the four major functions of utilities management are defined as: (1) operations management, (2) inspection and maintenance, and (3) utilities allocation, and (4) management analysis and control. Each function exists in varying degrees of complexity regardless of size or type of operation. Each function is essential in furnishing required utilities services.

PART 1
OPERATIONS MANAGEMENT

4100 SCOPE

Operations management is directed at the production and delivery of utility services to customers as required to accomplish their assigned mission. The goal of operations of utility systems to conserve energy and financial resources.

Management control of operations must be directed toward the basis objective of providing reliable, high quality and economical utilities services to accomplish the mission. To meet this objective, the utilities manager must:

a. HAVE THE PROPER STAFFING TO OPERATE THE SYSTEM Utilities managers must provide sufficient personnel to operate systems. Guidelines from the Navy Manpower Engineering Center (NAVMEC), NAVFAC and EFDs should be used to develop a local staffing plan. In order to reduce required staffing levels, heating plants, cold storage and refrigeration plants, and pumping plants are to be automatically controlled wherever practical. Management must emphasize training of supervisors and operating personnel. This training can be both informal and formal, but a training plan should be developed for all utilities personnel.

b. ESTABLISH STANDARD OPERATING PROCEDURES (SOP) FOR ALL MAJOR PLANTS AND SYSTEMS. The SOP should cover operating instructions, start-up and shut-down instructions, operator maintenance, periodic maintenance and actions in emergency situations. A single line diagram should be posted in all plants along with the SOP. Operating personnel should be well versed in procedures and supervisors should conduct periodic reviews with operating personnel.

c. DEVELOP CONTINGENCY PLANS FOR RESPONDING TO UTILITY OUTAGES. Interruptions of service generally reduce activity effectiveness in accomplishing its mission. Up-to-date contingency plans shall be maintained for each utility service. The plan should:

(1)Identify available emergency generation units.

(2)Identify inter-connections and isolation points in service lines.

(3)Identify all possible sources of outages.

(4)Establish a procedure for curtailment and restoration of utility service to customers in priority order.

Some considerations for prioritizing curtailment and restoration of services are mission, production and mobilization requirements, and safety. Procedures for handling each type of outage shall be developed. Utilities personnel shall be trained to restore services quickly and safely. Standby, emergency or alternate facilities are to be installed and maintained only as necessary to meet departmental operational requirements.

d. SCHEDULE APPROPRIATE EQUIPMENT AND PERSONNEL TO MEET NEEDS. Each activity should periodically collect demand data in order to develop typical seasonal demand curves for normal weekday and weekend loads. Operating schedules can be established to meet demand at the lowest possible production cost.

e. COORDINATE PRODUCTION OPERATIONS WITH PURCHASED UTILITY SERVICES TO OPTIMIZE SYSTEM RELIABILITY AND OVERALL COST EFFECTIVENESS. Utility services are to be purchased from existing commercial systems where economically possible in lieu of construction or expansion of Navy owned utility systems.

PART 2
INSPECTION AND MAINTENANCE

4200 SCOPE

Inspection and maintenance operations are directed toward minimizing system down time at minimum cost. This is achieved by maintaining all active real property to a standard which will prevent deterioration beyond normal wear and tear, and inactive facilities to a standard commensurate with reactivation requirements, in the most economical manner possible.

Utility inspection and maintenance programs, consistent with accepted engineering standards and practices, are to be established. NAVFAC MO-321 and MO-322 provide detailed information and guidance on inspection and maintenance procedures for short facilities. These procedures shall be applied to the inspection and maintenance of all utility systems. NAVFAC MO-324 addresses the specialized inspection and certification requirements of boilers and unfired pressure vessels.

PART 3
UTILITIES ALLOCATION

4300 SCOPE

Utilities allocation is directed toward recovering the costs of utilities operations through equitable billing practices and the establishment of utility rates. It includes minimizing waste by encouraging sound utilities usage practices.

4300 METERING. Meters should be installed wherever cost effective and in the following specific circumstances:

a. New Construction - New facilities should be provided with electric, water, and natural gas meters, as appropriate. Steam meters should be provided for new facilities where the annual energy cost component of steam will exceed $50,000.

b. Energy-Converting Devices - All energy-converting devices with outputs greater than 20 MBTU/hr or 1,000 kW, such as boilers, turbines, and generators, shall be metered.

c. Energy Retrofit Projects - Meters shall be installed on Energy Conservation Investment Program (ECIP) projects if the total project SIR is at least 2.5, including the cost of the meters, and if the cost of the meters does not exceed 10 percent of the total cost of the project.

d. Customer Requirements - Meters shall be installed at the customer's request on a reimbursable basis for billing, energy management or project validation purposes.

NAVFAC MO-221, Utilities Metering, provides detailed guidance on the selection, installation, operation and maintenance of metering equipment.

4302 UTILITY ESTIMATES

Where metering is not considered technically or economically feasible, utility consumption shall be estimated. NAVFAC MO-303, Utilities Target Manual, provides guidance for establishing estimates for most utility services.

