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TECHNICAL MANUAL

**ELECTRICAL DESIGN,
INTERIOR ELECTRICAL SYSTEM**

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
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ELECTRICAL DESIGN, INTERIOR ELECTRICAL SYSTEM

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***Supersedes TM 5-811-2/AFM 88-9, Chap. 2, dated December 1946.**

CHAPTER 1

GENERAL

1-1. Scope. This manual is a general guide for the design of interior electrical power, lighting, and auxiliary systems. Criteria contained herein should achieve economical, durable, efficient, and dependable systems to support Army and Air Force installations. The provisions of AFM 88-15 which differ from the criteria contained herein will take precedence at Air Force installations. Where special conditions and problems are not specifically covered in this manual, acceptable industry standards will be followed. Modernization of electrical systems within existing facilities solely for the purpose of meeting criteria in this manual is not required. The criteria contained herein are not intended to be retroactively mandatory.

1-2. Standards and codes. Applicable industry organization and technical society standards and codes will apply to equipment, materials, and construction

covered by this manual. However, the minimum requirements of NFPA No. 70, National Electrical Code (NEC), and ANSI C2, National Electrical Safety Code (NESC), must be met. Applicable standards and other documents, both Government and non-Government, are referenced in the text and listed in appendix A.

1-3. Symbols. Symbols for plan and detail drawings will conform to the requirements of ANSI Y32.9. Symbols for one-line, three-line, riser, schematic, and wiring diagrams will conform to the requirements of ANSI Y32.2.

1-4. Detailed criteria. Detailed interior electrical system design criteria for confinement facilities are included in appendix B; for Army medical facilities, in TM 5-838-2; and for Air Force medical facilities, in AFM 88-50.

CHAPTER 2

POWER SYSTEM REQUIREMENTS

2-1. Characteristics. Electrical characteristics of the power system will be selected during the initial design phase to provide a safe and efficient distribution of power, and will be based upon the size and types of loads to be served. The neutral conductor of all distribution systems operating at phase-to-phase voltages of 600 volts or less will be solidly grounded, except where ungrounded-neutral systems are required by the NEC, or as other applicable criteria specifically authorize.

a. Voltage. Distribution and utilization voltages employed will be of the highest order practicable consistent with the load to be served. Generally, single-phase, three-wire, 120/240-volt or three-phase, four-wire, 208Y/120-volt systems will be used to serve small lighting and power loads. Large lighting and power loads will normally be served by three-phase, four-wire, 480Y/277-volt systems. Ventilated dry-type transformers will be used to reduce the voltage to meet 120- or 208-volt requirements. Electrostatically-shielded, ventilated dry-type transformers will be provided where required by criteria for specific project applications. Other voltages will be used as necessary to serve specific loads. Delta-connected systems with the mid-point of one phase grounded will not be used except as specifically authorized by the Using Agency on an individual project basis.

b. Frequency. Generally, 60 Hertz will be the frequency employed for distribution and utilization voltages. Other frequencies may be used to serve specific loads or subsystems where required by the Using Agency.

2-2. Normal source systems. Generally, normal source systems will consist of radial distribution configurations consisting of a single transformer for each building or group of buildings for loads of 500 kVA or less at 208 volts, or 2,000 kVA or less at 480 volts. An economic analysis will be provided for 208-volt systems larger than 500 kVA or serving motors larger than 25 horsepower. For facilities having loads in excess of the above, secondary-selective configurations, consisting of double-ended transformer installations with normally open, interlocked bus-ties, and either open or closed switchgear lineups, will be used. In such instances, each transformer of the double-ended system will be sized to serve approximately 60 percent to 80 percent of the total demand load served.

a. Load shedding. Automatic load shedding provisions will be provided only where specifically authorized by HQDA(DAEN-ECE-E), WASH DC 20314, or as authorized by TM 5-838-2 for Army hospitals. For Air

Force projects authorization will be provided by HQ USAF/LEEEU, WASH DC, 20332, or by AFM 88-50.

b. Transformers. Distribution-class transformers used for facility power supply will normally be located exterior to such facilities, either on poles or at grade, and will be of the mineral-oil-insulated, self-cooled type. Criteria for exterior transformer installations is given in TM 5-811-1/AFM 88-9, Chapter 1.

