TM 3-34.45(FM 3-34.480)

ENGINEER PRIME POWER OPERATIONS

August 2013

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This special conversion does not integrate any changes in Army doctrine since 27 October 1997 and does not alter the publication's original references; therefore, some sources cited in this TM may no longer be current. For the status of official Department of the Army (DA) publications, consult DA Pam 25-30, *Consolidated Index of Army Publications and Blank Forms,* at http://armypubs.army.mil/2530.html. DA Pam 25-30 is updated as new and revised publications, as well as changes to publications are published. For the content/availability of specific subject matter, contact the appropriate proponent.

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Technical Manual
No. 3-34.45

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ENGINEER PRIME POWER OPERATIONS

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Preface

Technical Manual (TM) 3-34.45 supports engineer, Army, and joint missions throughout full spectrum operations. This TM provides a doctrinal basis for planning and employing engineer prime power assets in the operational environment. It describes the responsibilities, relationships, capabilities, constraints, planning considerations, and logistical requirements associated with engineer prime power operations.

The fundamental purpose of this TM is to integrate engineer prime power operations into the Army strategic and operational missions and support to joint operations. The primary audiences for this TM are engineer commanders and staffs. This TM will help support commanders and staffs or those who may require prime power support to understand the engineer prime power mission. Federal, state, and local government officials will find this information useful in homeland security planning.

This publication applies to the Active Army, the Army National Guard (ARNG)/Army National Guard of the United States (ARNGUS), and the United States Army Reserve (USAR) unless otherwise stated.

Terms that have joint or Army definitions are identified in both the glossary and the text. These terms and their definitions can be found in FM 1-02. For other definitions in the text, the term is italicized, and the number of the proponent FM follows the definition.

Appendix A contains a metric conversion chart. Appendix B outlines the most frequently asked questions about prime power. Appendix C discusses the electrical specialists of each Service of the U.S. military and the special role they play within their respective Service.

The proponent for this publication is the United States Army Training and Doctrine Command (TRADOC). Send comments and recommendations on Department of the Army (DA) Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Commandant, United States Army Engineer School, ATTN: ATSE-DD, Suite 336, 320 MANSCEN Loop, Fort Leonard Wood, Missouri 65473-8929. Submit an electronic DA Form 2028 or comments and recommendations in the DA Form 2028 format by e-mail to <doctrine.engineer@wood.army.mil>.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

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Chapter 1

Electrical Power

Electrical power is an essential element of military operations. Without it, many crucial systems are unable to operate. Command and control (C2) functions are highly reliant on dependable electrical power. Administrative, health service, and logistical support operations would be jeopardized without it. Many weapons systems are dependent on electrical power for operation. The proliferation of automated data processing equipment that supports modern warfare further contributes to the dependency of the Army on electricity. This growing dependence on electricity causes an increased requirement for the quantity and quality of power for support operations. The indispensable nature of electrical power compels commanders and planners to recognize their electrical-power needs and to ensure that those needs are met.

ELECTRICAL-POWER CONTINUUM

1-1. Electrical power encompasses the entire spectrum of power generation, distribution, and transformation that supports military operations. This spectrum covers tactical power, prime power, and commercial power.

TACTICAL POWER

1-2. Tactical power is generated by a mobile electrical-power unit dedicated to supporting the missions of units engaged in combat operations. Tactical power uses two classes of generators: precise and utility. These standard military generators are highly mobile, produce low voltages, and do not require the use of transformers. They have an output capacity that ranges from 0.5 to 200 kilowatts. These generators are in the unit table of organization and equipment (TOE) and are referred to as tactical generators (TACGENS). Distribution systems for tactical power are usually very simple. They often consist of standard components, such as field wiring or the Army distribution illumination set, electrical (DISE). Installation, operation, and maintenance of TACGENS and distribution equipment are the responsibility of the using unit.

PRIME POWER

1-3. ***Prime power*** **is continuous, reliable, commercial-grade utility power produced by prime power generators. Prime power plants are comprised of the Army family of nontactical generators that are larger than 200 kilowatts and produce low- and medium-level voltage.** Typically, prime power assets are employed in the communications zone or at an intermediate staging base (ISB), but they may be used to support critical facilities or large base camps in forward areas. This nontactical power is provided on an as needed basis to support military operations as directed by the theater Army or joint task force commander.

1-4. Prime power fills the gap between tactical power and commercial power and is generally used—

- When it is not practical or economically feasible to use TACGENS.
- When commercial power is not available.
- When the benefits of increased reliability and efficiency from consolidation and centralization of power systems outweigh the time, money, and material cost of providing the power.

1-5. A prime power plant may be comprised of different types of single or multiple generator sets, from military to commercial generators. However, only utility class sets with an output capacity of 525 kilo volt-amperes or larger are used from the military family of generators for prime power. Single sets may be low voltage (producing 416/240 volts at 50 hertz or 208/120 volts at 60 hertz) or medium voltage (producing 3,800 volts at 50 hertz or 4,160 volts at 60 hertz). Output capacity is 625 kilo volt-amperes for low-voltage sets and ranges from 525 to 1,875 kilo volt-amperes for medium-voltage sets. All of the single sets may be deployed in a multiple-unit power plant configuration for increased output capacities. All prime power generators require special site preparation for installation.

1-6. Prime power generator sets and power plants in the medium-voltage range require the use of switchgear, transformer, and medium-voltage rated cabling for operation. Prime power generation systems may be employed as a stand-alone power source (isolated load) or in parallel with a commercial-power source (load-sharing or peak-shaving modes). The use of prime power requires the construction of distribution networks to deliver power to the users. Installation, operation, maintenance, and repair of prime power assets are the responsibility of the engineer prime power units.

COMMERCIAL POWER

1-7. Commercial power is the generation systems that are fixed, nonstandard systems. Their output capacity may vary from a few megawatts to several thousand megawatts. Commercial power may be used as an option but may not be compatible or reliable with your needs in a joint operations area (JOA).

PRIME POWER OPTIONS

1-8. Prime power operations are a subset of the general engineering function of the Engineer Regiment. Engineer prime power units provide an essential continuity between power from TACGENS and commercial sources (figure 1-1). Prime power units provide technical assistance and staff planning to support development of electrical-power solutions for military operations. Prime power units also possess a limited capability to provide interim contingency power to satisfy the critical electrical requirements above the capability of TACGENS and below the availability of commercial power or to augment the power available from either source. The portion of the continuum that is exclusively prime power represents power generation and distribution accomplished by prime power units with their organic equipment. The intersections of TACGENS and commercial power with prime power represent areas of shared responsibility.

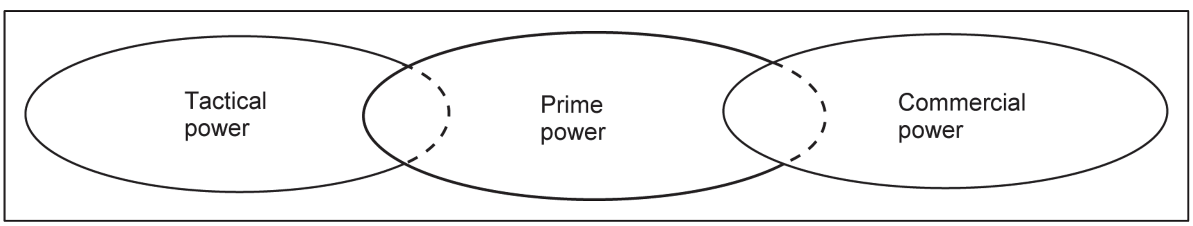

Figure 1-1. The power continuum

1-9. One example of an overlap between TACGENS and prime power can occur when a prime power unit designs and installs a distribution network that is powered by either TACGENS or commercial generators. Responsibility for providing, operating, and maintaining the generators lies with the user. Another overlap between prime power and commercial power may occur when a prime power unit repairs and maintains part of a distribution network on a commercial grid or when the unit taps into a commercial-power source to provide power to a user. Chapter 2 provides detailed information on the prime power missions and capabilities.

1-10. Engineer prime power units provide power-related technical expertise in support of operations across full spectrum operations. During war, the primary objective of prime power operations is to support the electrical-power portion of the civil engineer support plan. This support may include—

- Technical expertise and staff assistance to planners.
- Interim contingency power generation and distribution.

- Limited critical power infrastructure repair.
- Electrical distribution system installation, maintenance, and repair.
- Technical advice to the United States Army Corps of Engineers® (USACE), the Defense Contracting Management Agency, the base contracting office, and unit points of contact (POCs).

POWER GENERATION EQUIPMENT INSTALLATION MAINTENANCE AND REPAIR

1-11. Prime power units are designed to operate in the communications zone or theater sustainment area. They may operate as far forward as the mission dictates.

1-12. The primary objective of prime power units during stability operations is to provide power-related technical support and limited interim contingency power generation. Prime power units engaged in stability operations may assist in sustaining operations by powering base camps, participating in peak-shaving operations, or providing temporary power to key facilities, such as hospitals and government centers.

1-13. Maintenance and repair of prime power organic equipment is performed by prime power Soldiers. Depot-level maintenance and repairs are done by the prime power heavy maintenance section when required.

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Chapter 2
Prime Power Missions and Capabilities

Engineer prime power units support general engineering efforts theater-wide by providing advice and technical assistance on all aspects of electrical power. They provide limited, interim contingency power generation to critical facilities, which spans full spectrum operations. Prime power efforts and capabilities must be closely integrated and synchronized with general engineering efforts to achieve the effects intended in a theater civil engineer support plan.

POWER RELATED TECHNICAL ASSISTANCE

2-1. The prime power unit performs many technical, power-related tasks. A two-Soldier team will—

- Provide power-related planning and staff assistance.
- Conduct an electrical-load survey.
- Analyze and design power distribution systems.
- Perform damage assessment of distribution systems.
- Provide power-related technical assistance to the representative of the contracting office.

PROVIDE POWER-RELATED PLANNING AND STAFF ASSISTANCE

2-2. The prime power unit provides power-related technical assistance to the appropriate engineer staffs. The prime power representative is the theater subject matter expert for electrical power. He acts as a special staff officer to the theater engineer providing information and recommendations on power-related issues.

CONDUCT AN ELECTRICAL-LOAD SURVEY

2-3. An electrical-load survey is an analysis of power requirements. The load survey is a vital step in providing prime power support. A prime power team conducts the load survey to determine the supported power and distribution requirements of a unit. The load survey also determines the required level of reliability and identifies any special power demands or problems. The recommended power source is determined based on the load survey. A thorough load survey must be completed before installing a power plant or designing a distribution system.

ANALYZE AND DESIGN POWER DISTRIBUTION SYSTEMS

2-4. The electricity produced by prime power plants must be transformed to the required voltage and distributed to the intended users. Transformation can be accomplished by the organic equipment of the platoon or by commercial non-modified table of organization and equipment (non-MTOE) transformers. Organic transformation equipment provides power (380/220 volts at 50 hertz or 208/120 volts at 60 hertz) when employed with a prime power generator.

2-5. The prime power platoon is equipped with a limited supply of distribution equipment. This equipment is used for an interim distribution system while the supported unit procures the bill of materials (BOM) necessary to construct a system to replace the organic equipment of the prime power platoon. The supported unit provides nonstandard, primary distribution material and all secondary distribution material. Secondary distribution material includes the cable, splice kits, load distribution centers, circuit breakers, distribution panels, and ground rods that are required to make the connections from the secondary side terminals of the transformers to the intended users. Prime power Soldiers will develop the BOM for the distribution system.

PERFORM DAMAGE ASSESSMENT OF DISTRIBUTION SYSTEMS

2-6. The prime power platoon has the knowledge and equipment to assess damage to existing distribution systems. The platoon can assess aerial or underground primary or secondary distribution systems, as well as distribution systems within facilities. The prime power team performs a visual inspection of the system to identify any physical damage. They can perform electrical and infrared tests on components of the system. Prime power personnel can provide an after-action report outlining the damages found and provide a BOM of electrical equipment needed to make repairs to the electrical system. When inspecting existing commercial electrical systems for damage, one danger to be aware of is damaged and leaking transformers. These may contain polychlorinated biphenyls (PCBs), which present hazards to the environment and the Soldier.

PROVIDE POWER-RELATED TECHNICAL ASSISTANCE TO THE REPRESENTATIVE OF THE CONTRACTING OFFICE

2-7. The prime power unit provides power-related technical assistance to the representative of the contracting office. Prime power personnel can help develop specifications for performance contracts and purchase contracts for electrical material. In addition to developing specifications for contracts, prime power personnel also help perform the technical evaluation of the bids that are received. This assistance is available to military engineer units and supporting USACE personnel.

DISTRIBUTION SYSTEM CONSTRUCTION MAINTENANCE REPAIR

2-8. Prime power platoons can install and maintain temporary, primary, and secondary distribution systems. All distribution systems are designed and constructed with approved materials and methods, to include the appropriate protective devices. Prime power units have a limited capability to maintain overhead distribution systems. Construction and maintenance of extensive overhead distribution systems should be accomplished through the use of contracts or USAR power line platoons within the prime power battalion. Prime power personnel can make connections to existing distribution networks.

2-9. Prime power platoons are not used for performing interior electrical work. This function is performed by vertical construction platoons and engineer utilities detachments. When installing a secondary distribution system, the responsibilities of the prime power platoon end at the service entrance. The prime power platoon is responsible for making the connections to the service equipment. Service equipment, installed by interior electricians, includes the main distribution panel or switched fuse box inside the structure.

POWER GENERATION

2-10. Engineer prime power units can produce large quantities of reliable power with their organic generators. They can also install, operate, and maintain non-MTOE power generation equipment and some fixed commercial-power plants. This power generation capability can be used in a variety of military base camp configurations as well as seaports, airfields, C2 nodes, and other critical facilities. The power generation capability of the unit also allows them to operate, maintain, and perform damage assessments of fixed commercial diesel engine power plants.

ORGANIC EQUIPMENT

2-11. Each prime power platoon is equipped with four 1,050 kilo volt-ampere power units, giving the platoon 2.52 megawatts of continuous power production capability and 3.36 megawatts of peak power production. Table 2-1 lists the possible configurations and manpower requirements for continuous operation. This table also lists the output capacity of plants with various configurations. Appendix D provides an in-depth discussion of power generation.

Table 2-1. Power plant configuration options (at 60-hertz)

Number of Generators	***Installed Capacity (in kilo volt-amperes)***	***Continuous Operating Capacity (in kilo volt-amperes)***	***Percent of Platoon Required to Operate Plants***
4	4.200	3.150	100
3	3.175	2.100	100
2	2.125	1.050	50
1	1.050	0.525	50

Note. Manpower requirements are for continuous operations and distribution construction and maintenance. When the plants are used in the standby mode, manpower requirements may be reduced depending on the frequency and duration of operation time.

2-12. The platoon can install and operate these plants in two configurations. The plant can serve as the primary power source in the isolated configuration or augment an existing power source in a load-sharing or a peak-shaving configuration. As a primary power source, which is most common, prime power is employed when providing power to locations where commercial power is not available. The load-sharing mode is used to supplement existing power and add capacity to the commercial source. Figure 2-1 shows the stand-by and load-sharing or peak-shaving modes connectivity.

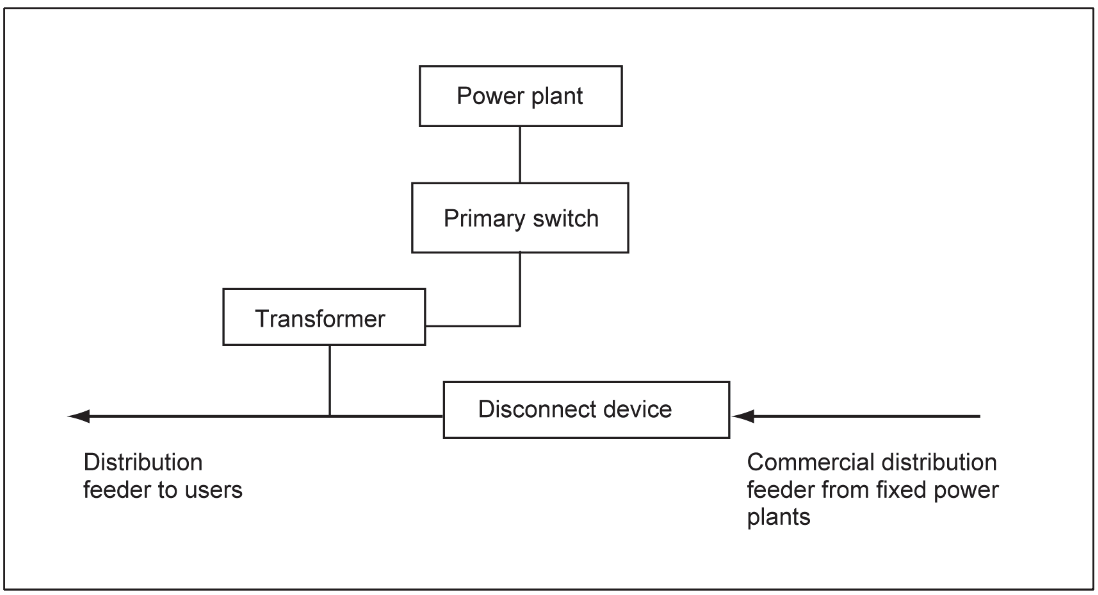

Figure 2-1. Stand-by and load-sharing or peak-shaving modes

WAR RESERVE EQUIPMENT

2-13. The prime power battalion is responsible for operating and maintaining a war reserve consisting of generators of various sizes ranging from 625 to 1,875 kilo volt-amperes. The prime power loan program manages the war reserve equipment.

