CHAPTER 14
ENERGY SOURCE SELECTION AND CENTRAL HEATING CRITERIA

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ENERGY SOURCE SELECTION, CENTRAL HEATING CRITERIA AND PETROLEUM FUEL FACILITIES

1. ENERGY SOURCE SELECTION AND APPLICATION CRITERIA (ARMY FACILITIES LOCATED IN THE CONTINENTAL UNITED STATES, ALASKA AND HAWAII).

a. Policy.

(1) Applicability. These criteria apply to all new construction, and all future major rehabilitation or improvement projects, or both.

(2) General. The primary fuel source to be used in any new heating system or for any fuel conversion will be the most life cycle cost (life cycle cost) effective fuel available for that system. However, current legislation affecting new or conversion coal plant studies, or both, in CONUS stipulates that: "This cost-effective requirement is not applicable to a comparison between anthracite and bituminous coal."

(3) Procedures. Life cycle cost evaluations will be determined in accordance with the guidance contained in TM 5-802-1 (reference 14-1) for Special Energy Conservation studies - Non-Renewable Resources, except where otherwise specified. The fuel price differential escalation values will be those formulated by the National Institute of Standards and Technology (reference 14-2) as published by HQUSACE in its annual update memorandum. New central plant useful life and that of central plant conversions will be 25 years. Individual heating systems in buildings will utilize the accepted industry standard (see ASHRAE Systems Handbook or equivalent type publications (reference 14-3)) for the useful life for the type of proposed equipment. The best available price information will be utilized. Fuel costs will be those existing locally or projected by the suppliers for the area. Projected availability and costs for coal may be obtained from the Defense Energy Supply Center, Fort Belvoir, VA 22060-6222. The incremental electric and gas rates, including increased demand and energy charges that would result from the additional load, will be used where electrical and gas energy costs are being evaluated. All costs for fuel and power distribution system additions, upgrades, and retrofits will be appropriately costed in the economic evaluations.

(4) Primary consideration will be given to interconnection to existing central plant systems or large systems in buildings for new heating and energy using systems. If such systems do not exist, are not practical or cost effective, the fuel selection criteria listed in subparagraph 1.c., below, will apply.

b. Third Party Financing.

(1) Long-term (up to 30 years) contracts with a third party may be entered into to build, own, and operate with private venture capital, a plant to furnish either energy or fuel to an Army installation. The Congress has indicated that the military services are to aggressively pursue third party financing before any future large scale heating or power plants are authorized for military construction funding. In addition to the factors previously cited for in-house life cycle cost analyses, comparison of third party venture contracts with new construction, the status quo, or district heat, if applicable, will be conducted using the following constraints:

(a) A current dollar present worth discounting analysis will be done in accordance with the guidance contained in the most recent Defense Energy Program Policy Memorandum for Third Party Financing (reference 14-4) and the most recent Defense Energy Program Policy Memorandum for Defense Facilities Energy Selection (reference 14-5).

(b) Corporate income taxes paid by the venture capital proposer of third party contracts will be considered as benefits to the government and shall be calculated using the maximum corporate rate of the appropriate period (for example, currently 34 percent in 1988 and beyond).

(2) The recommendation of a third party energy supply contract must be accompanied by a comprehensive cost and benefit analysis which explores all relevant issues and constraints, and presents a clear case for the selected alternative. An example of the detail of such an analysis would be a matrix of the total life cycle costs of the various alternative projects arrayed against a range of discount factors, such as 10 percent, 7 percent, and the latest long-term bond rate.

(3) New electric (base load) power plants will not be constructed without the capability to use coal or another alternative fuel as a primary energy source. This capability is satisfied if the plant has inherent design features to permit the addition of equipment, including pollution control devices, which would allow coal or an alternate fuel to be utilized as a primary fuel source and is not physically, structurally, or technically precluded from using such fuels. This capability shall not be interpreted to require that the plant be immediately able to use coal or another alternate fuel on its initial day of operation. The term alternate fuel shall be as described in following paragraph 1.d.(2).