(1) Distribution-class transformers may be located within large buildings at centers of load to avoid long low-voltage feeders and to attain a more economical installation. Generally, high fire point liquid-insulated or nonflammable fluid-insulated transformers, will be utilized within buildings in accordance with the requirements of the NEC, where rated primary transformer voltage exceeds 600 volts. Ventilated- or sealed-dry-type distribution transformers or mineral-oil-insulated units will be provided indoors, in accordance with the NEC only where they prove to be more economical than high fire point liquid-insulated or nonflammable fluid-insulated units. An economic analysis will be provided in the design analysis, along with the rationale supporting the decision, which will address life cycle cost comparisons between high fire point liquid-insulated, nonflammable fluid-insulated, ventilated- and sealed-dry-type, and mineral-oil-insulated units, including all building features required to accommodate each type, such as a vault and drainage system where required. All transformers and equipment addressed in the analysis will be equal in every electrical respect, including but not limited to capacities, voltages, overload capability, and basic impulse-insulation level (BIL), to accommodate a realistic comparison.

(2) Transformers have a primary voltage of 600 volts or less for the supply of lower voltages will be of the ventilated-dry-type, normally for floor or wall mounting, and will not exceed 500 kVA capacity. Where floor or wall mounting is not practicable, such units may be installed above suspended ceilings provided that all necessary electrical and working clearances are maintained; adequate access is provided; and future removal is not hampered by piping, ductwork, or other obstacles.

(3) Transformers located within buildings where noise is of concern, such as hospitals and administrative facilities, will have a low noise-level rating commensurate with the application, and will be provided with vibration isolators to minimize sound transmission to the building structural system.

(4) Transformers normally will not be operated in parallel, since the resulting excessive interrupting duty requirements placed upon protective devices will greatly and unnecessarily increase the installation cost for such an arrangement. In those few cases where parallel operation is unavoidable, the design analysis will provide detailed rationale supporting the proposed arrangement.

2-3. Alternate source systems. An alternate source system will normally consist of battery supplies for small loads such as fire alarm or emergency lighting systems, or may include one or more diesel-engine-driven power generating units with associated controls and auxiliaries designed to provide electrical power during an interruption of the normal power supply for large loads. Facilities permitted to employ alternate source systems are given in AF 420-43.

a. Criteria. Alternate source system criteria for confinement facilities are given in appendix B, in AFM 88-50 for Air Force hospitals, and in TM 5-838-2 for Army hospitals. Starting, operating, and testing features for alternate sources given in TM 5-838-2 and in AFM 88-50 may be applied to other facilities, except that provisions for generator parallel operation and automatic load shedding therein will not be authorized for other Army facilities except as approved by HQDA(DAEB-ECE-E), WASH DC 20314. For Air Force projects approval will be obtained from HQ USAF/LEEEU, WASH, DC 20332.

b. Loads. Loads to be served by an alternate source, except as provided for in appendix A of TM 5-838-2, and AFM 88-50, will consist of critical systems and equipment only. Such critical loads will normally include alarm and detection systems, essential communications, exit and emergency lighting, security and surveillance systems, lighting required to conduct essential operations, generator-location lighting, and selected receptacles. For specific facilities, communications equipment, essential refrigeration, and other mission-essential equipment will also be supplied, as required by the Using Agency.

c. Battery supplies. For various facilities, such as auditoriums, some barracks, and others as required by the NEC and NFPA No. 101, alternate source systems may consist of integral- or central-system battery equipment. Where such equipment is appropriate, the decision to use either integral-system batteries (such as for exit lights) or central-system batteries (such as for combination loads consisting of extensive exit and emergency lighting systems and fire alarm and detection systems as well as for similar loads) will be left to the discretion of the designer, based upon economics, maintenance considerations and costs, and technical feasibility. Battery rooms (or rooms or areas in which batteries are

charged) will be provided with ventilation sufficient to prevent the accumulation of over 2 percent gaseous hydrogen by volume. Battery rooms will not be located in hazardous areas and will not require hazardous location wiring or equipment. In general, approximately 0.016 cubic feet per hour of hydrogen gas is produced from each fully charged cell per charging ampere. Batteries and chargers of less than 50 volts do not require separate rooms or enclosures with access by qualified persons only (reference NEC 110-17). An exhaust fan will be provided to exhaust air at the required rate and vent directly to the outside. The fan will be supplied without switching by the battery charging circuit, or will be supplied separately but provided with an electrical or fail-safe mechanical interlock (such as a sail-switch), in order to prevent de-energization of the fan or fan circuit while the chargers are operating.

d. Non-MCA (Military Construction Authority) funded items. Equipment providing uninterruptible power system (UPS) support and/or other power conditioning between the power system and load may or may not be included under project construction contract authority depending upon the load. See AR 420-43 and AR 310-34 for construction project authority as a function of the load served. These systems include items such as static and rotary UPSs, motor-generator buffers, frequency convertors, and regulators.