FIXED POWER PLANTS

2-14. Prime power units have a limited capability to operate, maintain, and perform damage assessment of some fixed commercial-power plants, specifically diesel engine plants. Continuous operation of large fixed plants exceeds the manpower capabilities of the prime power platoon. The prime power platoon should work with local power plant operators or contracted technicians familiar with the plant. Army prime power Soldiers are not trained to operate nuclear, fossil fuel, or hydroelectric plants. They are capable of providing technical advice regarding such facilities in emergency situations.

BASE CAMP POWER SUPPORT MODELS

2-15. Prime power platoons are capable of providing power to base camps of various configurations, such as—

- Standard base camp designs (Force Provider, United States Air Force bare base).
- Standard base camp designs (Army Facilities Components System [AFCS]).
- Nonstandard base camp designs.

STANDARD BASE CAMP DESIGNS (FORCE PROVIDER, UNITED STATES AIR FORCE BARE BASE)

2-16. Prime power battalion assets will be used to support elements of the Army Premier Base Support System (Force Provider) when directed by the Army Assistant Chief of Staff, Operations and Plans (G-3). Missions associated with the Force Provider system include theater reception, an ISB, rest and refit for Soldiers, redeployment, and base camps for stability operations. Figure 2-2 shows the layout of a typical Force Provider module. A prime power platoon can support a three-module Force Provider package (base camp), along with a C2 cell, a signal detachment, and a small medical facility with its organic personnel and equipment. The total planned population for each camp is 1,800 people. The C2 cell, the signal detachment, and the medical facility are all mission critical and must have a backup power source in addition to base camp power (responsibility of the supported unit).

2-17. Power for Force Provider sites can be delivered by the twenty-seven 60-kilowatt TACGENS that are organic to each Force Provider set or through the use of prime power generation assets. The Force Provider site requires the prime power connection kit if a central power plant is requested. The kit includes all the required power transformation and distribution equipment. The connection kit is not organic to each Force Provider set, and planners must request the kit through Force Provider channels if they intend to use prime power equipment.

STANDARD BASE CAMP DESIGNS (ARMY FACILITIES COMPONENTS SYSTEM)

2-18. The AFCS contains JOA construction plans that incorporate prime power as an electrical power source. Electrical-distribution plans are based on the availability of a four 4,160-volt, three-phase power source, which is the output voltage of prime power plants. The AFCS lists the required materials, to include distribution transformers, and the anticipated work requirements to install an initial standard electrical-distribution system (design life of up to 6 months). The cable for the initial standard electrical-distribution system is ground-laid. It is marked with fences and signs and is buried at road and track crossings. Electrical safety-related construction standards are not relaxed for initial standard construction. A temporary standard electrical-distribution system has a design life of up to 24 months. The cable for the temporary standard electrical-distribution system is normally buried or installed overhead.

2-19. The Theater Construction Management System (TCMS) is a computer-based system for construction planning, design, and management used by military engineers for contingency construction activities. It combines state-of-the-art computer hardware and software with the AFCS's design information to support and enhance the accomplishment of engineer mission activities in the JOA or other mission areas. TCMS is updated and distributed annually. It provides the automation tools that are necessary to use the AFCS's information to accomplish JOA engineering and construction activities in support of mission requirements. TCMS includes several design options for using prime power in standard AFCS base camps.

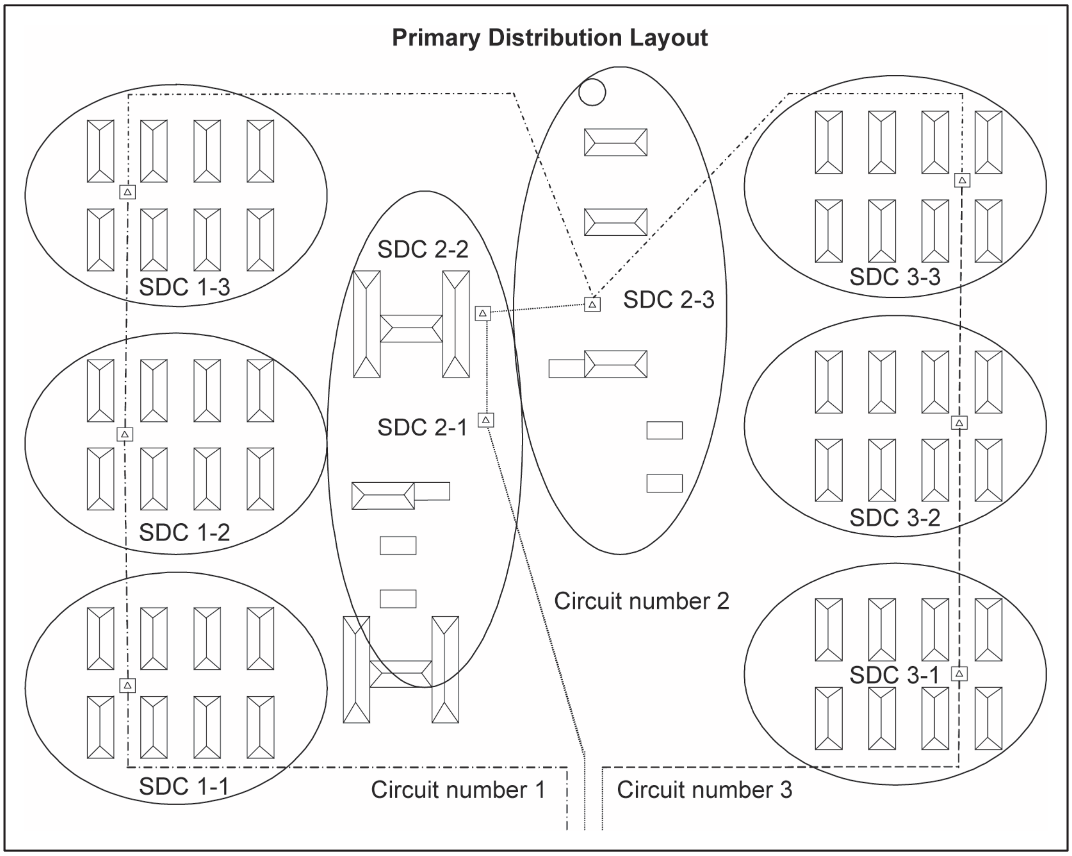

Figure 2-2. Typical force provider module (550-man)

NONSTANDARD BASE CAMP DESIGNS

2-20. Prime power platoons can provide power to nonstandard base camp configurations. The planners of the nonstandard base camp must request the prime power team during the design phase. The prime power team will provide technical assistance by analyzing the power requirements, selecting the power plant site, and designing the distribution system. Early involvement of a prime power team is essential to ensure full integration of the electrical utility into the base camp master plan.

2-21. As with nonstandard base camps, it is critical that the prime power plan is incorporated early by requiring a prime power team in the initial planning phase. The standard distribution equipment of the platoon provides power to an isolated camp that lacks its own distribution system. Prime power personnel will connect the secondary distribution centers (SDCs) (transformers) to organic standard Army DISE boxes. The organic distribution equipment of the prime power platoon is intended for use only as an initial and temporary distribution system. It is the responsibility of the supported unit to procure all primary and secondary distribution equipment associated with using prime power. The construction of primary and secondary distribution systems requires large quantities of relatively expensive equipment and materials. These materials may be difficult to procure in theater and/or may require a significant lead time. Chapter 5 provides information on the type, quantity, and size of a basic distribution system BOM.

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Chapter 3

Engineer Prime Power Unit Organization

The prime power platoon is the basic building block for conducting prime power operations. Prime power platoons are small, highly deployable, modular units that provide electrical-power support across full spectrum operations. The platoon is capable of deploying independently of its higher headquarters, but does require administrative and logistical support (discussed in Chapter 5) upon arrival in a JOA. If two or more platoons deploy for a mission, a prime power engineer company headquarters deploys to provide C2, sustainment, and specialized technical support to the mission. In peacetime, each prime power company consists of a company headquarters and four prime power platoons, augmented with one prime power platoon and one power line platoon from the Reserve Component. These prime power companies are organized along with a headquarters and headquarters company under an engineer battalion (prime power). The battalion higher headquarters is USACE, which is a Direct Reporting Unit (DRU). A cell from the battalion headquarters is deployed if more than one subordinate company is required to support a particular theater or contingency. This cell usually includes logistics, liaison, or coordination capability. It provides C2 of the companies; liaison and coordination; and specialized maintenance, administrative, and limited logistical support.

ENGINEER BATALLION (PRIME POWER)

3-1. The battalion commander is an engineer lieutenant colonel. The battalion executive officer and operations staff officer (S-3) are both engineer majors. The personnel staff officer (S-1) and the logistics staff officer (S-4) are engineer captains. Figure 3-1 further describes the organization of the battalion.

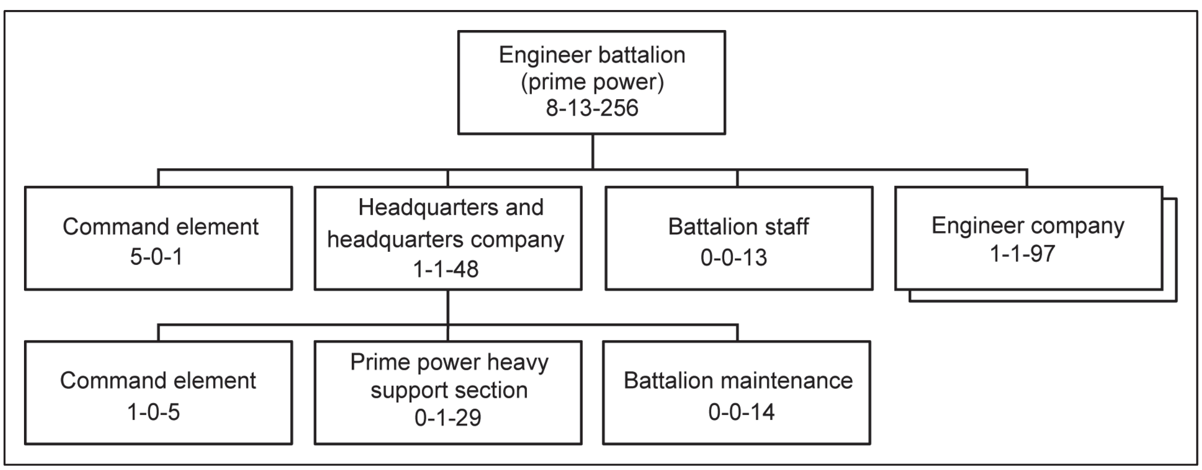

Figure 3-1. Engineer battalion (prime power) organization

3-2. A prime power heavy support section that is organic to the headquarters and headquarters company is capable of performing field-support and sustainment support maintenance of prime power plant and provides specialized Class IV, VII, and IX support to subordinate units.

3-3. Elements of the battalion headquarters may deploy to a JOA in the event that more than one subordinate company is deployed in support of the same theater. The battalion headquarters task-organizes a support cell to deploy with and support subordinate elements.

3-4. The battalion provides several additional functions relevant to operations short of war. These functions include—

- Rapid worldwide deployment of engineer prime power assets in response to contingency missions or emergencies.
- Staff liaison, coordination, and war planning with engineer commands, USACE, United States Army Forces Command, unified and specified commands, and joint task force headquarters.
- Management and coordination of military prime power requirements worldwide.
- Management of the prime power generator war reserve. The battalion can provide, on a reimbursable loan basis, power generation equipment to support the Department of Defense (DOD) and other federal agency activities worldwide.
- The battalion can provide training on power generation equipment for both military and civilian (U.S.) and foreign personnel.

ENGINEER COMPANY (PRIME POWER)

3-5. The company consists of a headquarters platoon, four active duty prime power platoons, one prime power platoon (USAR), and one power line platoon (USAR). The organization of the company is further described in figure 3-2. The engineer prime power company headquarters provides the following:

- C2 of subordinate prime power platoons.
- Power-related staff assistance, technical advice, and coordination with the host nation, higher headquarters, supported units, and other engineer units.
- Administrative and limited logistics support to subordinate prime power platoons, to include specialized Class IV, VII, and IX support.

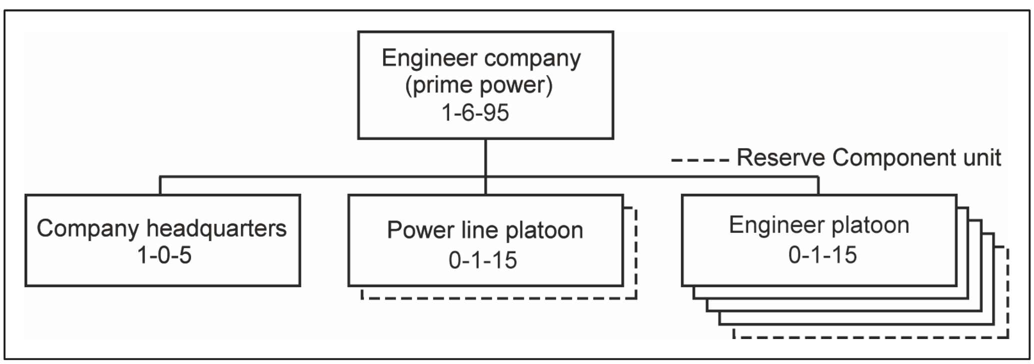

Figure 3-2. Engineer company (prime power) organization

ENGINEER PLATOON (PRIME POWER)

3-6. The engineer platoon (prime power) is an autonomous unit. It is the basic building block for the company and battalion (prime power). The platoon can be deployed independently or as part of a prime power company, battalion, or task force. The 16-man platoon includes 14 noncommissioned officers (NCOs) with a military occupational specialty (MOS) 21P, prime power production specialist. These NCOs have ranks of sergeant through sergeant first class. The platoon noncommissioned officer in charge (NCOIC) is a master sergeant with a MOS 21X, general engineering supervisor. The platoon officer in charge (OIC) is a warrant officer with a 210A5 specialty. The platoon is organized into two 7-man sections. Figure 3-3 shows the organization of the platoon.

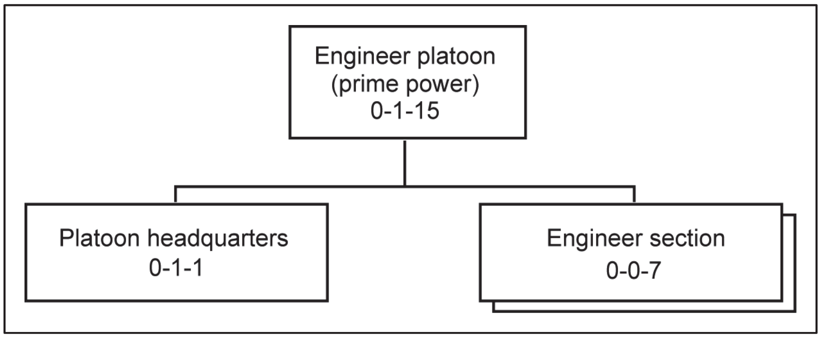

Figure 3-3. Engineer platoon (prime power) organization

3-7. In addition to power generation equipment, prime power platoons also have limited distribution capabilities and equipment organic to the unit. The distribution system gives the platoon the ability to deploy and provide power to an isolated and dispersed load (such as a standard Army base camp) that does not have its own distribution system. The organic distribution equipment of the platoon serves as an immediate interim solution. The base camp will procure distribution materials for the longer-term missions. Chapter 5 lists the organic distribution equipment allocated to each platoon.

3-8. Training and experience gives prime power NCOs an in-depth working knowledge of electrical and electromechanical systems. Each 21P NCO possesses one or more power-related additional skill identifiers (ASIs). The ASIs include: mechanical, S2; electrical, S3; and instrumentation, E5. Six personnel in each platoon are qualified to perform overhead distribution maintenance (ASI of U4). The skills and knowledge of these NCOs enable them to execute electrical-field engineering on a wide range of power generation and distribution systems.

ENGINEER PLATOON (POWER LINE)

3-9. The power line platoon can be employed independently or as part of a prime power company, battalion, or task force. The 17-man platoon includes 7 NCOs and 9 enlisted Soldiers with an MOS 21Q, transmission and distribution specialist (RC). The platoon OIC is a warrant officer with a 210A5 specialty. The platoon is organized into three 5-man sections. Figure 3-4, describes the organization of the platoon.