(4) The owner or operator of any new base loaded electric power plant which uses natural gas or petroleum as its primary energy source must also comply with the Department of Energy notification requirements of PL 100-42, Section 201(d) (reference 14-6).

(5) The Fuels Use Act, PL 95-620 (reference 14-7), which requires congressional approval and a waiver from the Department of Energy for the use of fuels other than coal in heating plants over 14 649 868 W (50 MEGA BTUH) has been rescinded by PL 100-42 (reference 14-6). New and conversion plants will utilize the most cost effective fuel system. There is no provision in the law for waivers or debate concerning this issue.

(6) Projects that fall into the following categories may, but need not, be subject to the use of third party financing:

(a) Projects under 29 299 736 W (100 MBTUH) input.

(b) Projects outside of the continental United States, Alaska, or Hawaii.

(c) Projects solely to provide emergency or standby capacity.

(d) Modifications or repairs, or both, involving less than 50 percent of the capacity of existing heating and power plants, and when the extent of contractor ownership and output could not be readily segregated from that of the government.

c. Energy Source Selection. If subparagraphs 1.a. and 1.b., above, do not apply, the following criteria will be used:

(1) Electric Heating. The availability and reliability of ample electric power in the future is uncertain. Combined with lower overall 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 and full consideration of more energy efficient forms will be made. The use of co-generation, heat pump applications and heat recovery techniques is encouraged where economically justified. The use of electric resistance heating for personal comfort is normally prohibited, except for the following:

(a) Where used as supplemental heating in a heat pump.

(b) Where the total load is less than 4395 W (15000 BTUH), and resistance heating is the most

economical option on a life cycle cost basis.

(c) Where a life cycle cost analysis indicates it is cost effective, there is assurance of the availability from the local utility company, and approval of the Major Army Command (MACOM) are provided.

(2) Coal. Coal is the only energy source with a projected future supply greater than the near term future demand. The design of all large boiler heating and power plants will be based on their future convertibility to the burning of coal. Space will be reserved around new plants to allow for coal handling and storing, and ash removal. New buildings designed to house oil or gas fired systems will make no provision for solid fuel storage or handling equipment within the buildings.

(a) Life cycle cost analyses for construction of new central plants, or conversions of existing large plants to the extent practical, will consider the use of coal as a primary fuel source. Where the use of coal is not a practical consideration because of geographic location or other compelling circumstances, supporting documentation for its omission will be included as part of the economic analysis. Army installations located in the various coal marketing areas, either anthracite or bituminous, will include coal as a fuel source candidate for all new or converted central plants, or both.

(b) Replacement boilers or additional boilers for existing plants will generally continue to burn the present fuel or fuels. Exceptions will require comprehensive supporting documentation consisting of life cycle analyses and the rationale for the proposed change in the fuel source.

(3) Fuel Oil and Natural Gas. The selection of oil or natural gas, or dual fuel capability (oil and gas) will be supported with life cycle cost analyses comparing all viable fuels available to the location. New oil fired plants of 1 464 987 W (5 MEGA Btu/Hr (MBTUH)) and up to 5,859,947 W (20 MBTUH) will be capable of burning all grades of fuel oil through No. 5. All new oil fired plants above 5,859,947 W (20 MBTUH) will be capable of burning all grades of fuel oil through No. 6, except where oil is the alternate fuel in a dual fuel plant. Light oils will be considered for larger systems where climatic conditions dictate or where heavy oils are not economically obtainable. Replacements and additional boilers will be capable of burning the widest range of fuels burned in the existing facility.

(a) All major oil or natural gas plants will be installed with multiple fuel capability where economically feasible. This backup capability will ensure mission support during a specific fuel interruption and allow discretionary fuel use based on prevailing costs.

(b) Where natural gas is selected as either the primary or secondary (interruptible) fuel source, assurance of availability will be obtained from local suppliers prior to consideration of its use.