2-4. Services. Service-entrance equipment will be located in readily accessible spaces to facilitate disconnection of power in case of emergency. The service-entrance location will be coordinated with the exterior distribution system to ensure that service and feeder circuit lengths are as short as practicable.

a. Low-voltage services. Low-voltage service conductors (600 volts and below) normally will be installed underground from transformers either on poles or at grade. Aerial low-voltage service will be provided for buildings having service ampacities of 200 amperes or less which are located in areas of installations where appearance is of no concern, such as industrial or warehousing areas. Ampacity of services will be adequate for the total demand load. When demands will not occur simultaneously on all feeders, a demand factor of 85-90 percent will be applied to the summation of the individual feeder demand loads. Where experience indicates that a lower demand factor may be applied satisfactorily for service conductor sizing, such a factor may be used.

b. Services exceeding 600 volts. Services exceeding 600 volts will be limited to large facilities requiring a multiplicity of load centers, facilities having motors of 150 horsepower or larger, or those facilities where low-voltage services are impracticable due to cost or

technical feasibility. Services to structures will be installed underground. Incoming services tapped from aerial distribution circuits will be provided with surge arresters at the service entrance equipment.

c. Service equipment. For services exceeding 600 volts, metal-enclosed, manually operated, fusible load-interrupter switches or power circuit breakers will normally be used. For low-voltage services, molded-case or low-voltage power circuit breakers, or fusible disconnect switches will normally be used. However, low-voltage power circuit breakers will be selected only where the added cost incurred by their use can be justified by operational considerations. Generally, a single disconnecting means will be provided for each facility. Multiple disconnects will be avoided, except where major economies can be realized in large capacity services or where multiple service voltage requirements exist. Equipment ampacities will be adequate for the estimated demands, plus a reserve of approximately 10 to 20 percent for future growth. Larger reserves may be applied where a specifically documented need exists. Equipment will be capable of safely performing all interrupting functions based on the available system capacity and characteristics.

d. Meters. Energy usage and demand meters will not be provided for all facilities. Provisions for the installation of such meters will be made where authorized by HQDA(DAEN-ECE-E), WASH DC. For Air Force projects authorization will be obtained from HQ USAF/LEEEU, WASH DC.

e. Equipment rooms. Equipment room space required by major items of equipment such as switchgear, transformers, and generators will be determined at the earliest practicable phase of design. Closets for the installation of panelboards, equipment racks, and similar items will also be provided where appropriate. Equipment space requirements will be coordinated with mechanical system requirements and the structure design. Direct exterior access to major equipment areas will be provided wherever practicable to facilitate

removal and maintenance. The design of equipment rooms and closets will be such that equipment can be removed and replaced without interference with other systems or equipment, and without requiring building modifications. Ventilation will be provided as required to permit equipment to operate within normal ambient temperature limitations; otherwise, the equipment will be derated accordingly.

2-5. Grounding. The neutral conductors of all systems operating at 600 volts or less, phase-to-phase, will be solidly grounded. Ungrounded neutral systems or circuits will be permitted only where specifically authorized by other criteria. Methods of grounding and installation will conform to the requirements of the NEC except as modified herein. Generally, grounding electrodes will consist of metallic rods not less than 3/4-inch diameter, 8 feet long, driven into the earth at the exterior of the building. The effectiveness of driven rods depends upon soil temperature, resistivity, and moisture content. Soil characteristic test borings will be helpful in determining the most effective electrode material and arrangement to be used where experience is lacking in such regard for a given project location. Copper-clad steel rods will normally be used. Where low soil resistivities are encountered and corrosion may occur due to electrolytic action between adjacent underground metallic masses and copper-clad rods, zinc-coated or stainless steel rods will be used. In areas where a deep water table exists, sectional-type rods may be used in series, driven to a depth to attain permanent moisture. Rods may be installed in multiples on a lateral spacing not less than their buried depth. Electrode resistance to ground should not exceed 25 ohms under normally dry conditions.