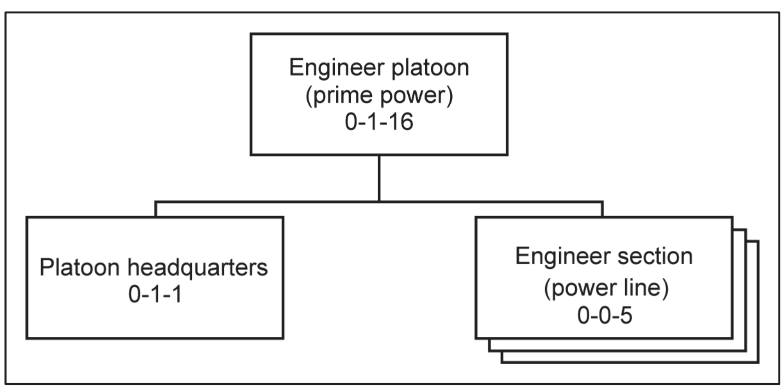

Figure 3-4. Engineer platoon (power line) organization

3-10. A power line platoon has the equipment, manpower, and expertise to perform many highly technical power-related tasks to include the following:

- Construct and maintain overhead distribution systems.
- Assess and repair commercial-power distribution systems.
- Provide host nation personnel with power line training and assistance in civic-action projects.
- Provide technical assistance in developing a BOM for distribution systems.

Chapter 4

Power Plant Unit Employment

Due to the specialized and technical nature of prime power missions, planners must consider a wide variety of planning guidelines when determining if prime power is an appropriate option to accomplish a given mission and, if so, how prime power should be used. Proper planning and consideration will ensure that prime power Soldiers are effectively employed to complete the mission.

GUIDELINES

4-1. The following guidelines will enhance the employment of prime power assets and will result in more reliable electrical service:

- Determine how much power is needed and the source.
- Plan to upgrade service after initial installation.
- Determine the required level of service and reliability.
- Specify the date and duration of the requirement.
- Coordinate funding requirements.

4-2. Electrical-power planning should never be an afterthought. Power requirements are an integral part of the theater-based development planning process and the resulting plan.

4-3. The prime power unit will conduct a preliminary reconnaissance before committing assets. The prime power platoon will identify the power needs and recommend the best way to fulfill them. The platoon will conduct a load survey to determine how much power is required and where it is required and then design systems to provide power based on the survey. The prime power unit will recommend the best power source based on the level of reliability required and available assets. Many times, the power requirements are so complex that the supported unit is unable to communicate its power needs. A thorough reconnaissance will clarify their needs.

4-4. Commercial power is used when it is available. Commercial power is usually reliable in developed countries. Prime power platoons can make connections to commercial distribution networks or coordinate with the utility company to have them make the connection. Once connected, the system can provide continuous power service virtually maintenance free. A major advantage of using commercial power over installing a plant is that the prime power platoon remains available to perform other electrical work. When a plant is installed, the platoon or part of the platoon is fully committed to operating and maintaining the plant instead of performing other power-related missions. This takes greater advantage of the technical training of the platoon.

4-5. The power source should be matched to the load requirements. Resources that are ill-suited for a particular application should not be committed. A common violation of this guideline occurs when a large prime power plant is installed to provide power to a relatively light load. This is an inefficient use of power generation assets that could be better used elsewhere. Operating large prime power generators under light loads increase the wear and tear on the generator engines. Prolonged misuse will cause carbon fouling and buildup, reduced engine performance, and eventual engine failure. Prime power equipment should be considered when the assessed load exceeds 437.5 kilo volt-amperes.

4-6. Load increases should be considered during planning and made to provide adequate power. If future plans indicate that growth will increase power demands, build distribution systems to handle the growth. This can be done either by overbuilding the system initially or by building it so that it can be readily expanded as needed. Systems that are not anticipating growth should still be designed and built to accommodate 150 percent of the estimated demand.

4-7. Plant deployment, installation, and distribution system construction is a time-consuming procedure. This process precludes the rapid relocation and setup of power plants and their associated distribution networks. Generally, it takes a full prime power platoon up to 5 days to construct one organic power plant and have it operational, depending on the amount of site preparation required. The 5-day rule of thumb does not include construction of a distribution system to provide power from the plant to the user.

4-8. Distribution system construction and installation is influenced by the following variables:

- The type of system required (underground or aerial).
- The availability of the BOM.
- The availability of engineer assets for trenching or mine clearing.
- The threat of the enemy and local security situation.
- The availability of contractor support.
- The availability of a local national skilled and unskilled work force.

4-9. Generally, it is feasible to install a prime power plant for units or activities that plan to use it for 30 days or more. Units relocating often should use TACGENS or relocate to facilities powered by the commercial grid or an existing prime power plant. Expanding an existing prime power plant and its distribution network is usually more practical than relocating it.

4-10. Deployed units will rely on their TACGENS for initial power needs. Units and activities that are in place for extended periods will need to upgrade their facilities. Power produced by low-voltage TACGENS should be replaced by prime power or commercial power. This replacement increases reliability and saves wear and tear on TACGENS. Stand-alone prime power plants should be replaced with commercial power as it becomes available. Prime power plants should be used up to 6 months as a temporary power solution. At this time, the supported units should plan to switch to commercial power, purchased commercial generators, or contract power assets (such as the logistics civil-augmentation program, local contractors, and USACE contracts). When considering purchased commercial generators, the maintenance and refueling requirements must be addressed. As a strategic asset, prime power equipment and personnel must establish power quickly, and then support the next high-priority mission as the situation continues to develop.

4-11. The priorities of employment of prime power support are the same as those for other engineer support in the JOA.

4-12. Planners should consider the use of prime power war reserve assets when it is impractical to employ organic prime power assets or when the mission is known to be long term. Prime power Soldiers will install these assets and train the supported unit organic personnel (normally MOS 52D, power generation equipment repairer) to assist in the operation and maintenance of the plants. This provides the supported unit sustained reliable power while reducing the long-term manpower requirements on the prime power battalion. War reserve assets may be used for backup power as well.

COMMAND AND CONTROL AND REQUEST PROCEDURES

4-13. Prime power units in theater operate under the following C2 guidelines. Engineer prime power units are theater engineer assets. They are assigned or attached to the senior engineer headquarters in the theater. As such, they will most likely be employed in a general-support role throughout the theater.

WARFIGHTING COMMAND AND CONTROL

4-14. Based on the policies and priorities of the theater Army commander, theater engineers determine relative priorities and allocate prime power assets on a task basis. When appropriate, theater engineers may further task-organize prime power assets to achieve the desired level of responsiveness while balancing the unique support requirements of prime power units.

REQUEST PROCEDURES

4-15. Request channels for prime power support during warfighting operations are shown in figure 4-1. In a smaller theater where the theater engineer brigade performs the engineer command function, it assigns missions to the prime power unit.

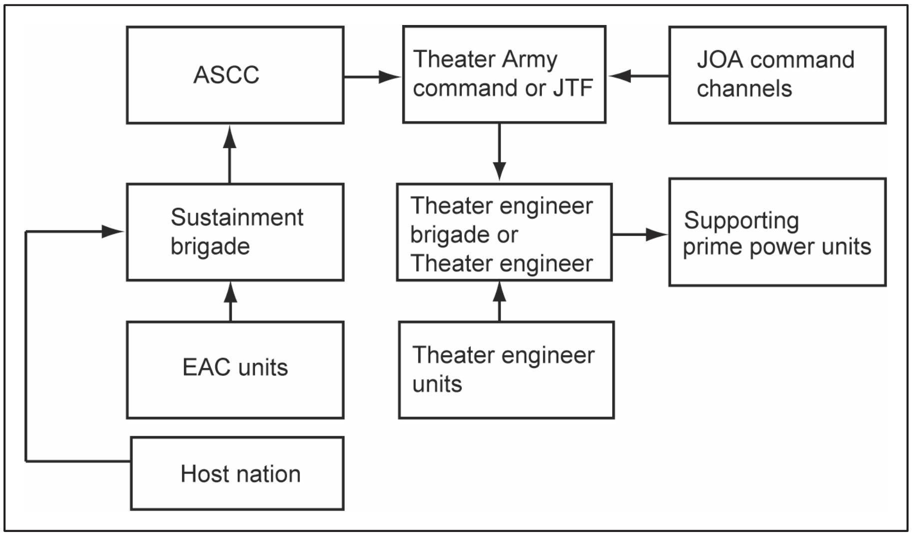

Figure 4-1. Warfighting prime power support request channels

4-16. Echelons above corps (EAC) units, located in the communications zone, request support through the sustainment brigade. The requests are forwarded through the Army Service Component Command (ASCC) to the theater Army command or joint task force (JTF). The theater Army command or JTF approves requests, assigns their priority, and tasks the theater engineer to support them. The theater engineer assigns the missions to the supporting prime power unit. Support requests from the host nation are submitted to the sustainment brigade and are handled like all other requests.

4-17. Requests for prime power support in the JOA are submitted through command channels to the theater Army command. Approved requests are assigned priority and are tasked to the theater engineer, who assigns the mission to the supporting prime power unit. All requests should include as much mission detail as possible and an estimated time for work completion. If available, information as outlined in appendix E should also accompany requests.

4-18. Coordination with other theater engineer units is very important when working together on a construction mission. Close coordination before and during construction will preclude on-the-job confusion between units and will reduce safety hazards associated with electrical construction.

4-19. As a part of USACE field force engineering, liaison officers will be activated and placed on the combatant commander's engineer staff during warfighting operations. These liaison officers can assist with prime power planning and facilitate the request procedure.

STABILITY OPERATIONS

4-20. Prime power units are employed in many roles in stability operations, from providing power to American facilities, to providing technical assistance and training directly to the host nation. The C2 relationships established will be dependent on the role of the prime power units in these operations.

COMMAND AND CONTROL

4-21. The operational control-command relationship is used extensively in the employment of prime power units. The prime power Class IV, VII, and IX requirements are highly specialized. This requires deployed companies and platoons to maintain supply channels with the prime power battalion. Companies and platoons depend on the battalion for electrical engineering support and personnel replacements. Prime power units rely on the supported unit to provide unit organizational maintenance (minus organic generators), food, health, religious, legal, finance, and personnel services. Chapter 5 contains detailed information regarding logistical support.

4-22. Engineer prime power units also support other types of stability operations. Prime power units supporting these operations will be part of a larger force, such as a JTF. As such, they will normally be under the operational control of the senior U.S. command that is participating.

4-23. Prime power units can be employed in national assistance operations independently or as part of a larger assistance effort. A prime power unit participating in national assistance operations with other military units will normally be under the operational control of the senior military commander or to the senior engineer commander, as appropriate. When operating independently (such as in support of a United States Department of State [State Department] assistance effort), the prime power unit will normally be under the operational control of the chief of the security assistance organization for the country being assisted. The security assistance organization chief is one of the military representatives within the country team. The country team provides advice and assistance to the ambassador.

REQUEST PROCEDURES

4-24. Figure 4-2 depicts request channels for routine requests. Routine requests are a result of preliminary planning for a particular operation, exercise, or activity. These requests may originate from Army units, JTFs, or sister Services conducting operations or exercises. Requests may also originate from government agencies needing support for domestic or foreign activities.

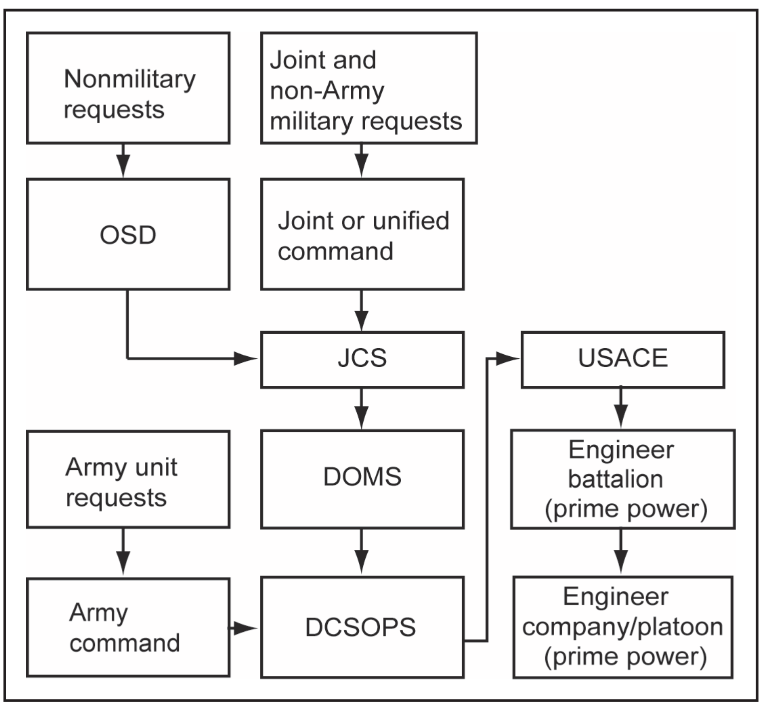

Figure 4-2. Routine prime power support request channels

4-25. Joint and non-Army military requests are forwarded through the appropriate joint or unified command to the Joint Chiefs of Staff (JCS) for approval. Nonmilitary requests are forwarded to the Office of the Secretary of Defense (OSD) for approval. Once approved, support taskings are forwarded to the Directorate of Military Support (DOMS), who determines which Service will support the taskings. The taskings selected for Army support are forwarded to the DA Deputy Chief of Staff for Operations (DCSOPS).

4-26. Requests from Army units are forwarded through the appropriate Army command to DCSOPS for approval. All taskings are forwarded to USACE and finally to the engineer battalion (prime power). The battalion commander selects the company or platoon to support the requirement.

DISASTER RESPONSE OPERATIONS

4-27. Prime power units frequently execute worldwide disaster response missions. The procedures for requesting and employing prime power assets for these missions are different than those that support military operations. Disaster response missions fall into two categories:

- Disaster response to foreign nations.
- Disaster response in the continental United States (CONUS), Alaska, Hawaii, and U.S. territories.

4-28. Differentiation is made along these lines according to federal law. Army participation in disaster response missions is covered in the national response plan.

COMMAND AND CONTROL

4-29. Military participation in foreign disaster response missions falls into the category of contingency operations. DOD takes part in foreign disaster response operations following the request for assistance and allocation of funds by the State Department. Prime power units participating in foreign disaster response are under the operational control of the senior commander or the senior engineer commander.

4-30. When supporting disaster response operations in CONUS, Alaska, Hawaii, or U.S. territories, a prime power unit will be attached to the USACE division providing Emergency Support Function-3 (ESF-3) that is under the operational control of the Federal Emergency Management Agency (FEMA). The combatant commander of the regional unified command appoints the Deputy Commanding General for Alaska, Hawaii, and U.S. territories. The ASCC commander appoints the defense coordinating officer (DCO) for disasters in the 48 contiguous states.

REQUEST PROCEDURES

4-31. Figure 4-3, page 4-6, shows emergency request channels. Requests for emergency prime power support are associated with disaster response operations. They originate from the State Department for overseas disasters or from the federal coordinating officer (FCO) or the DCO for domestic disasters. FCO or DCO requests are routed to USACE, which tasks the engineer battalion (prime power). State Department requests are routed through the OSD to the JCS. The JCS tasks the director of the DOMS, who determines which Service will support the tasking. The taskings selected for Army support are forwarded through the Army G-3 to USACE, which tasks the engineer battalion (prime power).

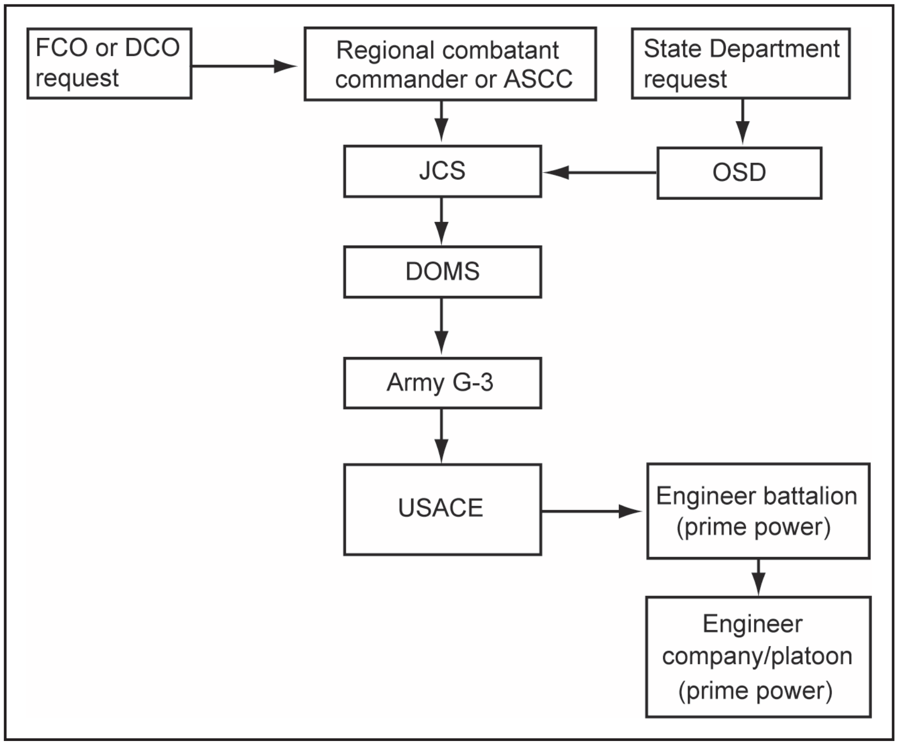

Figure 4-3. Emergency prime power support request channels

Chapter 5

Prime Power Planning Considerations

The integration of prime power units into the general engineering concept of an operation is unique and highly technical. Planners must consider the existing level of infrastructure within the JOA, the logistical support requirements, and the long-term power requirements. Prime power Soldiers provide technical advice and assistance to theater engineers throughout the planning process.