(4) Liquefied Petroleum Gas (LPG). Due to uncertain availability in times of fuel shortages, and because designers are less familiar with the operation and maintenance characteristics of this fuel, its use is not encouraged. Where circumstances and availability are conducive to its use, the requirement concerning life cycle cost effectiveness is applicable and must support its selection.

(5) Renewable, Geothermal, Solar, Biomass, and Synthetic Fuels. The Army supports and encourages the development of these alternate energy sources. Specific application of these nonconventional energy sources will be made wherever life cycle cost-effective and when there is confidence in the ability of technology to provide adequate mission support.

(6) Refuse Fuel. Specific application will be made whenever:

(a) Life cycle cost-effective and practical in comparison with other available alternatives.

(b) The use of mass burning of unprocessed raw refuse has been proven successful in several installations.

(c) Refuse Derived Fuel (RDF) is derived by a size reduction and sorting process of industrialized wastes and it can be economically procured as a large flake suitable for overfeed stoker systems. It should be noted that the cost of processing increases the fuel cost which requires a thorough analysis when determining life cycle costs.

(7) Waste Oils. It has been demonstrated that waste oil can be successfully burned in water and fire-tube boilers without significant air pollution or operational problems. Specific applications will be made wherever life cycle cost-effective and practical in comparison with other available alternatives. Its use is encouraged where economically beneficial and wherever a significant source exists.

d. Application Criteria.

(1) Energy Storage. A minimum of 30 days supply based on the maximum continuous expected demand will be provided for liquid fuel fired plants. All new coal-fired plants will be provided with a minimum of 90 days supply.

(2) Fuel selection.

(a) Energy sources will be selected with careful consideration of national reserves, local fuels availability, and life cycle cost analysis. Use of renewable energy sources is encouraged, such as waste products, solar, wind, geothermal, refuse derived fuel (RDF), and wood. Special consideration will be given to the use of coal in accordance with Title 10, 10 USC 2690, Section 2690 (reference 14-8), where its use is life cycle cost effective.

(b) The energy source selected for new heating systems, or for fuel conversions, will be the most life cycle cost effective fuel available for that system. The economic analysis of both in-house and privately funded alternatives will include economic assumptions used to perform the evaluations. A sensitivity analysis, comparing the effects of changes in initial investment, and operating costs will be included to enable reviewing officials to fully evaluate how changes in assumptions affect the project's viability.

(c) Large central plants will be designed with multiple fuel capability where life cycle cost effective.

(d) The minimum supply of the backup fuel will be determined by the installation DPW. Local conditions and ready availability of fuels for emergency situations will be the criteria used to determine the quantities required for onsite storage.

(3) Pollution Abatement. All facilities must be designed, maintained, monitored, and operated to conform to all applicable air and water pollution standards established by Federal, state, and local authorities.

2. CENTRAL HEATING CRITERIA.

a. Applicability and Requirements. The provisions contained in this paragraph apply to new construction and existing facilities at Army installations and activities, and projects accomplished by either appropriated or non-appropriated funds when all or part of the equipment maintenance and operating costs are funded from appropriated funds.

b. Weather Data.

(1) Basis. Weather data used according to these criteria will be obtained only from the current edition of the Joint Services Manual, TM 5-785, NAVFAC P-89, AFM 88-29 (reference 14-9). Revised weather data or weather data for new Army installations will be supplied only by the headquarters of the single authorized weather service for the Department of the Army. Local or regional weather activities will not be used as a source of data, unless such data or applicable data from a climatologically nearby military installation are not contained in the Joint Services Manual.

(2) Winter Design Temperature. Heating for all facilities will be designed on the basis of 97.5 percent Winter Design Data Heating Column of the Joint Services Manual, except for those critical areas where specialized technical requirements demand an exact temperature.

c. Heating Plant Capacity.

(1) Design.

(a) Central plants consisting of heat generators or multiple boilers will be designed to be expandable, when facilities are expected to require future expansion.

(b) The number and size of units will be selected to efficiently handle both the maximum winter design load and the minimum summer load. With one unit off the line, the remaining unit or units will be capable of carrying not less than 65 percent or more than 75 percent of the maximum winter design load. Values above 75 percent of the maximum winter load will be justified by a study that will be forwarded to HQUSACE CEMP-E for approval.

