Diesel Electric Generating Plants

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Section 1: INTRODUCTION

1.1 Scope. Data and criteria provided in this course apply to the design of diesel-electric generating plants for prime and standby/emergency duty. Considerations for incorporating the cogeneration of steam and/or hot water to satisfy export heat loads, or to generate additional electric power, are addressed.

1.2 Diesel-Electric Generating Plant Types. This course addresses stationary diesel-electric generating plants of two duty types: Prime Duty and Standby/Emergency Duty electric generating plants. Duty types and the electrical loads which are served by each are addressed in Section 2.

1.3 Definitive Designs and Guide Specifications. Several organization have prepared definitive designs and guide specifications for stationary diesel-electric generating plants which are summarized in Table 1 as to capacity ranges in kilowatts (kW), corresponding guide specifications, and definitive designs for each duty type.

Table 1
Summary Diesel-Electric Generating Plant NAVFAC
Definitive Designs and Guide Specifications
for Duty Types and Generating Capacity Ranges

Duty Type	Generating Capacity	Definitive Design Number
Prime	10 kW to 500 kW	None Available
	501 kW to 2500 kW	Design 1
	2501 kW and larger	Design 2
Standby/ Emergency	10 kW to 300 kW	None Available
	301 kW to 1000 kW	Design 3
	1001 kW to 3000 kW	Design 4

1.4 Usage: Definitive designs are available for both prime duty and for standby/emergency duty plants.

Section 2: GUIDANCE

2.1 Diesel-Electric Generating Plant Design. Diesel-electric generating plants should be designed to satisfy either prime duty or standby/emergency duty electrical service requirements in fulfilling the temporary or permanent mission of the intended activity at the lowest life-cycle cost. This course is not intended for portable generating units.

2.2 Sources of Electric Power. Many commercial and industrial facilities will normally be provided with several sources of electric power. Sources include commercial and government-owned electric generating plants. The number and types of sources required depend on the mission of the facility, activities taking place there, and the existing equipment. Specific design criteria for various types of facilities are referenced in their design manuals. Guidance for sizing, calculating electric loads and requirements for specific design features are contained in this course.

2.3 Duty Types and Loads. Stationary diesel-electric generating plants are separated into two duty types for design: Prime Duty and Standby/Emergency Duty.

2.3.1 Prime Duty Electric Generating Plants. Prime duty electric generating plants are designed for continuous service and are sized for peak electrical demand during normal peacetime operations. Continuous service is defined as operations exceeding 4,000 hours per year or when a plant is run, or planned to be run, more than 40,000 hours within the initial 10 years of operations. A generating plant is also considered to be prime duty if it is the only source of electricity, regardless of the operating schedule.

2.3.2 Standby/Emergency Duty. Any generating plant operating fewer hours per year than a prime duty plant is considered a standby/emergency duty plant as long as it is not also the prime source of electric power.Several types of standby/emergency duty plants are required to satisfy statutory and regulatory requirements within the United States (U.S.). Types are explained below but will be addressed simply as standby/emergency throughout the remainder of this course. The standby/emergency source of power should be sized to satisfy mobilization and emergency loads in the event of an outage of the prime source of power.

2.3.2.1 Standby Electric Source. The standby source of electricity for a facility is sized for the minimum essential operating load. When added to the capacity of the prime source of electricity, the combined generating capacity must be sufficient to serve the estimated peak electric demand under mobilization conditions.

2.3.2.2 Emergency Electric Source. The emergency source of electrical power is to provide electrical service to vital operations whenever there is an interruption of the prime source of electricity. Vital operations are those activities wherein an interruption in electrical supply can be tolerated for only a relatively short period. For certain operations, the

permissible interruption may be as long as 4 hours; for others it is only a few seconds.

2.3.2.3 Uninterruptible (No-Break) Power Supplies. Uninterruptible Power Supply (UPS) systems are required for certain electronic equipment and for other equipment performing critical functions which cannot tolerate any power interruption. An UPS system provides continuous disturbance-free (regulated) electric power and contains a battery bank which "floats-on-the-line." Standby/emergency diesel-electric generators are provided to backup such systems, since battery installations normally are sized to supply power for not more than 15 minutes.

2.3.3 Electrical Loads. Facility electrical loads, defined in NAVFAC DM-4.01, are categorized for each electrical source.

2.3.3.1 Primary Load. The primary load, which includes the critical load, is the peak electrical demand under peacetime conditions.

2.3.3.2 Minimum Essential Operating Load. This constitutes the minimum electric load necessary to support absolutely essential operations. Illumination is reduced to the bare minimum; all convenience and other loads are suspended. Refer to NAVFAC DM-4.01 and to the National Fire Protection Association, Inc, (NFPA) No. 70 National Electrical Code (NEC); Articles 517, Health Care Facilities, 700, Emergency Systems and 701, Legally Required Standby Systems for specific criteria and guidance in determining this load.

2.3.3.3 Vital Operation Loads. Vital operations are defined as those activities where an outage will cause the loss of the ability to perform primary missions. The loss of the ability to satisfy these loads could result in disastrous situations or in extreme safety hazards as compared to minor disruptions and inconveniences.

2.3.3.4 Critical Loads. The critical electric load is that part of the electrical load which requires continuous quality electric power. Examples include facilities such as hospitals, dry docks, shipyards, cold-iron support, and those facilities with computers or electronic equipment, as found in data processing and communications centers.

2.4 Planning Considerations.

2.4.1 Methods of Satisfying Electric Loads. The following alternate methods of satisfying electric load demands should be considered:

a) rehabilitation of existing equipment,

b) replacement of existing installations,

c) new installations,

d) consolidation of electric generating installations,

e) modernization,

f) cogeneration,

g) multiservice possibilities, for example, one electric generating plant to serve more than one installation, or

h) government versus commercial ownership and/or operations of facilities.

2.4.2 Evaluation Factors. Consider the following factors when planning and evaluating types of sources and when selecting electric generating facility types and systems:

a) actual loads, such as electrical lighting, miscellaneous power, heat, refrigeration, etc., and their duration,

b) mobilization requirements,

c) future expansion plans,

d) permanence of the electric generating plant and the facility which it serves,

e) standby/emergency electrical loads and requirements,

f) potential for cogeneration applications,

g) utility rate structure,

h) continuous integrity of utility service,

i) effects of planned energy conservation measures, and

j) past experience with other electric generating plants.

2.5 Commercial Versus Government Ownership (Prime Duty Only).

2.5.1 Commercial Ownership. Commercial sources (electric utility companies) should be utilized for the prime source of electrical power unless it can be proven that it is necessary or more economical for the Government to perform the service. The possibility of inducing private industry to undertake the operation must be examined before Government ownership may be considered.

2.5.1.1 Third Party Financing. Third party funding of major facilities energy systems should be vigorously pursued for facilities within the United States. (Refer to DEPPM 85-3, Defense Energy Program Policy Memorandum, Third Party Funding of Facilities Energy Systems). A major facilities energy system is defined as a project affecting 50 percent or more of a plant with thermal energy input of 100 million British thermal units (Btu) per hour (h) or more. Third party funding consists of contracting with a private sector firm for the construction, operation and maintenance of a major facilities energy system located on a Defense installation.

Purchase this course to see the remainder of the technical materials.