2-6. Lightning and static electricity protection. Criteria for lightning and static electricity protection will be provided in accordance with provisions of TM 5-811-3/AFM 88-9, Chapter 3. Grounding electrodes for such systems will be interconnected below grade with the power system electrodes.

CHAPTER 3

POWER DISTRIBUTION AND UTILIZATION

3-1. Distribution equipment. Distribution equipment will provide adequate capacity for the loads to be served (para 2-4c). Equipment will have adequate interrupting capacity for the duty encountered, and will be capable of safely withstanding the short-circuit stresses produced by the supply system. Wherever practicable, time-current characteristics of protective devices will be fully selective and coordinated so that the protective device nearest the fault will function first.

a. Switchgear and switchboards. Switchgear and switchboards will be of the dead-front, floor-mounted, free-standing, metal-enclosed type utilizing circuit breakers or fusible switches as circuit protective devices. Space-only cubicles and appropriate bus provisions will be installed for future protective device additions, as necessary to accommodate designed load growth.

b. Panelboards. Distribution panelboards will be of the wall-mounted, dead-front type, either circuit-breaker or fusible-switch-equipped. Branch-circuit panelboards will be of the wall-mounted, dead-front type, equipped with circuit breakers. Loadcenter panelboards will be used only where eight or fewer circuits are supplied therefrom and where light duty can be expected, except as authorized from military family housing.

3-2. Utilization equipment.

a. Motor controllers. Motor controllers normally will be of the magnetic, across-the-line type, except that for motors with starting kVA that will result in more than a 30 percent transient voltage dip, controllers will be of the reduced-voltage or current-limiting type. Manual controllers may be used within the limitations imposed by the NEC, where appropriate. Motor control centers having disconnect devices, branch-circuit overload protection and controllers mounted in a single assembly may be used where several motors are grouped in a particular area, as in mechanical equipment rooms. Control-circuit voltages will not exceed 150 volts to ground. In grounded-neutral systems, the neutral conductor will be directly connected to the starter coils. Where control power transformers (CPT) are used, the grounded leg of the CPT will be directly connected to the starter coils.

b. Motors. Motors will have mechanical and electrical characteristics suitable for the conditions encountered. Generally, motors of more than 1/2 horsepower rating will be polyphase when such service is available. Smaller motors will be single-phase. Motor voltage ratings will be suitable for the voltage supplied. The use of 230-volt

motors on 208-volt systems will be avoided.

3-3. Wiring systems. Generally, wiring systems will consist of insulated conductors installed in metal raceways, except that in combustible construction branch-circuit wiring may consist of metal-clad or moisture- and corrosion-resistant nonmetallic-sheathed cables installed in areas as permitted by the NEC. Raceways and cables will be concealed wherever practicable in finished spaces.

a. Feeders. Feeders will have an ampacity adequate for the loads to be served (para 2-4c). Demand factors applicable to feeder loads will be based upon the nature of the individual loads and their use characteristics. The following demand factors should normally be used, except where experience permits the use of other factors known to be satisfactory for a specific application:

— Lighting loads, continuous Use (offices, shops, etc.)	100 Percent
— Lighting loads, noncontinuous use (living areas, storage, etc.)	80 percent
— Convenience outlet loads, general use	60 percent
— Electric food service and preparation loads	65 percent
— Mechanical equipment loads, continuous use	100 percent
— Mechanical equipment loads, cyclic use	80 percent

b. Branch circuits. Branch circuits will be rated a minimum of 20 amperes, except where lesser ratings are required for specific applications. Branch circuit conductors will in no case be less than No. 12 AWG.

c. Voltage drop. The combined voltage drop on feeders and branch circuits will not exceed 5 percent, based upon the assumption that transformer load centers are located within the facility. Where such load centers are located exterior to the facility, the combined voltage drop for service conductors, feeders, and branch circuits will be limited to 5 percent. Individual voltage drop on feeder and branch circuits will not exceed the recommendations of the NEC.

d. Ground-fault circuit protection. Generally, ground-fault circuit protection will be provided as required by the NEC. Such protection will not be provided beyond those applications specifically required by the NEC except as authorized by HQDA(DAEN-ECE-E), WASH DC, and for Air Force projects by HQ USAF/LEEU, WASH DC.

e. Hazardous locations. Wiring systems in hazardous locations will conform to the NEC requirements for the particular hazard encountered. Project construction drawings will outline the extent of each hazardous location, describing the applicable vertical and horizontal limits of the hazard and identifying each hazardous location by NEC Class, Division, and Group. Designation of either specific maximum operating temperatures of equipment or temperature ranges will also be indicated.