INTEGRATION INTO THE GENERAL ENGINEERING CONCEPT

5-1. Prime power assets and capabilities must be carefully integrated into the overall general engineering concept and employed to support the objectives of the theater civil engineer support plan. The subject matter expert of any engineer capability is the best prepared to provide assistance in integrating and synchronizing engineer efforts with those of other units.

5-2. Planners should consider the full range of prime power capabilities (described in Chapter 2) when analyzing mission requirements and allocating units to those missions. Prime power units deploy, install, operate, and maintain large power plants. However, their ability to provide technical expertise and battle damage repair of existing infrastructure will produce more immediate and profound results than the time- and manpower-intensive process of constructing a new power system.

5-3. During complex missions (such as base camp construction) particular attention must be given to synchronizing prime power with the efforts applied to vertical and horizontal construction. Early involvement of the prime power unit in the master planning process is crucial. It is important to have prime power personnel involved in regular construction meetings to maintain logical sequencing of the overall project. Figure 5-1, page 5-2, shows roles and responsibilities for the various military specialties involved in constructing an electrical-power system and demonstrates the potential complexity of synchronizing the parties involved.

5-4. Engineer planners should set the conditions for mission success with the supported unit commander by managing expectations from the beginning of the planning process. Construction of a new power system is a laborious process, with few interior tangible results until the system is complete and power is delivered. The same is true with repair or rehabilitation of an existing, battle-damaged system. Other key points include—

- Understanding that high-voltage electrical materials are seldom off-the-shelf items and can take months to procure.
- Using precompleted or existing contingency contracts or existing indefinite-delivery, indefinite-quantity contracts can save weeks or months of administrative time for purchasing construction materials and power-related services.
- Realizing that prime power BOM is expensive and reflects the cost of the increased reliability and higher level of service of utility-grade electrical power.
- Realizing that a functional distribution system is still required to deliver electrical service to the end user once power plant installation is complete. Installation of an organic prime power plant requires about 5 days once all equipment is on-site.
- Beginning the planning for follow-on power support (commercial power, contractor, or another military unit) early to allow for detailed planning and mobilization and the smoothest possible transition from prime power to its successor. Some critical issues to consider include the future requirement and duration, funding, contracting mechanisms, and possible distribution reconfiguration requirements resulting from prime distribution voltage changing from

4,160 volts, alternating current (VAC). Army prime power units are extremely low-density units with high operational tempo.

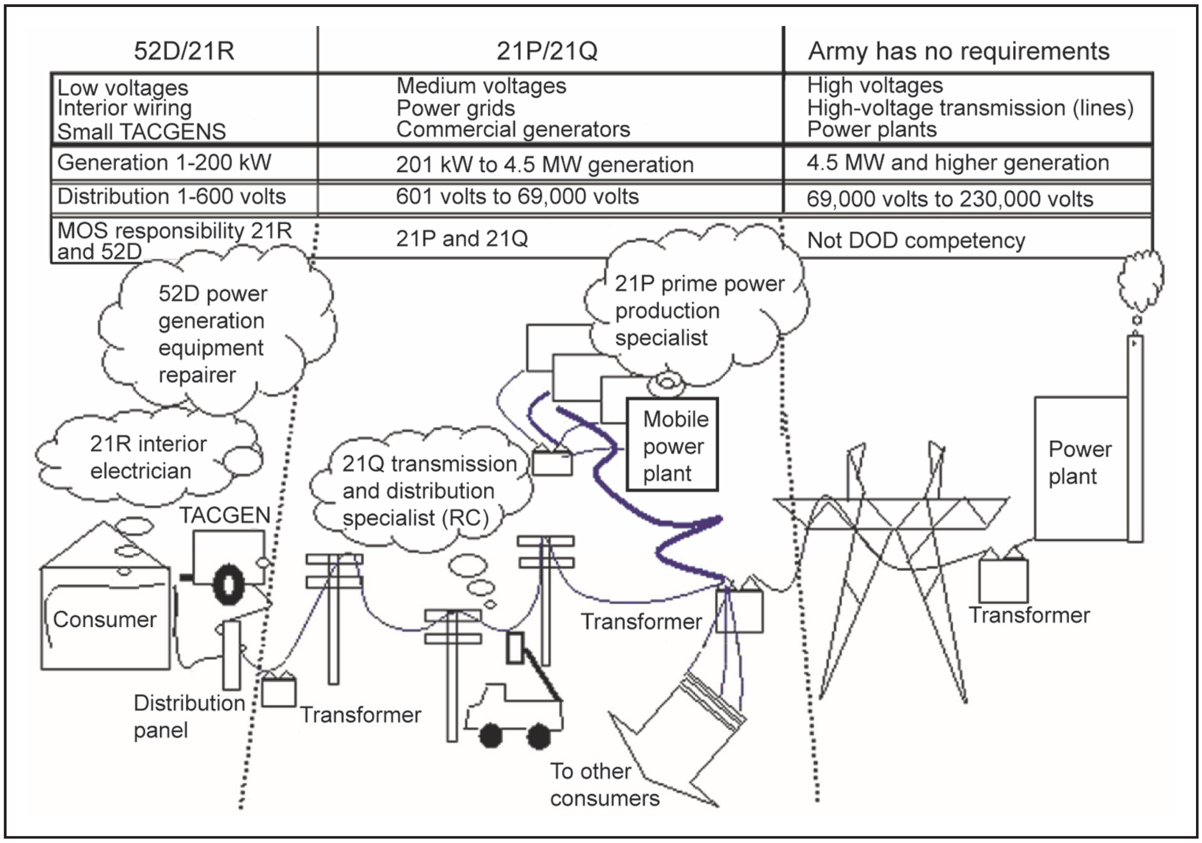

Figure 5-1. U.S. Army MOS roles on the battlefield

THEATER INFRASTRUCTURE LEVEL

5-5. Planners should consider the development of the JOA infrastructure in terms of utilities, a skilled labor workforce, and sustainable power sources. Theaters with less developed infrastructures will require more prime power support than well-developed infrastructures. At wartime, developed infrastructures can be crippled in a short period of time. The extent of damage will influence the impact on the restoration of commercial power and may take months or years. Loss of commercial-power production will be detrimental to military operations and civilian activities. It will greatly increase the demand for electrical power produced by TACGENS, non-MTOE generators, and prime power plants.

5-6. Development of the civil engineer support plan at the unified and specified command level should examine the impact of extensively war-damaged electrical utilities. The civil engineer support plan should determine the requirement for prime power support to provide electricity to critical facilities under these circumstances. Logistics planners should consider the availability of sources of supply for power-related materials in the theater. This includes generators, distribution cable and wire, connecting devices, switch boxes, transformers, and protective devices. Planners should consider the availability and reliability of potential sources for power-related service and performance contracts. The support and coordination of the power authority as well as contracting with local power engineers and engineering firms should be considered. Materials and services not locally available have to be imported to the JOA. Planners should consider distribution voltage and frequency. This is critical if plans call for using commercial power. In most cases where U.S. forces will maintain a long-term operational presence in a theater, transition of military facilities to commercial power is a likely and a desirable end state for power. Planners should strongly consider basing the theater electrical standard on host nation voltages and frequencies. When voltage and frequency are not compatible with the intended use, power must be obtained from an alternate, compatible source or when possible, converted for compatibility. Appendix F lists the frequency and voltage of worldwide power systems. Due to large volume of fuel required for extended operations, the prime power generation site will require the construction of a secondary containment system for the fuel storage. This containment is required for both stationary fuel tanks and when fuel tankers are used. Any external fuel lines running from the storage tanks to the generators will also require some means of containing fuel spills, and a spill containment kit should be available on-site.

LOGISTICS CONSIDERATIONS

5-7. Prime power operations require considerable logistical support. Distribution system construction support, movement, fuel, and personnel support account for most of the logistical requirements.

CONSTRUCTION SUPPORT REQUIREMENTS

5-8. The establishment of a prime power plant, coupled with a distribution system, normally requires construction effort beyond the capability of the platoon. Site preparation in a bare base theater may include basic earthwork (clearing, grubbing, leveling, and compaction) that must be accomplished by an engineer construction unit or a local contractor. Distribution system installation will require constructing ditches and/or erecting poles. In addition, overhead-line installation and repairs require support from others. Planning for prime power plants must include these tasks, as a minimum.

TRANSPORTATION

5-9. Prime power units require transportation support to relocate power plants and associated equipment. All organic or war reserve equipment (with the exception of electromotive diesel [EMD] units), including generators, cable, control vans, and transformers can be transported on flatbed or lowboy trailers. EMD units must be moved by rail. Mobile substations are trailer-mounted and only require tractor support to move. Deployable power generation and distribution system (DPGDS) 1,050 kilo volt-ampere (840 kilowatt at 0.8 power factor) power production units (organic generators) are trailer-mounted and are Department of Transportation (DOT) certified for highway travel speeds up to 55 miles per hour. DPGDS power units require a 915-series tractor or commercial equivalent for movement. Organic equipment can also be moved by air.

5-10. Prime power companies and platoons require materials-handling equipment support to upload and download equipment subsequent to relocation. A 40-ton crane and a 10,000-pound rough-terrain forklift can support this requirement. Equipment specifications for all types of organic and war reserve generator assets are listed in table 5-1, page 5-4. Forklift or crane support beyond the organic capability of the platoon may be required when constructing distribution networks. Units involved in erecting and/or repairing and making connections to overhead distribution networks will require the use of a line truck, which is organic to Reserve Component power line platoons.

Table 5-1. Generator specifications

Equipment Type	Equipment Physical Dimensions			
	Weight (in pounds)	*Height (in inches)*	*Width (in inches)*	*Length (in inches)*
Caterpillar® (1,500 kW)[1]	78,000	162	96	480
EMD (1,500 kW)[1]	115,000	135	124	484
Essex (500 kW)[1]	25,000	96	96	240
MEP-012-lightweight (750 kW)[1]	25,000	101	96	250
MEP-208-heavyweight (750 kW)[1]	40,000	100	96	330
MEP-810B DPGDS (1,050 kilo volt-amperes)[2]	29,000	130	96	264
[1] Power war reserve asset [2] Organic to prime power platoons				

SUPPLY

5-11. Construction of non-MTOE distribution systems requires massive quantities of material. Prime power units deploy with only a small basic load of these items (table 5-2). Platoons are equipped with limited distribution assets that may serve as an interim solution; however, the wide diversity of this material makes it impossible for a prime power unit to maintain a stock level adequate to accomplish all construction tasks. Prime power units rely on supported units to procure construction materials. These materials are available through normal supply channels and, in some theaters, through contracting, local procurement, and host nation supply. There is a considerable amount of BOM required to construct the primary and secondary distribution systems. The procurement of these materials requires a substantial number of transportation assets, to include multiple aircrafts if the materials must be transported by air. Table 5-3 lists an approximate BOM for a 1,500-man base camp, to include weights and volumes of the materials.

Table 5-2. DPGDS distribution equipment

Item	*Quantity*
Dead break elbow (600 amperes, 15 kilovolts for 500-MCM cable)	12
Load break elbow (1/0 gauge) with 15-kilovolt cable	100
Load break elbow (200 amperes, 15-kilovolt termination)	35
Power distribution panel (25 kW)	34
Power distribution panel (35 kW)	2
Primary cable (15 kilovolts with concentric neutral number 1/0 gauge; 4,500 feet spooled on two reels)	4
Primary cable (500 MCM; 15 kilovolts concentric neutral; 1,000-foot reel)	1
Primary cable reel pallet	2
SDC (150 kilo volt-amperes)	11
Secondary cable (50 foot, 60 amperes)	34
Secondary cable (100 foot, 20 amperes)	100
Secondary cable (100 foot, 100 amperes)	4

Table 5-3. Major end-item BOM for a 1,500-man base camp

Item	*Quantity*	*Length*	*Width (in inches)*	*Height (in inches)*	*Weight (in pounds)*	*Total Weight (in pounds)*
60-ampere cable	1 reel	5,000 foot	N/A	N/A	5,100	5,100
100-ampere cable	1 reel	6,000 foot	N/A	N/A	12,000	12,000
200-ampere load break elbows	300	10 inches	8	3	5	1,500
Distribution panels	106	22 inches	18	18	50	5,300
Primary cable with reels	14 reels	40,000 foot	N/A	N/A	3,100	43,400
Transformers	32	61 inches	48	72	2,500	80,000

5-12. The prime power platoon identifies the required materials during the design process and develops a BOM. These materials may be locally procured or obtained through supply channels (Class IV) by the supported unit. The standard DISE can be incorporated into the secondary distribution network. The DISE is a Class VII item that is listed on some TOEs of the units. Appendix D contains more information on power transformation and distribution networks.

5-13. The operation of a prime power plant requires a daily resupply of diesel fuel. The fuel is delivered to the power plant by the supported unit. The consumption rate depends on the plant size and electrical load. As a planning factor, the unit should plan for the consumption of 5,000 gallons per day per power plant. The supported unit provides on-site fuel storage equipment based on the fuel consumption rate, generally in the form of a fuel blivet. The supported unit provides the Class III packaged products that are required for generator services.

5-14. When deployed independently, prime power platoons require support from their attached or operational control higher headquarters for all classes of supply. The platoon receives this support from the prime power engineer company when several platoons and the company headquarters are deployed together. The prime power engineer company and the battalion headquarters and headquarters company establish supply accounts and provide for their subordinate platoons. The battalion provides the highly-specialized repair items.

SERVICES

5-15. Services for mess, laundry and bath, chaplain, medical, and other troop life support must be provided. These services are obtained through either the higher headquarters or the supported unit.

MAINTENANCE

5-16. The supported unit must be prepared to provide maintenance support for the tactical vehicles of the prime power company and other common items above the operator level as the prime power company has a limited maintenance capability. All levels of maintenance through general support can be performed on the prime power generation and distribution equipment within the battalion by prime power Soldiers.

COMMUNICATIONS

5-17. Prime power units have very little organic, tactical communications equipment. Each platoon is equipped with a single-channel ground and airborne radio system (SINCGARS); however, the supported unit must provide all other communications requirements, to include Non-secure Internet Protocol Router Network (NIPRNET), SECRET Internet Protocol Router Network (SIPRNET), Class “A” telephone, and cellular telephones if required and available.

MISSION SPECIFIC CONSIDERATIONS

5-18. The following paragraphs are factors that affect the overall operation of the power generation equipment. These factors affect the efficiency of plant operations and must be considered by both prime power units and planners.

CLIMATE

5-19. Climatic conditions affect prime power operations. The low temperatures and short periods of daylight encountered during winter in polar regions adversely affect manpower efficiency but will not degrade equipment performance. Under these conditions, expect significant work rate deterioration during the installation and construction phase. Operations in different types of regions are discussed below.

- **Tropical and coastal.** Tropical and coastal regions require additional equipment maintenance to combat corrosion from humidity and salt spray. In tropical regions, humidity and high temperatures degrade the performance of generators. Under extreme conditions, power plant output may have to be degraded as much as 25 percent.
- **Desert.** Desert regions require intense and frequent maintenance due to heat and dust. Grounding problems are often encountered in these climates due to extremely high soil resistivity. Units may have to construct grounding grids and use soil additives and water to overcome grounding problems.
- **Mountainous.** In mountainous regions above 1,500 meters, the thin air degrades the performance of power generation equipment and reduces manpower efficiency. To compensate, units should derate generators and anticipate slower work rates with frequent rest breaks.

TERRAIN AND VEGETATION

5-20. Rugged terrain and dense vegetation affect plant siting and distribution system routing. Each generator in a power plant requires a prepared level surface. Plant sites may need to be cleared and leveled before installing generators. Some power plants require the construction of pads for the placement of the generators. Spacing between units and orientation with prevailing winds is critical and can further increase area requirements. Rugged terrain and dense vegetation restrict construction of distribution lines to cleared areas, such as roadways. These restrictions result in longer lengths of distribution lines, increased conductor sizes, and additional manpower requirements. Equipment used in laying distribution cable is not suited for cross-country use in rugged terrain. If installing overhead distribution, an additional 20 feet must be cleared along the roadway.

LIGHTING

5-21. Artificial lighting is necessary when constructing or repairing distribution systems at night. Prime power platoons are equipped with two remote area-lighting sets. Remote area-lighting sets are used at the power plant to provide general lighting for safety and security, and specific lighting for more critical or technical operations, such as refueling. The hazards associated with electrical construction and repair are deadly. They are greatly compounded if work is attempted under blackout conditions.

NOISE

5-22. Planners must consider the noise generated by power plants when selecting a site. Power plant site selection should balance the significant noise generated by a power unit, force protection, and the advantages of a central location. The power plant should be located away from life support and administrative areas but should still be as centrally located as possible. Use of tree lines and natural ground contours between power plants and highly populated areas can reduce noise interference. Use of prevailing winds can reduce the noise factor by placing plants downwind of high-use areas.