(2) Heating Load. Heat losses will be calculated according to the method specified in the ASHRAE Fundamentals Handbook (reference 14-10). For building interior design temperatures, see chapters 13 and 16. The "U" or overall Heat Transmission Factors will be calculated in accordance with the life cycle cost analysis method prescribed in chapter 11.

(3) Standby Heating Equipment. Heat generators, heating pumps, and standby boilers will not be provided unless justified.

3. HEATING AND COOLING TRANSMISSION LINES.

a. Heating and Cooling. Heat and chilled water distribution systems will be designed in accordance with TM 5-810-17 (reference 14-11). Valve manhole designs will conform to **\3** CEGS 02570 ***/3/*** (reference 14-12).

(1) Steam and Medium or High Temperature Water Distribution Systems. Steam and medium or high temperature water distribution and transmission lines from the source to points of use within a facility for new or replacement lines will be installed in the following order of preference: (a) above ground **\3** in accordance with CEGS 02554 (reference 14-19) ***/3/***, (b) shallow concrete trench, (c) direct buried. Shallow concrete trench systems are only allowed for site conditions as described in CEGS **\3** 02553 ***/3/*** (reference 14-13). If direct-buried, **\3** require systems to ***/3/*** be installed in accordance with CEGS **\3** 02552 ***/3/*** (reference 14-14). Site classification criteria contained in the notes of CEGS **\3** 02552 ***/3/*** will be used for classifying all direct buried system sites. Direct buried systems will only be used where aesthetics or functional requirements preclude the use of above ground or shallow concrete trench systems, e.g., where the water table is above the bottom of the trench. Buried locations classified as severe in CEGS 02552 will use drainable, dryable, air pressure testable steel conduit systems.

(2) Low Temperature Heating and Cooling Distribution Systems. **\3** Require chilled ***/3/*** and low temp

heating water distribution systems **\3** to be installed in accordance with **/3/** CEGS 02555 (reference 14-15). For new heat distribution systems and major replacement or renovation of existing high temperature systems, consider using low temperature heating distribution systems. Life cycle cost, less complicated operation and maintenance tasks resulting in lower costs, possible requirements for high temperature source by some end users, and other factors will influence the analysis.

4. **\5**GAS SYSTEMS.

a. Gas. Gas (natural gas, manufactured gas, liquefied petroleum gas (LPG) air mixtures above the upper combustible limit, LPG in the gaseous phase, or mixtures thereof).

b. Building Services Piping. Require gas piping in buildings to conform to ANSI Z223.1/NFPA 54, *National Fuel Gas Code*, and ASME/ANSI B31.9, *Building Services Piping*, to include requirements for sizing of gas piping, joint selection, and venting of appliances. Where problems such as long self-supported spans, unstable ground, mechanical or sonic vibrations, and thermal forces other than seasonal exist, the engineer should design to meet the requirements of ANSI B31.3, *Chemical Plant and Petroleum.*

(1) Pipe design. Require cathodic protection for all underground ferrous piping. TM 5-811-7, *Electrical Design, Cathodic Protection*, contains additional guidance pertaining to cathodic protection on underground pipelines. Provide cathodic protection to extensions of existing systems. Provide testing stations in cathodic protection systems.

(2) Other components. The criteria for design of pipe bends, branch connections, heads and closures, flanges and reducers are given in ASME/ANSI B31.9.

(3) Limitations. Do not allow copper pipe or tubing if the gas supplied contains more than an average of 0.3 grains of hydrogen sulfide per 100 cubic feet of gas. Do not allow aluminum pipe or tubing in exterior locations or underground.

(4) Use of plastic materials. Only allow plastic pipe to be used outside underground, or as risers as permitted by Title 49, *Code of Federal Regulations*, Part 192. Require the use of plastic materials in accordance with the criteria established by the AGA “Plastic Pipe Manual for Gas Service”; by Title 49, *Code of Federal Regulations,* Part 192 (which contains the minimum federal safety standards for the transportation of gas and for pipeline facilities); and by the referenced standards and specifications.