(1) Where governing criteria are such that the need for sealing fittings is not clearly expressed, and differing interpretations of NFPA requirements could occur, sealing fittings will be provided, and project drawings will reflect that provision.

(2) Instances occur where military terminology is not expressed in terms consistent with the civilian sector. In such cases, the function to be performed will govern the requirement for hazardous locations design. As an example, repair shops in vehicle or motor maintenance facilities and self-help garages are normally considered hazardous locations equivalent to commercial garages as concerns function. Accordingly, the NEC requirements for commercial garages will be followed for such a military-equivalent facility.

(3) Every effort will be made to locate electrical equipment in nonhazardous areas of facilities having hazardous locations. General exceptions to such a requirement are lighting fixtures in paint-spray booths and similar situations where electrical equipment must be located within a hazardous location due to functional requirements.

f. Raceway systems. Raceway sizes will not be less than 1/2 inch and will be based upon the use of moisture-resistant thermoplastic, moisture- and heat-resistant thermoplastic, or synthetic rubber insulated conductors. Raceway sizes greater than 1/2 inch nominal trade size will be indicated on the project construction drawings.

(1) Generally, raceways used for interior wiring systems will consist of rigid, threaded, zinc-coated steel conduit; intermediate metal conduit; or electrical metallic tubing. Limited use will be made of rigid aluminum conduit. Use of plastic conduit within structures will be limited to applications below concrete slab-on-grade construction and in highly corrosive, non-hazardous locations where metallic conduits will corrode due to atmospheric conditions.

(2) Flexible metal conduit will be used for permanent connections to large appliances, equipment, and motors where movement may be involved or where equipment vibration is of concern. Flexible metal conduit may also be used for lighting fixture connections above suspended ceilings in accordance with the NEC, and with Underwriters Laboratories approved and labeled equipment and control assemblies.

(3) Surface metal raceways or multi-outlet assem-

blies normally may be used only for building improvements or renovations, or for applications where a multiplicity of cord-and-plug connected equipment will be utilized in a limited space, such as in some areas of medical facilities and laboratories.

(4) Underfloor ducts may be used in large administrative or other areas where extensive power and communications facilities are required that cannot be adequately served by wall outlets normally provided. Ducts should have nominal cross-sectional areas of 3 square inches for power service and 8 square inches for communications service. Preset inserts should be provided on 24-inch centers. Ducts should be installed parallel to exterior walls, with the first row approximately 5 feet therefrom. Additional rows should be spaced on 8 foot centers. Junction outlets should be kept to a minimum, located at strategic points to facilitate wiring to panelboards or cabinets, and spaced not more than 50 feet apart.

(5) Busways or cablebus may be used for feeders and service entrances where more economical than equivalent-ampacity insulated conductors in raceways. Plug-in busways may be used in industrial or shop areas to serve a multiplicity of power outlets or motors.

(6) Cable trays may be used as a support system for—

- Wiring methods that may be used without a tray such as metal-clad cable or conductors in conduit.
- Multiconductor type cables such as UF or SE.
- Single conductors where permitted by the NEC.

(7) Cellular steel floor may be used in large structures having extensive power, lighting, and communications wiring requirements where the combination of structural adequacy and raceway access capability so provided will result in major economies as compared to conventional building systems. Where the use of cellular steel floor is anticipated, electrical and structural designs will be closely coordinated, beginning at the earliest practicable design phase.

(8) Branch-circuit wiring within lightweight, demountable, metal-stud partitions may consist of properly supported metal-clad cable or nonmetallic-sheath cable systems installed through nonmetallic bushed or grommeted holes or slots in the framing members. Outlet boxes for such applications will be of metal, grounded by the cable grounding conductor, and securely supported by bar hangers or equivalent means between framing members.