4303 UTILITY SALES TO DOD CUSTOMERS

DOD customers will reimburse the activity supplying utility services, on the basis of quantity consumed times the established activity rate, in accordance with NAVCOMPT Volume III, Chapter 7. The direct impact of reimbursables on the utilities operating budget requires that activity rates be properly established and periodically adjusted as changing costs dictate. However, supplying activities should not make or lose money on utility services. Established activity rates should only be changed if the prior fiscal year annual Utilities Cost Analysis Report (UCAR) shows a net gain or loss greater than 5% of the total cost to deliver utilities.

4304 UTILITY SALES TO PRIVATE PARTIES

Policies relating to the sale of utility services by the Navy are presented in the NAVCOMPT Manual, Volume 3, Chapter 5 and Volume 5, Chapter 2. Sales of utility services to private parties require the approval of the responsible NAVFACENGCOM engineering field division. EFDs are responsible for ensuring that there are no reasonable alternatives to sale of utility services to private parties, that the Navy is not in competition with private or public utility companies, that private party rates recover all costs of producing and distributing utility services and that private party rates are at least equal to local commercial utility rates. Activities providing utility services to private parties are required to:

a. Prepare determinations and findings for each private party contract stating that alternate sources of service are not available.

b. Calculate private party utility rates using NAVCOMPT Volume III (for O&MN funded activities) or Volume V procedures (for business operation funded activities).

c. Provide an comparative analysis of local commercial utility rates. The responsible NAVFACENGCOM engineering field division shall review this information and approve or disapprove the sale.

4305 AUTOMATED ALLOCATION AND BILLING PACKAGES

Activities are encouraged to pursue utilities management modernization opportunities within their organization as computer hardware and software is available. NAVFAC sponsored utilities management software packages available through the EFDs include:

a. Public Works Management Automation (PWMA) Utilities Module - This module currently is written in COBOL and is operated on MS-DOS compatible microcomputers. The Utilities module allocates utility consumption and provides DEIS-II feeder information, Utilities Cost Analysis Report (UCAR) production and purchase information, and customer billing information. The module will continue to be supported and maintained by NAVFACENGCOM. The capability to download data from hand held meter reading equipment has been added. The module will be modified to be compatible with recent changes in the UCAR format.

b. UCAR Database (UCAR-DB) Module - This is a database program that automates production of the UCAR, reducing clerical and mathematical errors. UCAR-DB produces management summaries of utilities production and cost history data (monthly, quarterly and annually) in graphical form. It can also be used to prepare "projected" UCARs. The program is available as a compiled Dbase application. UCAR-DB accepts a download file of utility production and purchase information from the PWMA Utilities module, or it can operate as a stand-alone program allowing manual entry of this information. In either case, cost account data must be manually to complete the UCAR.

4400 MANAGEMENT ANALYSIS

Management analysis is directed toward obtaining and interpreting data on utility system operation and performance in order to quantify service quality, reliability, efficiency, and cost. Proper management analysis can identify corrective actions required and potential cost saving opportunities. Particular emphasis must be placed on the effective use of budget, cost, operating, property and fiscal information at all levels.

4401 UTILITIES COST ANALYSIS REPORT (UCAR). The principal management report is the Utilities Cost Analysis Report (UCAR), NAVCOMPT Form 2127. The UCAR consolidates fuel consumption, production and purchased quantities and associated costs into one report. This report is designed for management control and planning at the activity level. It also provides valuable data for the EFDs, the claimants and NAVFAC. The UCAR provides:

a. Comparison of the quantities of production with the cost of operations.

b. Data to develop costs trends.

c. Data to develop consumption trends.

d. Data to project the utilities operating budget.

e. Data to project operating cost for future major projects.

f. An early warning of potential problem areas.

4402 MANAGEMENT USE OF THE UCAR. When used by management on a regular basis, the UCAR can improve overall effectiveness of utilities operations. Selected line items from the UCAR, such as total quantities, total costs and unit costs for produced, purchased, and delivered utilities, should be charted monthly or quarterly to analyze trends. Each utility type must be studied independently and thoroughly so the data presented in graphic form is meaningful.

a. Unit Cost Trends - The effectiveness of utilities operations depends on the performance of personnel and equipment. The UCAR is a vital tool in determining how well these two elements are functioning. Only through routine analysis of trends can warning signals be discovered. The following are some means to gauge personnel and equipment performance:

(1) Total Quantities and Costs Produced, Purchased, and Delivered - Actual quantities and costs can be plotted and compared against prior year costs for the same time period. Deviations of 5% or more should be investigated. Possible causes for the deviations may be personnel changes, mission changes, weather fluctuations, equipment failures and the effects of cost and usage control. The effects of the various causes may be compensated for by normalizing the data. For instance, in the consumption of steam for heating purposes, dividing the quantities consumed by the number of heating degree days for the same period will provide a unit quantity per heating degree day which can be readily compared to different periods. Consumption trends can project when the plant capability will be exceeded. This information is useful for early planning but caution must be exercised. Every effort to reduce consumption must be made prior to committing funds for expansion or additional purchase of utilities.