(5) Anodeless gas risers. Require factory-assembled anodeless risers to be recommended by the manufacturer for the gas used and to be leak-tested by the manufacturer in accordance with written procedures. Require service head adapters to be recommended by the manufacturer for the gas used by the manufacturer and to be design-certified to meet the requirements of Category I of ASTM D 2513, and U. S. Department of Transportation, *Code of Federal Regulations*, Title 49, Part 192.281(e). Require the manufacturer to provide the user qualified installation instructions as prescribed by U.S. Department of Transportation, *Code of Federal Regulations*, Title 49, Part 192.283(b).

(6) Earthquake actuated (seismic) shutoff valves. Require seismic shutoff valves (sometimes referred to as California, or Koso, Valves) to comply with ASCE 25-97*, Earthquake Actuated Automatic Gas Shutoff Devices***. /5/**

5. AUTOMATED HEATING PLANTS. Gas-fired and oil-fired heating units will be equipped with automatic controls and firing systems, and safety devices to the extent necessary to provide non-attended operation as practicable. Such plants will be equipped with surveillance equipment for monitoring operations at a central manned location as practicable.

6. PETROLEUM FUEL FACILITIES. Except as modified herein, designs for construction, modifications and improvements of military land-based facilities which receive, store, distribute, or dispense liquid fuels, liquefied petroleum gases (LPG) and compressed natural gas (CNG) will conform to MIL-HDBK-1022 (reference 14-18).

7. REFERENCES.

14-1 TM 5-802-1, Economic Studies for Military Construction Design - Applications

14-2 NBS Handbook 135, Life Cycle Costing Manual for the Federal Energy Management Program, National Institute of Standards and Technology (NIST)

14-3 ASHRAE Systems Handbook, American Society of Heating, Refrigerating, and Air Conditioning Engineers

14-4 Defense Energy Program Policy Memorandum for Third Party Financing, (recent edition)

14-5 Defense Energy Program Policy Memorandum for Defense Facilities Energy Selection, (recent edition)

14-6 Public Law 100-42, Powerplant and Industrial Fuel Use Act of 1978, Amendment

14-7 Public Law 95-620, Powerplant and Industrial Fuel Use Act of 1978

14-8 Title 10, United States Code (10 USC 2690), Section 2690

14-9 Joint Services Manual, TM 5-785, NAVFAC P-89, AFM 88-29, Engineering Weather Data, July 1978 (this reference may be obtained from: The U.S. Army Adjutant General Publications Center, 2800 Eastern Blvd., Baltimore, MD 21220).

14-10 ASHRAE Fundamentals Handbook, American Society of Heating, Refrigerating and Air Conditioning Engineers

14-11 TM 5-810-17, Heating and Cooling Distribution Systems

14-12 Corps of Engineers Guide Specification **\3** (CEGS) 02570 ***/3/***, Valve Manholes and Piping and Equipment in Valve Manholes

14-13 CEGS **\3** 02553 ***/3/***, Heat Distribution Systems in Concrete Trenches
14-14 CEGS **\3** 02552 ***/x/***, Underground Heat Distribution Systems (Pre-approved Systems)

14-15 CEGS 02555, Prefabricated **\3** Underground Heating/Cooling ***/3/*** Distribution System

14-16 CEGS **\3** 02556 ***/3/***, Gas Distribution System

14-17 TM 5-848-1, Gas Distribution

14-18 Military Handbook, MIL-HDBK-1022, Petroleum Fuel Facilities, 30 JUNE 1997, Defense Printing Service, Standardization Document Order Desk, Building 4, Section D, 700 Robbins Avenue, Philadelphia, PA 19111-5094; Also available on the Internet at http://www.hnd.usace.army.mil/techinfo/milhbk.htm or http://web.infoave.net/~southdiv/criteria/index.htm#MHPF.

\3 14-19 CEGS 02554, Aboveground Heat Distribution System ***/3/***