THREAT

5-23. The supported unit must provide security for the power plant. Power plants and transmission and distribution networks are likely targets for sabotage. Large commercial-power plants present key targets for long-range, surface-to-surface missiles, and aerial raids. Prime power plants supporting critical facilities and their associated distribution networks are likely sabotage targets as well. Recognizing the vulnerability of power plants allows planners to prepare their defense. Prime power and commercial-power plants have significant noise and heat signatures. This must be considered when threat capabilities include infrared- or thermal-imagery surveillance and targeting. If sandbagging and/or barrier walls and overhead cover are considered for force protection, adequate airflow must be maintained.

PERSONNEL

5-24. Prime power production specialists are highly trained in their individual specialty. Another facet not previously discussed is their ability to supervise and manage power-related projects using unskilled and semiskilled troops and indigenous workers. This function is especially useful when manpower requirements of the mission exceed the prime power capabilities of the unit. The members of the prime power platoon can train and supervise semiskilled troops and indigenous workers in power plant operations. Personnel with some electrical background (such as interior electricians or generator mechanics) are good candidates. Once trained, these personnel can assist with power plant operations, freeing platoon members for additional missions.

SAFETY

5-25. Working with electrical systems poses certain hazards. Accidents can result in electrical fires and death by electrocution. Prime power units continually stress and practice safety and quality control in all work. Prime power personnel do not work on energized medium- or high-voltage circuits. They de-energize these circuits before performing work and keep them de-energized by using caution and clearance (lockout and tagout) procedures. The National Electrical Safety Code, DA safety regulations, and Occupational Safety and Health Administration regulations must be followed. They also perform a safety inspection of circuits before energizing them. Current industry standards are used as quality control standards for materials and methods.

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Appendix A

Metric Conversion Chart

This appendix complies with current Army directives, which state that the metric system will be incorporated into all new publications. Table A-1 is a metric conversion chart.

Table A-1. Metric conversion chart

U.S. Units	***Multiplied By***	***Equals Metric Units***
	Length	
Feet	0.30480	Meters
Inches	2.54000	Centimeters
Inches	0.02540	Meters
Inches	25.40010	Millimeters
Miles (statute)	1.60930	Kilometers
Yards	0.91400	Meters
	Volume	
Gallons	3.78540	Liters
	Weight	
Pounds	453.59000	Grams
Pounds	0.45359	Kilograms
Short tons	0.90700	Metric tons
Long tons	1.01600	Metric tons
	Length	
Centimeters	0.39370	Inches
Meters per second	2.23700	Miles per hour
Millimeters	0.03937	Inches
Kilometers	0.62137	Miles (statute)
Meters	3.28080	Feet
Meters	39.37000	Inches
Meters	1.09360	Yards
	Area	
Square centimeters	0.15500	Square inches
Square meters	10.76400	Square feet
Square meters	1.19600	Square yards
	Volume	
Liters	0.26420	Gallons

Table A-1. Metric conversion chart

U.S. Units	***Multiplied By***	***Equals Metric Units***
Weight		
Kilograms	2.20460	Pounds
Metric tons	1.10200	Short tons
Metric tons	0.98400	Long tons

Appendix B

Frequently Asked Questions

B-1. How do I get in touch with a prime power unit to request support?

In a JOA, support requests should be directed to prime power higher headquarters, normally the theater engineer command or engineer brigade (theater Army). They may also be routed through the theater Army or JTF engineer staff for forwarding to the appropriate engineer headquarters. Prime power units will accept "walk-in" support requests and pass the request on to their higher headquarters.

Emergency requests to support disaster response are handled differently, depending on whether they are in CONUS, U.S. possessions overseas, or foreign countries. However, in all cases, the Army G-3 directs USACE to provide prime power assistance to the organization that is the executive agent for the disaster response mission. The standing contact for requesting support is at the USACE operations center.

For routine or training mission support or in the event of difficulty establishing contact through official channels, contact the operations officer for the 249th Engineer Battalion (Prime Power). See Chapter 4 for request procedures.

B-2. What kind of support can prime power units provide my unit?

Prime power units can provide a variety of solutions to all types of electrical problems. Their core competency is in providing power-related technical assistance, including planning, providing staff assistance, designing electrical layout, conducting technical reconnaissance, and assisting in managing technical contracts. They can analyze facility power requirements, construct and maintain electrical distribution systems, and repair existing power systems. Prime power units may use their organic equipment, contracted equipment, or captured equipment to generate and distribute utility-grade electrical power. However, this is the most manpower intensive use of prime power units, so it is seldom the best solution.

See Chapter 2 for the capabilities of prime power.

B-3. The compound my unit is occupying is going to be a long-term base camp. Can prime power Soldiers help with the electrical portion of the master plan?

Absolutely. In fact, involving prime power Soldiers early in the master planning process is ideal, ensuring that the installation electrical system is enough to support the end state of the master plan. Prime power Soldiers specialize in design of power systems and can certainly provide planning input.

B-4. We are constructing a big base camp. Can we get a prime power unit to install and operate a centralized power plant for us?

Maybe. A prime power unit can use its organic equipment to provide a facility (such as a base camp) an interim solution for large-scale, utility-grade power. Often, it is faster and more economical to use prime power to facilitate transition to a longer-term solution, such as restoration of commercial power or use of a contractor if those options are available. However, in some cases, prime power may be the best or the only option and, if their higher headquarters decides this is the most judicious use of their Soldiers and equipment, then they can install and operate a centralized power plant for your base camp.

Bear in mind that the power plant is only one piece of the puzzle. Before a power plant can be effective, you need a plan for primary distribution, transformation, and interior wiring. If you are asking for a prime power plant, it is important to get prime power Soldiers involved in the planning process immediately to ensure that the electrical plan is complete and synchronized with the rest of the base camp plan and design.

B-5. Our base camp has been told that a prime power unit is coming to install and operate a centralized power plant. We also have been told that it could be a couple of months after they arrive before we actually have power in our buildings. What takes so long?

It depends on the conditions at your base camp and the time and materials that will be required to have a functioning electrical distribution system (cable, panel boxes, and transformers). The materials could take weeks or even a few months to order and deliver. If the distribution system has to be built from scratch, it could take quite a bit of time to complete. Even the power plant can take a week or longer to install.

A couple of key suggestions are—

- First, get prime power Soldiers on the ground for a reconnaissance as early as possible. They can ensure that the plan is sound, the right materials are ordered, and that they understand the priorities of effort before the main body deploys.
- Second, use innovative contracting mechanisms to shorten the procurement timeline. Precompleted contracts to support contingency operations will save valuable time. USACE often has several such programs in place and is usually willing to help.
- Finally, manage expectations on the base camp. It will take time to get the power system up and running. The day the generators arrive, a big extension cord cannot be run to every tent on the camp. The most critical loads will get power first. Perceptions to the contrary will only breed frustration rather than putting a positive spin on the huge improvement that utility-grade power will provide.

B-6. We are getting ready to receive a prime power platoon at our base camp, but we have been told that if we use their organic power plant we will have a large BOM (transformers, cable, and so forth). Do prime power units have all those on hand for us to use?

Prime power units are only authorized to keep on hand a limited amount of materials for electrical distribution systems, and these materials are only capable of providing U.S. specifications (208/120 volt at 60 hertz) power to about a battalion-sized element. Unless those limited materials meet the requirement of your base camp, then a BOM will have to be developed and the materials procured. It is best to get prime power Soldiers to reconnoiter your site as soon as possible to ensure that the right type and quantity of materials are ordered in a timely manner. Be aware that high-voltage electrical materials are expensive, especially for items that are not off-the-shelf (like transformers). Prime power Soldiers can help you with decisions about whether to use U.S. specifications electricity or local voltages and frequencies, a critical decision with long-term impacts. The prime power Soldiers will ensure that they understand your requirements and priorities at the base camp, to ensure that their plan supports your needs once the main body arrives.

B-7. My unit found a large, commercial generator that is in pretty good shape. Can a prime power unit get it running for us?

It depends on the type and condition of the generator, but prime power Soldiers can give it a thorough technical inspection and determine whether or not it is economically feasible to put it into operation. If the generator is diesel driven and operable, they can probably get it running again. However, prime power units only have a limited stockage of parts (prescribed load list) for their own organic power plant and the odds that they would have parts for a commercial generator, particularly a foreign-made generator, on hand are extremely slim. But they can identify the parts needed to return the generator to operation and assist in researching supply sources so the parts can be purchased if that is the option you want to pursue.

B-8. We found a large, commercial generator that runs, but we need help installing it safely. Can a prime power unit assist with that?

Absolutely. Prime power Soldiers can inspect the generator and prepare a list of materials required for the installation. Once you have procured those materials, they can install the generator and train your operators on start-up procedures, safe operation of the generator, and preventive-maintenance checks and services for the unit.

B-9. The tactical generators at my unit have been run into the ground and are not reliable anymore. Can a prime power unit fix them for us?

No. Tactical generators are a unit responsibility, including maintenance up to the organizational level. Direct- and general-support maintenance should be requested through the owning unit direct-support maintenance activity. Depending on the workload of the prime power unit, they may be able to assist in refresher training for MOS 52D, power generation equipment repairer, at the organizational and direct- and general-support levels, but they do not run a tactical generator repair shop.

B-10. The generator powering my facility caught fire. When can the 249th Battalion get a new generator for us?

Prime power units only have their organic power plants, consisting of four 1,050 kilo volt-ampere medium-voltage generators. These generators are probably not readily compatible with your facility. What you probably need is a low-voltage generator. The 249th Battalion does not keep a local depot full of these generators for emergency use. They can help you size and specify a replacement generator and they can assist with installation once it is delivered, but they will not be able to provide you with a replacement for the one lost.

B-11. Our facility's central air conditioning, sump pump, and hot water heater broke. Will a prime power unit come fix it?

No. There are other MOSs (52C, utilities equipment repairer, and 63J, quartermaster and chemical equipment repairer) whose functions include repair of those items.

B-12. We need to add more outlets and light fixtures to our tactical operations center (TOC), barracks, and administrative area. Can a prime power unit make the necessary improvements?

Prime power Soldiers can help with design of the electrical fixture layout and preparation of a BOM. However, interior electrical wiring is the responsibility of MOS 21R Soldiers in the engineer vertical construction platoons and utility detachments. MOS 21R is responsible for low-voltage electrical wiring, usually from a main distribution panel of the facility into the building to the user.

B-13. Can I get a prime power unit to plug one of their big generators into my unit TOC?

Prime power organic generators are large, medium-voltage machines that are much too large for division level and below headquarters. In addition, the power they produce would require transformers to be compatible with the equipment in your TOC. Given that, prime power Soldiers can probably help develop a better solution than trying to hook one of their generators directly to the TOC facility.

B-14. We are trying to get our facility hooked up to commercial power. Can a prime power unit help?

They may be able to depending on the compatibility of the facility with the local power supply, the condition of the local electrical infrastructure, and the availability of materials to do the work. Prime power Soldiers can do a technical reconnaissance to determine the feasibility of hooking up to commercial power and identify the level of effort and costs associated with the project. They are the proper people to conduct technical discussions with the local utility about the details of obtaining commercial-power service.

As far as actually making the connection to the commercial-power grid, there are a lot of potential solutions. Ideally, the local utility provider would use its work crews to make the connection since they have knowledge of and control over the system and ready access to the required construction materials. Local nationals or expatriate-contractor work crews could be hired to perform this work in situations where the local utility provider is unable to do the job. Finally, prime power units have a limited capability to work on commercial-type power systems (only up to 33,000 volts and with some restrictions on working on overhead power lines).

B-15. My unit has a town in its sector with no electricity because the power lines are down. Can a prime power unit fix the problem?

Prime power platoons have a limited capability to work on commercial-grade transmission and distribution, especially overhead lines. Depending on the specific situation, they may be able to help by executing the repairs. The likelihood of success is increased if one of the USAR power line platoons is in the theater, because they bring specialized equipment and training on high-voltage transmission and overhead electrical systems. Regardless, it is a good idea to have prime power Soldiers to look at and scope the problem from a technical viewpoint. They may be able to assist the local nationals in executing the repairs or to identify the requirement for a contractor to do the job. In any case, if restoring power to this town is a priority for your command, involving a prime power unit should help facilitate a solution.

B-16. The municipal power plant that services the sector of my unit is down for maintenance. Can a prime power unit fix it so that we can restore electrical service for the civilians?

If the plant is fueled by diesel, then the repair falls directly into an area of core competency for prime power. However, it is more likely that a commercial-power plant would consist of gas, steam, or hydro turbines. In this event, if the plant runs on anything other than diesel fuel, then prime power units will have little or no training or practical experience in repairing the equipment. Their training in generator theory and power systems will still enable them to understand the problems and to identify possible solutions. Prime power Soldiers can help devise a BOM or contract statement of work to get the repair done, but it is likely that the actual repairs will have to be completed by the power plant staff or by contractors.

B-17. My unit is on commercial power, but we want to hook our TACGENS up as backup in case commercial power goes down. Can a prime power unit help us with that?

Probably. If the voltage and frequency of your generator is compatible with the commercial power, prime power Soldiers can prepare a BOM for your unit to procure. Once the materials are on hand, prime power Soldiers can make the connections and train your generator operators on how to safely make the transition from commercial power to generator power and back to commercial power.

B-18. There is a substation in the basement of the building my unit is occupying that looks to be in good shape, but we do not want to start throwing switches and breakers to test it out. Can a prime power team help us determine if we can get power back to the building?

Definitely. Prime power Soldiers are experts in electrical distribution and have the training and equipment to test and inspect transformers, switch gear, and other components of substations. If the substation is operable (or can be made safe for limited operation through battle damage assessment and repair) and power is available, they will do what they can to get your substation "hot" and to restore the power.

B-19. My general has a big meeting this week and wants to make sure we have reliable power for the very important persons during the meeting. Can a prime power unit do something to guarantee we will not have a power outage during the meeting?

Although there are no guarantees when it comes to power, a prime power unit should be able to help you. Bear in mind that the solutions they will focus on are long-term improvements in reliability and capacity, so it may be tough to make a dramatic improvement to the power system in less than a week. They should be able to take a look at the current situation, make the most of what you have on hand to prepare for the short-term goal of reliable power for your very important persons, and devise a plan to support your long-term power requirements.

B-20. My unit needs help restoring commercial power to the local government building, water treatment plant, factory, and cultural site for important civil-military reasons. What can a prime power unit do to help?

If restoring power to that site is important, prime power Soldiers can help devise a solution as quickly as possible. Whether the answer is to work with the local utility to restore power, to return an existing backup generator into operation, to lease or buy a new generator for the facility, or to implement another plan, prime power Soldiers can help develop options to meet your needs. As with other power-related projects, be prepared to invest the time and money required to achieve the results you want.

B-21. How do I get prime power Soldiers direct support to my organization to support our power requirements?

Although it is comforting to have a couple of technicians conveniently on hand to serve as a security blanket for power issues, the reality is that there are only about 200 prime power Soldiers in the Army force structure (Active Army and USAR and TOE and table of distribution and allowances [TDA]). Because they are such a scarce resource, it is extremely unlikely that you will be able to get a prime power team to support you for anything other than a well-defined mission with a clear end state. If you have a power-related mission or series of missions, send a support request as described in Chapter 4.

B-22. Does the 249th Battalion have any power plants or other power generation assets that my unit could use for long-term support to our facility once our interim power needs have been met?

The 249th Battalion does not have generators to loan out. The prime power war reserve maintains a CONUS-based inventory of power generation equipment ranging from 625 kilo volt-amperes low-voltage generators to 5.625 mega volt-amperes power plants for use by DOD or other government customers on a reimbursable cost basis. Using this equipment for long-term requirements offers significant savings over the use of contracted equipment and may be an excellent solution for long-term power in a JOA, at a forward operating base, or at a fixed installation. For more information, contact the War Reserve Director.

B-23. We have some electrical problems at our location that we think are fairly minor and do not require a prime power team to deploy here if they could tell us what to check. Is there any way to do that?

Absolutely. As part of USACE, prime power units are equipped with the latest tools to support field force engineering and to enable reachback to CONUS-based expertise, including the Soldiers of the 249th Battalion and the faculty of the United States Army Prime Power School (USAPPS). These tools include secure and nonsecure video teleconferences, satellite-enabled data-transfer, telephone, and e-mail in order to provide the technical expertise required to or from the most remote and austere locations. To request reachback support from a prime power unit, contact the operations officer of the 249th Battalion.

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Appendix C

Interserviceice Electrical-Power Production

Each Service in the U.S. military has electrical specialists that play a special role in their Service and to the U.S. military. But only one skill set has been organized to bridge the gap between tactical power and commercial power on the battlefield and that is the 249th Engineer Battalion (Prime Power).

ARMY

C-1. USACE manages the only DOD skill set that is capable of bridging the gap between TACGENS and commercial power. The 249th Battalion was reactivated on 16 November 1994 by USACE in response to the missions performed by the Army prime power production specialist during Operation Desert Shield and Operation Desert Storm.