(2) Unit Production Cost - This item should be analyzed in detail to determine if the cost increase is due to fuel, material or labor increases and if the increase is justified. If fuel costs are increasing, is it due to inefficient operations, for example, reduced boiler efficiency due to fouling, adjustment errors in the nozzle settings or air mixtures, or excessive blowdown? If material costs are increasing, is it due to price increases, heavy repair costs, or unnecessary waste? If labor costs are increasing, is it due to salary increases, unusual amounts of overtime or additional personnel?

(3) Increase in Unit Purchase and Distribution Costs - If production costs have not risen, attention should be directed to distribution and purchase costs. Have purchase costs increased? In the case of purchased electricity, is there a demand penalty or a power factor penalty being paid, or both? If so, what can be done to control or eliminate the problem? Are distribution costs excessive? If so, is it due to system leaks or line losses and how can it be reduced?

b. Management Indices - In addition to individual UCAR line items of interest, management indices can be calculated from UCAR information and charted monthly or quarterly to gain additional insight into utility operations. Recommended management indices are shown in Figure 4-1.

c. Establish and Review Billing Rates - The UCAR provides the foundation for the development of rates. A realistic unit cost rate can be established only after accounting for all the costs to purchase, produce and distribute the utility service. The net gain or loss for each service should be studied and evaluated to determine if the rates should be adjusted. Rates should be reviewed monthly. Rates must not be changed more often than absolutely necessary and consideration must be given to the variability of the cost changes. If higher utility costs are temporary or sporadic, it may be ill advised to adjust the rates. Every effort must be made to reduce cost before rate increases are effected.

d. "Projected" UCAR - A "projected" UCAR should be developed for future and budget years to properly establish the predicted activity rate used to determine reimbursable costs. The "projected" UCAR is a projection of utilities operation and maintenance performance and is prepared in the same manner as the regular report except that projected cost increases will be added to known costs, e.g., labor, material, and fuel. Projecting the activity rate for the future/budget years will allow customers ample time to budget for increases in the normal budget cycle.

e. Prepare Utilities Budget - The UCAR provides the basis for preparation of the utilities budget for all naval activities. Budgets are based on anticipated program costs in relation to available revenue. The unit cost breakdown in the reports will enable the budget officer to translate anticipated consumption into definite dollar values. The UCAR itself then becomes the detailed justification for the quantity and cost estimates in the budget. Major Claimant Base Operations programs are normally funded by the O&M,N (17-1804) appropriation. Claimants funded in this manner are required to submit the PB-27 execution exhibit. This data will be used as Past Year of the Presidential/Congressional Budget submission and becomes the basis for future budget analysis. Accuracy is very important to the Major Claimants and OPNAV. Therefore, accuracy in the UCAR is important. If the UCAR is automated and programmed correctly, the PB-27 can be obtained as a data extract from the UCAR.

UTILITIES MANAGEMENT INDICES	UCAR LINE ITEM	SHOWS	HOW USED
Boiler Efficiency (Heat Source only)	8/2a	BTU output to BTU input	Compare with manufacturer's rating to reduce fuel consumption
Parasitic Plant Loads	9/8	Consumption of production plant auxiliary equipment	To increase production plant efficiency
Quantity Lost in Distribution	16/15	Unusable amount of total commodity produced or purchased	Trend distribution system efficiency to reduce waste
Demand/Production Capacity Ratio	21/19	Over/underloaded plants	Verify reserve production capacity Identify excess production capacity to be reduced or deactivated
Demand/Purchase Capacity Ratio	21/20	Over/underloaded service connections	Verify reserve purchase capacity
Fuel Cost per Unit Produced	23d/10	Portion of unit cost of production expended on fuel	Trend changes in fuel cost and plant efficiency Indicates need for fuel source change or efficiency improvements
Production Operations Labor Cost per Unit Produced	23a/10	Portion of unit cost of production expended on labor	Trend labor cost effectiveness
Production Operations Labor Cost to Plant Capacity	23a/19	Labor cost to plant capacity ratio	Establish labor cost standards for utility plant staffing Compare with similar plants
Total Maintenance Cost per Unit Delivered	$\frac{(26a+b+c)+(34a+b+c)}{17}$	Portion of unit cost delivered expended on maintenance	Indicates obsolescence and need to upgrade utility system
Production Maintenance Labor to Material	26a/26b	Efficiency of plant maintenance labor force	Trend plant maintenance execution efficiency
Distribution Maintenance Labor to Material	34a/34b	Efficiency of distribution system labor force	Trend distribution system maintenance execution efficiency
Net Gain or Loss to Date	45	Gain or loss of funds to supporting activity through sales to customers	Rates planning (Should be within 5% of actual cost to deliver utility service)

UCAR Utilities Management Indices
Figure 4-1