C-2. The 249th Battalion is headquartered in Fort Belvoir, Virginia, but is stationed at nine different installations worldwide. Since its reformation, the 249th Battalion has been a part of almost every military operation involving power requirements. The 249th Battalion deploys units that are tailored specifically for the assigned mission, as large as a company or as small as a two-person team, but typically a 16-Soldier detachment. Battalion Soldiers provide advice and technical assistance in all aspects of electrical power and distribution systems. They also maintain Army prime power generation and distribution reserve stocks. In peacetime, battalion Soldiers train DOD personnel in the operation, maintenance, and management of prime power generator sets, power plants, and associated distribution systems equipment; conduct power assessments and generator installations for critical facilities in nationally declared disaster areas; conduct peak-shaving operations; and upgrade and repair existing power facilities in support of humanitarian missions. The strength of the 249th Battalion is the Soldiers, MOS 21P, prime power production specialist.

C-3. The 21P Soldiers are some of the most technically trained Soldiers on the battlefield. To be awarded the 21P MOS, Soldiers must successfully complete 32 weeks of training at USAPPS, which provides a skill and knowledge base ranging from electrical theory to the ability to operate and maintain a power plant. Upon satisfactory completion of the 21P course, each Soldier is assigned one of three ASI codes, which requires an additional 18 weeks of training. These ASIs are S2, prime power production mechanical specialist; S3, prime power production electrical specialist; and E5, prime power production instrumentation specialist. These three ASIs provide the individual Soldiers with a specialty in which they receive in-depth training on their assigned portion of power production and maintenance. These ASIs alone would be quality training, but by building units around these skills with prime power platoons that make up the companies within the 249th Battalion, the Army has created a value-packed skill set.

C-4. The 50 weeks of individual technical training combined with task organization, which combines the three ASIs into a complete skill set, allows prime power units to—

- Provide technical expertise and staff assistance on all aspects of electrical power and distribution systems in support of full spectrum operations.
- Provide interim prime power generation and install provisional distribution systems.
- Provide technical expertise for repair and sustainment of electrical systems ranging between tactical and industrial power operations.
- Control and maintain the Army prime power generation and distribution war reserve assets.

NAVY

C-5. The United States Navy understands the quality of training provided by the USAPPS and sends a select group to receive the exact same training alongside the prime power production specialist at the

USAPPS. Upon completion of the 50-week course, Navy personnel become part of the mobile utilities support equipment (MUSE) program. The Navy MUSE program only has 38 slots. Due to the MUSE program personnel strength, these personnel typically only perform power plant installations for Navy operations during time of war and deployments. However, the MUSE program and the 249th Battalion often work together in disaster response operations. In addition to the MUSE technicians, the Navy also has Seabee construction electricians, who attend a 10-week course to learn interior and exterior electrical skills. The Seabee construction electricians train jointly with the Air Force and learn some of the same electrical distribution skills as taught at the USAPPS, but are trained to a different proficiency level.

AIR FORCE

C-6. The United States Air Force shares the same medium-voltage organic-power production equipment as the 249th Battalion, plus TACGENS, but the Air Force trains its personnel to a completely different skill set. The Air Force has two different electrical MOSs. The power production course (3EOX2) is a 10-week course, which teaches airmen how to operate and perform operator, direct-, and general-support maintenance on organic equipment and performs no distribution work. The electrical apprentice course (3EOX1) is a 16-week course, which combines interior and exterior electrical skills. This course provides skills needed to distribute power and maintain distribution networks after power production. Both these courses teach some of the same skills taught at the USAPPS, but neither course, alone or combined, teach the total skill set nor teach to the level of proficiency as that obtained by the prime power production specialist.

MARINES

C-7. The United States Marine Corps, due to mission needs, require a different approach to power requirements. Therefore, the skill set offered by their electrical MOS revolves around TACGENS. Marines receive 7 weeks of training on electrical theory, generators, and low-voltage distribution.

ALLIED FORCES

C-8. Recent conflicts have led to more multinational or coalition forces working together with the U.S. military and living together on joint base camps powered by prime power Soldiers. This has lead to several allied nations showing an interest in the 249th Battalion skill set as an alternative to tactical power and a means to bridge the gap with commercial power.

C-9. As mentioned earlier, the 249th Battalion was designed and organized because of the vital role that the prime power production specialist played during Operation Desert Shield and Operation Desert Storm. More recently, the 249th Battalion is scheduled to grow by 33 percent in a time of reorganization and transition due to the performance of prime power production specialists during Operation Enduring Freedom and Operation Iraqi Freedom. This highlights the importance of reliable power on the battlefield today.

Appendix D

Power System Concepts

This appendix discusses some of the technical concepts involved with prime power operations. Although knowledge of these concepts is not critical (for planners and commanders who employ engineer prime power units), it is useful.

POWER GENERATIONS

D-1. Prime power is electrical power that is continuously produced. It is not necessarily uninterrupted power. Power is produced by generators. Generators are machines and, as such, are subject to mechanical or electrical failure. They require periodic maintenance and service to avoid breakdown. To obtain a source of continuous or prime power, multiple generators are installed in parallel. This arrangement allows the performance of maintenance on one or more generators while the others produce power. Simply having a backup generator that can be installed in the event of generator failure does not constitute a prime power plant. The same multigenerator principle is used in the production of commercial power and can be used with some models of TACGENS.

D-2. U.S. Army prime power plants can produce power at either 50 or 60 hertz. When operating at 60 hertz (the frequency common to most U.S. systems), the output voltage of the generator is 4,160 volts at three phases. At 50 hertz, the output voltage is 3,800 volts at three phases. These output voltages are in the range described as medium voltage.

D-3. Figure D-1, page D-2, depicts a typical prime power plant. It shows that a generator may be isolated from the power load by opening the air switch between the bus and the generator. With the air switch open, maintenance can safely be performed on the isolated generator while other generators continue to produce power. A four-generator DPGDS plant, the type of power plant organic to Army prime power units, has an installed output capacity of 3.15 mega volt-amperes, which is based on the continuous operation of three generators. The peak capacity of the plant is 4.20 mega volt-amperes. This may only be attained for limited periods of time.

POWER DISTRIBUTION AND TRANSFORMATION

D-4. The following paragraphs discuss the different types of distribution networks. These are primary and secondary.

PRIMARY DISTRIBUTION

D-5. Primary distribution networks carry medium-voltage power from the power plant to the transformers or mobile substations. Primary distribution systems are constructed with extra heavy-duty, multiconductor, shielded power cable that is suitable for ground-laid or buried applications. These networks can be laid out in radial or loop patterns.

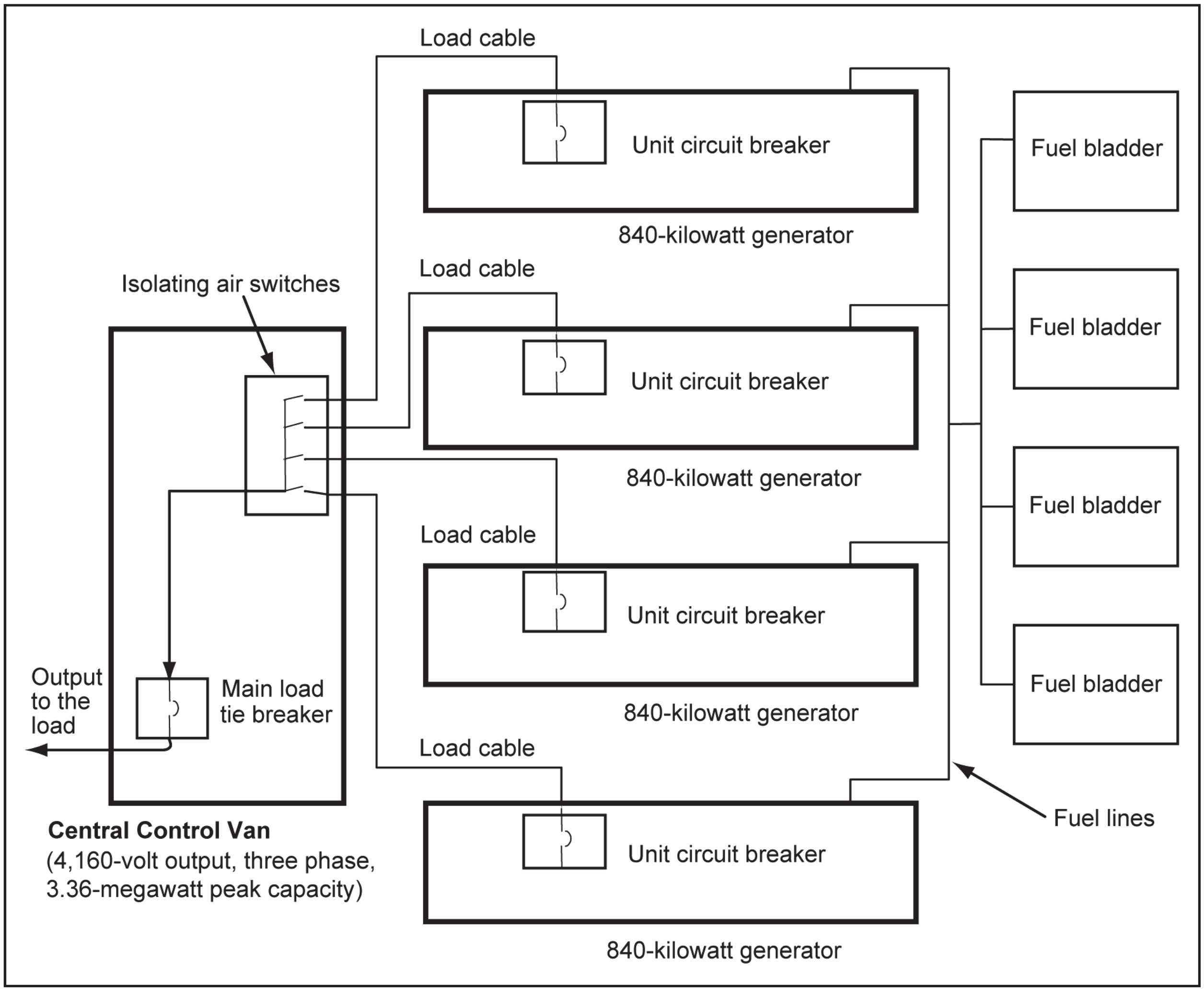

Figure D-1. Typical prime power plant

D-6. The radial layout is quicker and more economical to install (figure D-2). The loop layout is more reliable (figure D-3).

D-7. The medium-voltage power that is distributed on the primary system is stepped down to user-level voltage by transformers. Most transformers are more than 95 percent efficient. As a result, very little energy is lost in the transformation process. The power put into a transformer approximately equals the power coming out. In the case of step-down distribution transformers, the high-voltage, low-current power going into a transformer approximately equals the low-voltage, high-current power coming out. When a transformer reduces voltage, it increases the current proportionally.

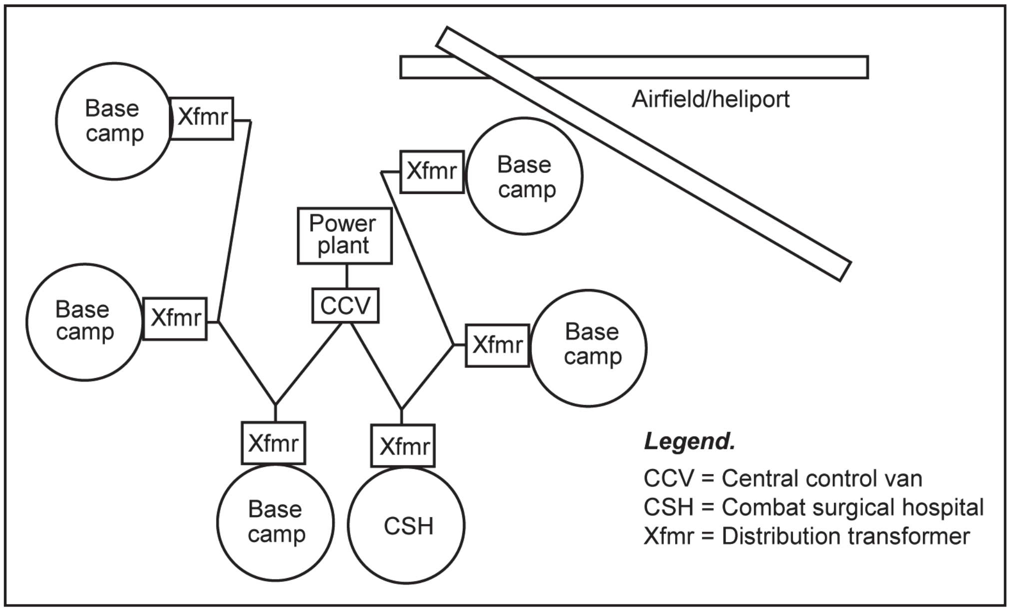

Figure D-2. Typical radial primary distribution network

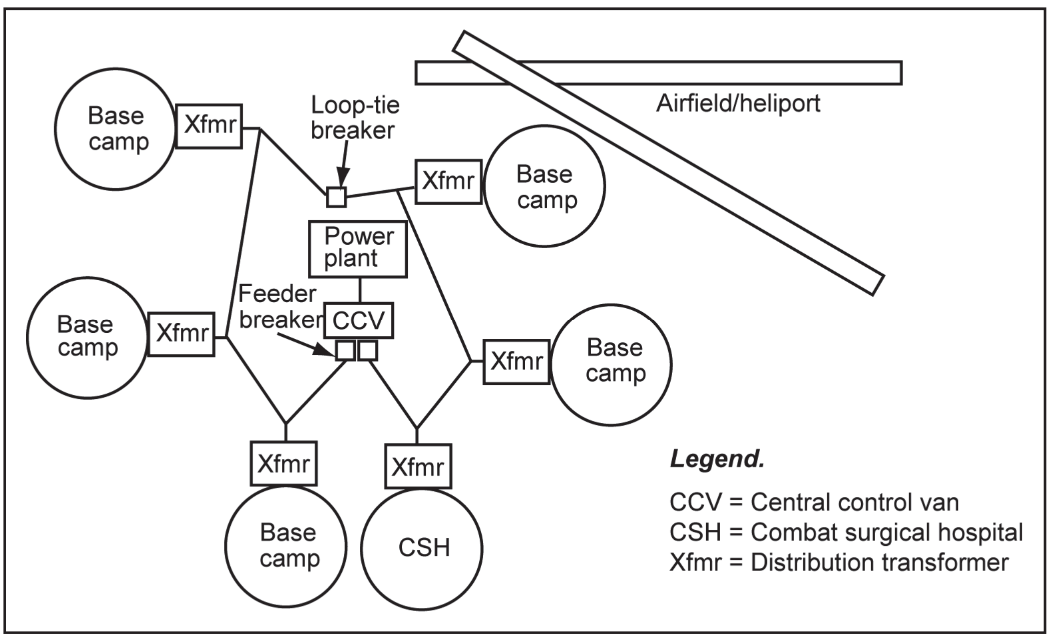

Figure D-3. Typical loop primary distribution network

D-8. Primary distribution voltage (medium voltage) is stepped down to user-level voltage by distribution transformers or mobile substations. A primary distribution system may incorporate either or both of these items. The system can incorporate distribution transformers and a switch gear that are organic to the prime power platoon, commercially obtained, or both. Using distribution transformers is advantageous when the electrical load consists of several small power requirements dispersed over a wide area. Figure D-4, page D-4, shows a typical primary distribution feeder using distribution transformers. Using distribution transformers allows power to be distributed at a higher voltage on smaller conductors and helps to reduce voltage drop and line loss.

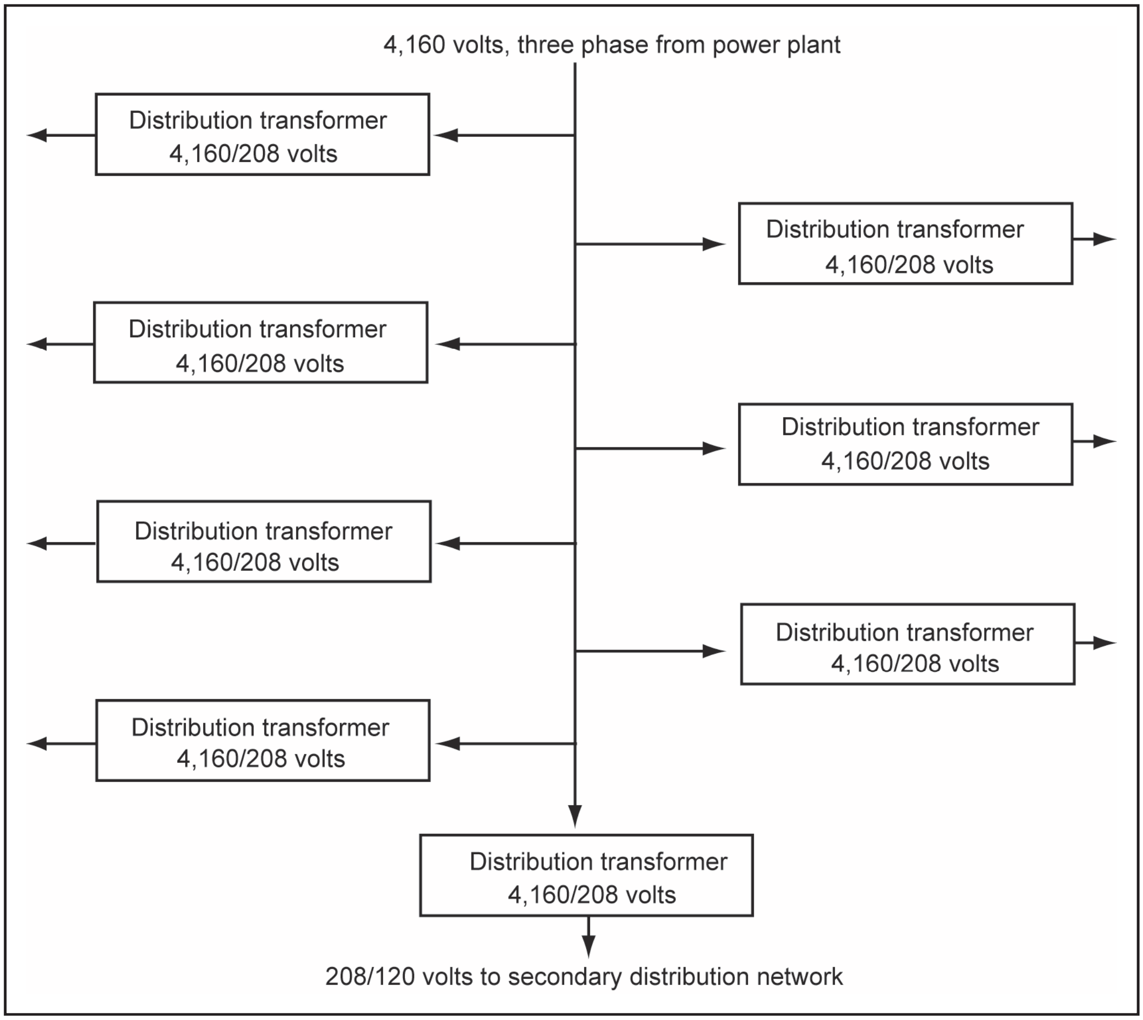

Figure D-4. Typical primary distribution feeder

D-9. Mobile substations are large, trailer-mounted transformers with self-contained switching and protective devices. Using mobile substations is advantageous when providing power to larger loads concentrated in a smaller area. Mobile substations are well-suited for powering industrial areas and large facilities. Multiple mobile substations can be employed in parallel to increase capacity. Figure D-5 depicts a typical application of mobile substations.

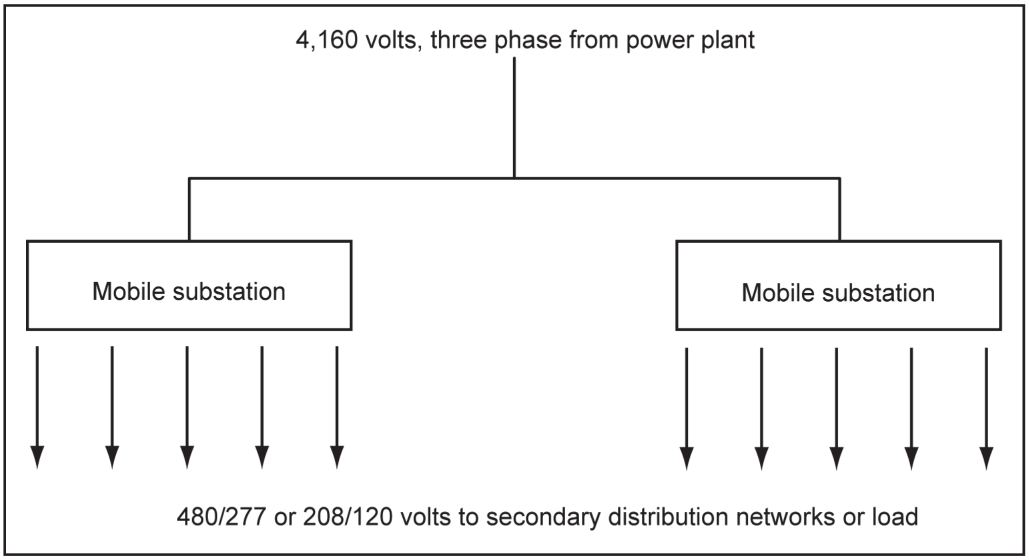

Figure D-5. Typical application of mobile substations

SECONDARY DISTRIBUTION

D-10. Once the voltage is stepped down to the user-level voltage at the transformer, the secondary distribution network carries the power from the transformer to the user. Secondary distribution systems are constructed with multiconductor cable when possible. Figure D-6, page D-6, depicts a typical, simple-secondary distribution network. Engineer prime power units are only responsible for the secondary distribution of a power system from the transformer to the main distribution load center (if one is used) or to the input of the main distribution panel box.

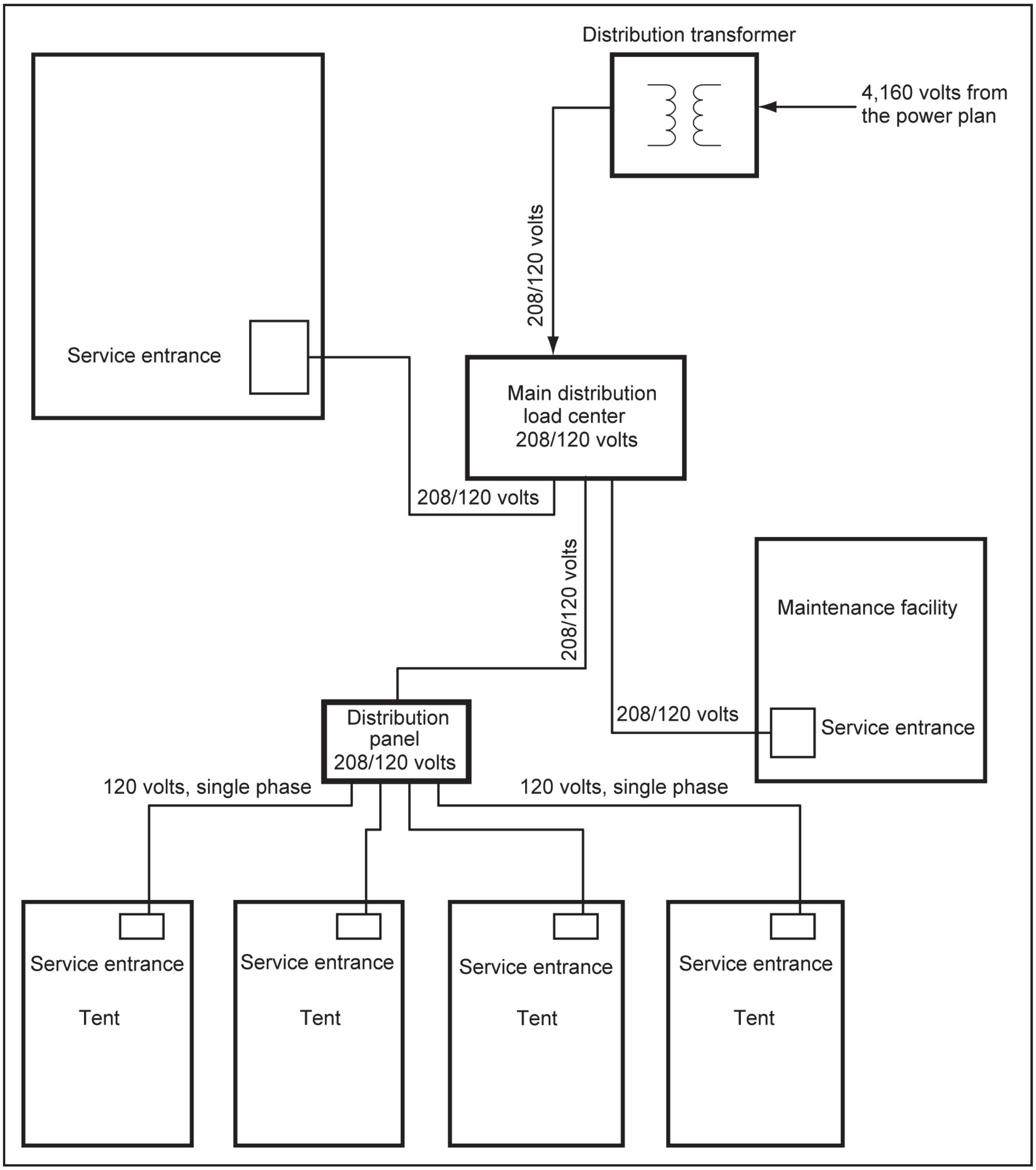

Figure D-6. Typical simple secondary distribution network

POWER SYSTEM CHARACTERISTICS

D-11. The consideration of power system characteristics is important in determining the use of power for specific applications. Some power system characteristics can be altered to suit the needs of the user.

OUTPUT VOLTAGE

D-12. Output voltage is the measure of the voltage at the output terminals of the power system. Large output voltage alterations can be made by using distribution transformers. Small output voltage changes can be made by adjusting the controls on the TACGENS and prime power generators. Devices, such as voltage regulators, can be used to make small-voltage adjustments to commercial power.

SINGLE- OR THREE-PHASE POWER

D-13. Most alternating current power is generated as three-phase power. Single-phase power can easily be obtained from a three-phase source. Three-phase power is provided at three separate output terminals that share a common neutral terminal. The voltage difference between phases is the result of each being +120 out of phase with the other two. For many applications where higher voltage, single-phase power is required, two-phase power can be used to provide power at approximately the needed, single-phase voltage. For example, a 208/120-volt system can provide 120-volt, single-phase power. It can also provide 208-volt, two-phase and/or 208-volt, three-phase power.

D-14. Three-phase power systems should be designed so that each phase carries about the same amount of load as the other two. This concept is called load balancing. Badly unbalanced loads will result in frequent tripping of protective devices and may damage equipment.

OUTPUT CAPACITY

D-15. Output capacity is the amount of power a system can deliver. It is usually measured either in apparent power, kilo volt-amperes, or real power in kilowatts with an associated power factor. Output capacity is limited not only by the size of the generation equipment but also by the rated capacity of the distribution system. Electrical conductors and devices (such as transformers, breakers, and switches) are designed and manufactured with specific limitations on current and voltage. When the power demands of the user exceed output capacity, the system is said to be overloaded and one of two things may occur. Either protective devices (such as fuses, breakers, or relays) are blown or tripped or else the system is damaged. The damage can occur in the form of melted conductors, burned connections, or blown transformers. Output capacity may be increased by upgrading distribution systems and by employing additional or larger generators.

RELIABILITY

D-16. Reliability is the measure of the ability of a power system to fulfill all the demands of the user without failure for long periods of time. Systems that are susceptible to outages, either scheduled or unscheduled, or that cannot provide all the power users need are not very reliable. Reliability can be improved by employing standby and load-sharing generators. It can also be improved by using redundant distribution systems (loop circuits) and enhanced by maintaining existing distribution systems and generation equipment.

PORTABILITY

D-17. Portability is the ability to rapidly relocate a power system that may be critical to certain operations. TACGENS are the most portable systems available. Since commercial power is tied to fixed facilities, it is the least portable. Prime power systems are portable but require more effort and time to move and install than TACGENS. Prime power plant installation may be feasible if the plant remains in operation (stationary) for 30 days or longer.

D-18. Alternating current (AC) power frequency is given in cycles per second or hertz. The most common worldwide systems are 50 and 60 hertz. The accepted U.S. standard is 60 hertz. Most countries establish one or the other as a national standard. They build their commercial-power systems accordingly. In a few countries, both systems may be encountered. Appendix F lists the commercial-power grid frequencies and voltages that various countries use.

D-19. Some equipment is sensitive to AC frequency and will not operate properly when powered by a source with a different frequency than the equipment is designed for. Units should ensure frequency compatibility for this equipment to avoid damaging it. Most transformers designed for 50-hertz operation can be used for 60-hertz application. Most 60-hertz transformers cannot be used for 50-hertz application unless they are significantly derated.

D-20. Prime power generation equipment can operate at 60 or 50 hertz. Most TACGENS operate at 60 hertz. Some specialized TACGENS operate at 400 hertz. The frequency power that is used extensively for aircraft systems, missile and avionics systems, signal systems, and some shipboard systems is 400 hertz. Frequency alterations are possible with the use of frequency converters.

LINE LOSS AND VOLTAGE DROP

D-21. Electrical conductors have some resistance. The amount of resistance depends on the type of metal, the cross-sectional area and length, and the temperature of the conductor. Copper is less resistive than aluminum. Conductors with larger cross sections and shorter lengths are less resistive than those with smaller cross sections and longer lengths. Conductors are less resistive at lower temperatures than at higher temperatures.

D-22. When electrical current flows through a resistive material, some of the energy is converted to heat, causing a drop in voltage. The energy converted to heat is called line loss, and the drop in voltage is called voltage drop. Distribution systems must be designed to safely carry the required amount of current while maintaining output voltage within the operating parameters of the devices being powered.

Appendix E

Support Request Information

This appendix addresses the key information that should accompany a request for prime power support. The prime power unit uses this information in formulating a preliminary assessment and support plan. The requester speeds the support process by providing detailed, accurate information regarding power needs.

E-1. The requester should provide the following information:

- **General information.**
  - **Unit**. Identify the requesting unit designation or activity.
  - **Location.** Identify the location of the requesting unit and the exact location where support is needed.
  - **POC and an alternate POC.** Identify POCs who are responsible individuals that are knowledgeable of the requested support requirements. Provide the telephone numbers or another means of contacting the primary and alternate POCs.
- **Description of support required.**
  - **Nature of support.** Include a description of the support that is needed and the general situation prompting the request.
  - **Special conditions.** State any special conditions that may affect the support request should be described (potential hazards; unusual voltage, current, or frequency requirements; or special grounding or protection requirements).
  - **Special considerations.** State any special considerations that affect the level of reliability required. Also include a description of the altitude and climate.
  - **Site layout.** Include a sketch or drawing showing the site layout for the requested support. If possible, it should be to scale and should show linear distances between load connections.
  - **Load estimate.** Provide an estimate of the load requirements for each separate load. If a load estimate cannot be given, state the type and the quantity of devices being powered. If possible, state the voltage requirements. The minimum total load should be 350 kilowatts.
- **Time frame.** State any time factor pertinent to the support request, such as the earliest start time, the latest completion time, and the expected time period the support is required.
- **Available power sources.** State the availability and accessibility of commercial power, TACGENS, and nonstandard generators. State the location of the nearest commercial distribution feeder. Provide information on the availability of TACGENS and nonstandard generators.

E-2. Figure E-1, page E-2, is a sample of a prime power support request.

1. General information.

a. Requesting unit: 952d RSG

b. Location: The unit location and group headquarters is near the intersection of Fester Cletus Freeway and Homer Buford Boulevard on the Royal Air Force Base (grid coordinates AM463988). The support location is adjacent to the group headquarters.

c. The POC is MAJ Kirk, commercial (123) 456-7890. Alternate POC is CPT Jones at (123) 456-7891.

2. Description of support required.

a. Nature of support. The Carla Belle Base Camp is to be expanded. The expansion will include the addition of 80 general-purpose medium tents for living quarters, 6 portable shower units, 10 commercial-type trailers for offices, a dental clinic, a post-exchange trailer, and a host nation-operated fast-food stand. The support needed includes expanding the existing secondary distribution network and connecting to existing commercial power to accommodate this new growth.

b. Special conditions. The dental clinic will have an X-ray machine. The operating voltage of this machine at the present time is unknown. The climate is dry with 4 to 6 inches of rain primarily in June through August.

c. Special considerations. None.

d. Site layout. A sketch of the planned site layout is attached.

e. Load estimate.

(1) Each tent will have 6 incandescent lights and 6 duplex outlets. The outlets will operate fans and personal devices.

(2) Each office trailer will have 8 fluorescent light fixtures, 6 duplex outlets, and 2 small window-unit air conditioners. The outlets will be used primarily for office equipment and machines.

(3) Each shower unit will have 10 incandescent light fixtures, 8 duplex outlets, and 1 electric 100-gallon water heater. These duplex outlets will have a ground-fault circuit interrupter protection and will be used for electric shavers and hair dryers.

(4) The dental clinic will have 8 fluorescent light fixtures, 1 X-ray machine, 6 duplex outlets, and 2 small window-unit air conditioners.

(5) The post exchange trailer will have 8 fluorescent light fixtures, 4 large refrigerators, 10 duplex outlets, 3 small window-unit air conditioners, and 10 exterior floodlights. The outlets will be used for cash registers.

(6) The only known data about the host nation-operated fast-food stand is that it will have refrigerators, freezers, ovens, deep fryers, and an electric grill. The only known data about voltage requirements is that the lights and outlets are 120 volts.

3. Time frame. The group commander has mandated that the base camp be habitable not later than 15 July. Construction is scheduled to begin on 18 June.

4. Available power sources. The Carla Belle Base Camp is currently powered off the commercial grid. The distribution feeder comes in from a buried system along Fester Cletus Freeway to 4 distribution transformers in the camp. The total capacity and the unused capacity of these transformers are unknown. The group headquarters has a 75-kilowatt generator for use in the event of power failure.

Figure E-1. Sample enclosure to a prime power support request

Appendix F

Frequency and Voltage Data

Different power frequencies and voltages are used in different parts of the world. In the United States, 60 hertz is the most common frequency. Secondary distribution voltages of 120/208, 120/240, and 277/480 are common. Table F-1 provides an extensive, but not exhaustive, list of the frequencies and secondary voltages for commercial-power systems in the many foreign lands and U.S. territories. This data is subject to change, so planners should verify the data before use.

Table F-1. Frequency and voltage in foreign lands and U.S. territories

Country	*Type of Current (AC or DC)*	*Frequency (in hertz)*	*Voltage*
North America, Central America, and the Caribbean			
Bahamas	AC	60	110/220, 115, 120, 120/208
Barbados	AC	60	110
Belize	DC	—	110/220
Bermuda	AC	60	110/220
Canada	AC	60	110/220, 110/220/550, 115/230, 155/230/575
Costa Rica	AC	60	110/220
Cuba	AC	60	110/220, 110/220/440, 115
Dominican Republic	AC	60	110/220/440, 120/240
El Salvador	AC	60	110/220
	DC	—	110
French West Indies	AC	50	110, 110/220
Greenland	AC	50	220
Guatemala	AC	60	110/220, 220, 230/400
	AC	50	220
Honduras	AC	60	110, 110/220
Jamaica	AC	50	110/220
Leeward Islands	DC	—	220
Mexico	AC	60	110/220, 125/220
	AC	50	110/125
Nicaragua	AC	60	110, 110/220
	AC	50	125, 127/220, 220
	DC	—	110
Panama	AC	60	110, 110/220
St. Kitts and Nevis	AC	60	110
St. Lucia	AC	50	230
St. Pierre and Miquelon	AC	50	110

Table F-1. Frequency and voltage in foreign lands and U.S. territories

Country	*Type of Current (AC or DC)*	*Frequency (in hertz)*	*Voltage*
Trinidad	AC	60	110/230
South America			
Argentina	AC	50	220/380, 220/440, 225/390
	DC	—	200, 220, 235
Bolivia	AC	50	110/220, 127/220, 220, 230, 240
	AC	60	220
	DC	—	110, 220
Brazil	AC	40	220
	AC	50	110/220, 115/220, 120/220, 125/216, 125/220, 127/220, 220/440, 230
	AC	60	110, 110/220, 120/220, 127/220, 210, 220
	DC	—	220
Chile	AC	50	220, 220/380
	AC	60	110, 220, 220/380
	DC	—	220
Colombia	AC	60	110/220, 115/230, 150/260, 220/380
	AC	50	110/220, 230/380
Ecuador	AC	60	110/220, 230/380
	AC	50	220
	DC	—	220
French Guiana	AC	50	110
	DC	—	110, 120, 125, 220
Guyana	AC	50	115/230
	AC	60	110/220
Paraguay	AC	50	220
	DC	50	220
Peru	AC	60	110/220, 220, 240, 380/500
	AC	—	110/120, 220, 230, 240
	DC	—	110/220, 220
Suriname	AC	60	220, 440
	AC	50	125
Uruguay	AC	50	220
Venezuela	AC	50	110/220, 120/240
	AC	60	110
Europe			
Aegean Islands	AC	50	127/220
	DC	—	220

Table F-1. Frequency and voltage in foreign lands and U.S. territories

Country	*Type of Current (AC or DC)*	*Frequency (in hertz)*	*Voltage*
Albania	AC	50	125, 125/220, 220, 220/390, 230
	DC	—	125/150
Austria	AC	50	110/220, 120, 125/220, 220/380
	DC	—	110/220
Azores Islands	AC	50	110, 220, 220/380
	AC	60	220
	DC	—	220
Belgium	AC	50	110/190, 115/220, 120/220, 127/220, 130/220, 220, 220/380, 220/390/500
	DC	—	110, 110/220, 220, 220/440
Bulgaria	AC	50	120/220, 150/220, 220/380
	DC	—	440
Canary Islands	AC	50	110/220, 115/190
Channel Islands	AC	50	230, 230/400, 240
	DC	—	210
Corsica	AC	50	120/200, 127/220
Crete	AC	50	127/220
	DC	—	220
Cyprus	AC	50	110, 220
	DC	—	220
Czechoslovakia	AC	50	110/220, 110/220/380, 200
Denmark	AC	50	110/220, 127/220, 220, 220/380
	DC	—	110/220, 220, 220/440, 240
England	AC	50	100/200, 200, 200/400, 210/250, 210/365, 210/420, 220/440, 227/380, 230, 230/400, 230/415, 230/460, 240/415, 240/480, 250/500, 460, 500
Estonia	AC	50	110, 200/380, 220/380
	DC	—	110, 200
Finland	AC	50	110/127, 115/220, 120/208, 127/220, 220/230, 220/380
	DC	—	110
France	AC	50	110, 110/115, 110/190, 110/190/240, 115/200, 115/208, 120/190, 120/210, 120/280, 125/215
	AC	25	110, 115/200
	DC	—	110, 110/220, 120
Germany	AC	50	110/220, 120/210, 125/220, 127/220, 220, 220/380,
	DC	—	110, 160/320, 220, 220/440, 600

Table F-1. Frequency and voltage in foreign lands and U.S. territories

Country	*Type of Current (AC or DC)*	*Frequency (in hertz)*	*Voltage*
Gibraltar	AC	50	110/240
	AC	76	110/240
	DC	—	440
Greece	AC	50	127/220, 220, 220/380
	DC	—	220
Hungary	AC	50	110/190, 110/220, 115/220/380, 120/210, 150/260, 238/380
	AC	42	105
	DC	—	150/300
Iceland	AC	50	220
Ionian Islands	AC	50	127/220
	DC	—	220
Ireland	AC	50	200/220, 220/250, 220/380
Isle of Man	AC	50	230
	DC	—	230
Italy	AC	50	120/120, 127/220, 145/250, 150/260, 160/280, 160/220/280
	AC	42	125, 127/220, 220
	AC	45	125/220
	DC	—	150/300
Latvia	AC	50	220/380
	DC	—	220
Lithuania	AC	50	220/380
	DC	—	110/220, 200/440
Luxembourg	AC	50	110/220
	AC	60	110/220
	DC	—	110/220
Madeira Islands	AC	50	220/380
	DC	—	110, 220
Mallorca Islands	AC	50	220/380
Malta	AC	50	100
	AC	100	100/200
Menorca Island	AC	50	110/125/220
Monaco	AC	42	110/115
Netherlands	AC	50	120, 125/216, 127/200, 127/216, 127/220, 150/260, 208, 220/380
	DC	—	220

Table F-1. Frequency and voltage in foreign lands and U.S. territories

Country	***Type of Current (AC or DC)***	***Frequency (in hertz)***	***Voltage***
Northern Ireland	AC	50	220
Norway	AC	50	130/220, 150, 220, 230
	AC	45	220
	DC	—	220
Poland	AC	50	110/220, 115/200, 120, 120/220, 127/220, 135/240, 220, 220/380, 300
	DC	—	110/220
Portugal	AC	50	110/190, 110/220, 127/220, 220/380
	AC	60	110/220
	DC	—	220
Romania	AC	50	120/208, 125/125, 220/220, 220/380
	AC	42	110/110, 150/150, 185/320
	DC	—	220/440
Scotland	AC	50	200/346, 200/400, 220/250, 230, 230/250, 230/400, 230/400/460, 240/415, 250
	DC	—	220/440, 230, 240/480, 400
Spain	AC	50	110, 110/125/220, 110/220, 115, 120/210, 125, 125/215, 125/220, 127/220, 210/220, 150, 150/260
	DC	—	110, 110/220, 125, 130/260, 150, 150/300
Sweden	AC	50	110/190, 110/220, 127/220, 220, 220/380,
	AC	60	110
	AC	25	220
	DC	—	120, 127, 220
Switzerland	AC	50	110/190, 125/220, 145/250, 220, 220/380, 250/435, 250/325
	DC	—	160, 220/440
Trieste	AC	50	127/220
Wales	AC	50	200/230, 220, 230/400
	DC	—	230, 230/460
Yugoslavia	AC	50	220, 220/380
Asia			
Afghanistan	AC	50	115/200, 220
	AC	60	230
Bahrain	AC	50	230/400
Cambodia	AC	50	110/190, 220

Table F-1. Frequency and voltage in foreign lands and U.S. territories

Country	***Type of Current (AC or DC)***	***Frequency (in hertz)***	***Voltage***
China	AC	60	110/190, 110/220, 200/350, 220/380
	AC	50	110, 110/190, 110/220, 120/200, 135/234, 200/346, 200/350, 220, 220/380, 220/440, 230, 230/380, 230/400, 250/440
	DC	—	220, 220/440, 225/450, 230, 230/460, 250/500
Iran	AC	50	220, 220/380
	AC	60	110
	DC	—	110
Iraq (Power systems in Iraq were extensively damaged in 1991. New systems may have different voltage and frequency.)	AC	50	200, 220, 230/400, 230/440
Israel	AC	50	220, 220/380
Japan	AC	50	100, 100/110, 100/200, 105/210, 110/210
	AC	60	100, 100/200, 110/200, 110/220
	AC	40	110/200
Jordan	AC	50	220/380
Korea	AC	60	110, 110/220, 220
Kuwait	AC	50	240/415
Laos	AC	50	115
Lebanon	AC	50	110, 110/190, 220, 220/380
Myanmar (formerly Burma)	AC	50	220, 420
	AC	60	220
Nepal	AC	60	120/220, 380/440
Okinawa	AC	60	110
Pakistan	AC	50	220, 220/380, 230/400
	DC	—	220
Russia	AC	50	110, 110/220, 120, 120/210, 120/220, 125/215, 127/220, 217/380, 220, 220/380
	DC	—	110/220, 220/440, 250/500
Saudi Arabia	AC	60	110, 110/220, 120/208, 127/220
Singapore	AC	50	220
Sri Lanka	AC	50	220/230, 230/400, 230/416, 240/416
Syria	AC	50	110, 110/190

Table F-1. Frequency and voltage in foreign lands and U.S. territories

Country	*Type of Current (AC or DC)*	*Frequency (in hertz)*	*Voltage*
	AC	60	110
Taiwan	AC	60	110, 200
Thailand	AC	50	110, 110/220, 220
	DC	—	110, 220
Turkey	AC	50	110/190, 220, 220/380
Vietnam	AC	50	115, 120/200, 120/208, 120/210
Yemen Arab Republic	AC	50	127/220
Africa			
Algeria	AC	50	110, 127/220, 220/380
Angola	AC	50	220
Benin	AC	50	230/400
	DC	—	220
Burkina Faso	AC	50	230/400
Cape Verde	DC	—	220, 230, 240, 280
Democratic Republic of Congo (formerly Zaire)	AC	50	220, 220/380
Djibouti	DC	—	220
Egypt	AC	50	110, 110/200, 110/220, 110/3,000, 200/3,000, 200/3,300, 200/6,000, 220, 220/6,000
	AC	40	110, 220
	DC	—	220/440
Ethiopia	AC	50	110/220, 110/125, 220/240, 127/220
Ghana	AC	50	220/380, 230/400
	DC	—	220, 220/440
Guinea	AC	50	115/200, 230, 230/400
Ivory Coast	AC	50	230
	DC	—	220
Kenya	AC	50	220/440, 240/415
Liberia	AC	60	110/220, 13,000
	AC	50	200
Libya	AC	50	125/220
Madagascar	AC	50	110/220, 115/220, 120/208, 220
Malawi	AC	50	230/400
Mali	AC	50	115/200, 230/400
Mauritania	AC	50	115/200
Mauritius	AC	50	230

Table F-1. Frequency and voltage in foreign lands and U.S. territories

Country	*Type of Current (AC or DC)*	*Frequency (in hertz)*	*Voltage*
Morocco	AC	50	110/220, 115/200, 115/220, 127/220
Mozambique	AC	50	200, 240
	DC	—	240
Niger	AC	50	230/400
Nigeria	AC	50	230, 230/400
Reunion Island	AC	50	220/310
Senegal	AC	50	115/200, 127/220
Seychelles	DC	—	220
Sierra Leone	AC	50	230/400
Somalia	DC	—	110
South Africa	AC	50	120/200, 200/220, 200/347, 200/400, 220, 220/380, 240/416, 250
	DC	—	230/460
Tanzania	AC	50	220/380, 230/400, 240
	DC	—	230
Tunisia	AC	50	110/190, 115/200, 127/220, 220/380
Uganda	AC	50	240/415
Zambia	AC	50	220/380, 230/400
Zanzibar	DC	—	220
Zimbabwe	AC	50	200/380, 230/400
Australia and Oceania			
Australia	AC	50	230/400, 240, 240/415, 240/480
	AC	40	110/200/550, 250, 250.440
	DC	—	220, 240/480, 480, 600
Fiji	AC	50	240/415
	DC	—	249/480
Guam	AC	60	110/220
Indonesia	AC	50	110/125, 115/200, 125, 125/200, 127/190, 127/220
Kirabati	DC	—	240/480, 500
New Caledonia	AC	60	125/220
	AC	50	110/120
New Guinea	AC	50	110/220, 240/415
New Zealand	AC	50	220/240, 230, 230/400
Philippines	AC	60	110/220, 220
Tuamotu and the Society Islands	AC	60	110

Table F-1. Frequency and voltage in foreign lands and U.S. territories

Country	*Type of Current (AC or DC)*	*Frequency (in hertz)*	*Voltage*
Samoa	AC	50	110/220
Sarawak	AC	50	230/400

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Glossary

SECTION I – ACRONYMS AND ABBREVIATIONS

AC	alternating current
AFCS	Army Facilities Components System
AFJMAN	Air Force joint manual
AR	Army regulation
ARNG	Army National Guard
ARNGUS	Army National Guard of the United States
ASCC	Army Service Component Command
ASI	additional skill identifier
ATTN	attention
BOM	bill of materials
C2	command and control
CONUS	continental United States
CPT	captain
DA	Department of the Army
DC	direct current
DCO	defense coordinating officer
DCSOPS	Deputy Chief of Staff for Operations
DISE	distribution illumination set, electrical
DOD	Department of Defense
DOMS	Directorate of Military Support
DPGDS	deployable power generation and distribution system
DOT	Department of Transportation
EAC	echelons above corps
EMD	electromotive diesel
ESF-3	emergency support function-3
FCO	federal coordinating officer
FEMA	Federal Emergency Management Agency
FM	field manual
G-3	Assistant Chief of Staff, Operations and Plans
ISB	intermediate staging base
JCS	Joint Chiefs of Staff
JOA	joint operations area
JTF	joint task force
kW	kilowatt(s)
MACOM	major Army command
MAJ	major

MANSCEN	United States Army Maneuver Support Center
MCM	thousand circular mils
MEP	mobile electric power
mil	military
MO	maintenance and operations
MOS	military occupational specialty
MUSE	mobile utility support equipment
MW	megawatt(s)
N/A	not applicable
NAVFAC	naval facilities
NCO	noncommissioned officer
NCOIC	noncommissioned officer in charge
NIPRNET	Non-Secure Internet Protocol Router Network
No.	number
OIC	officer in charge
OSD	Office of the Secretary of Defense
PCB	polychlorinated biphenyl
POC	point of contact
S-1	personnel staff officer
S-3	operations staff officer
S-4	logistics staff officer
SDC	secondary distribution center
SINCGARS	single-channel ground and airborne radio system
SIPRNET	SECRET Internet Protocol Router Network
TACGENS	tactical generators
TCMS	Theater Construction Management System
TDA	table of distribution and allowances
TM	technical manual
TOC	tactical operations center
TOE	table of organization and equipment
TRADOC	United States Army Training and Doctrine Command
U.S.	United States
USACE	United States Army Corps of Engineers
USAPPS	United States Army Prime Power School
USAR	United States Army Reserve
VAC	volts, alternating current
www	World Wide Web

SECTION II – TERMS

commercial power

Is the generation systems that are fixed, nonstandard systems. Their output capacity may vary from a few megawatts to several thousand megawatts.

output capacity

Is the amount of power a system can deliver. It is usually measured either in apparent power, kilo volt-amperes, or real power in kilowatts with an associated power factor. Output capacity is limited not only by the size of the generation equipment but also by the rated capacity of the distribution system.

output voltage

Is the measure of the voltage at the output terminals of the power system.

portability

Is the ability to rapidly relocate a power system that may be critical to certain operations.

***prime power**

Is continuous, reliable, commercial-grade utility power produced by prime power generators. Prime power plants are comprised of the Army family of nontactical generators that are larger than 200 kilowatts and produce low- and medium-level voltage.

reliability

Is the measure of the ability of a power system to fulfill all the demands of the user without failure for long periods of time.

tactical power

Is generated by a mobile electrical-power unit dedicated to supporting the missions of units engaged in combat operations.

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References

SOURCES USED

These are the sources quoted or paraphrased in this publication.

None.

DOCUMENTS NEEDED

These documents must be available to the intended users of this publication. An asterisk denotes that this source was also used to develop this publication.

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READING RECOMMENDED

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By order of the Secretary of the Army:

RAYMOND T. ODIERNO
General, United States Army
Chief of Staff

Official:

GERALD B. O'KEEFE
Administrative Assistant to the
Secretary of the Army
1322508

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