(9) Mineral-insulated cable systems, type MI, may be used in lieu of exposed conduit and wiring. Cable connections and terminations will be made in accordance with the manufacturer's recommendations to assure proper operation.

(10) Conductors will be of copper for sizes No. 6

AWG and smaller. For sizes larger than No. 6 AWG, copper or aluminum conductors will be permitted as a contractor option. Conductor insulation will be suitable

for the application and will conform to the NEC requirements for each application.

CHAPTER 4

LIGHTING

4-1. Basic considerations. The design of lighting systems will be developed to provide comfortable visibility conditions having adequate intensities for the safe and effective accomplishment of the tasks to be performed. The finish and color of room surfaces will be coordinated with the lighting system design to reduce glare, increase light utilization, and attain an acceptable brightness ratio. Light sources and fixtures will be selected to provide the most efficient and economical system practicable.

a. General illumination levels. General illumination levels will conform to the recommendation of the Illuminating Engineering Society (IES) Lighting Handbook as modified by DOD 4270.1-M. Such illumination levels reflect maximum authorized levels of illumination for military facilities. Deviations therefrom within a range of plus-or-minus 10 percent of that indicated are acceptable where space configuration or fixture arrangements dictate. Deviations from illumination levels beyond the plus-or-minus 10 percent range will be fully justified and documented in the project design analysis and will be authorized only where specifically approved.

b. Light sources. Fluorescent lamps will be used to the maximum extent practicable. Generally, high-pressure-sodium vapor type sources will be used for medium- and high-bay applications where color rendition is of no concern, for exterior fixtures mounted on buildings, and for parking area or walkway illumination. Where effective color rendition is required, the most efficient and economical source which provides the required illumination levels and chromaticity will be used. Incandescent lamps may be used in living areas of bachelor officer quarters and similar areas where low illumination levels combined with intermittent use would render other sources uneconomical, such as janitors' closets. Consideration may be given to the use of incandescent sources in hazardous locations, where life-cycle cost analyses indicate that such is advantageous versus other suitable sources, including energy costs.

c. Lighting fixtures. Lighting fixtures will be selected to provide the most appropriate design commensurate with the application and the source used. Generally, fixtures will be of standard commercial manufacture, except that special fixtures may be used where required by the architectural treatment of the building. Non-standard fixture requirements will be detailed on the project construction drawings and accompanied by competitive specification requirements. Locations and spacings of

fixtures will be coordinated with structural, mechanical, and other design requirements. Selection and hanging of fixtures in large rooms having high or sloped ceilings will be accomplished so that any required architectural effect or function will not be impaired. In air-conditioned areas having minimum illumination levels of 50 footcandles or more, fixtures will be suitable for use as an integrated air-conditioning and lighting system component. Dropped-dish diffusers may be used with fluorescent fixtures for decorative purposes in small offices or similar areas. The use of wrap-around lenses with fluorescent fixtures will be avoided wherever practicable to eliminate lens or hinge breakage associated with normal lamp replacement. Fluorescent fixtures normally will be of the 4-foot type, except that 8-foot fixtures may be used where requested and approved by the Using Service. The difficulties and costs associated with the storage and replacement of lamps for 8-foot fixtures render such fixtures unsuitable in some areas. Other lamp types suited to specific needs, such as "U"-shaped lamps, may be used in limited applications where linear 4-foot lamps cannot be employed.

d. Exit and emergency lighting. Exit and emergency illumination normally will be provided as required by NFPA No. 101. Emergency lighting systems will also be provided in key communications and other facilities where continuity of operation or protection of life and property is essential. Exterior exit steps or ramps will be lighted for egress safety, except that separate fixtures for that purpose will not be provided where other permanent exterior lighting provides the necessary illumination at the steps or ramps. Generally, exit and emergency lighting supplied by auxiliary sources will be provided by integral, battery operated fixed lighting units. Where clearances for headroom and passage would be encumbered due to low ceilings or narrow walkways, battery-operated fixed lighting units supplied by a central storage battery may be used. When an alternate power source such as a generator is available, that source normally will provide the sole auxiliary support for the exit and emergency lighting system.

4-2. Criteria for specific facilities.

a. Military nomenclature. Spaces within military facilities having specific functional requirements are frequently identified by different nomenclature than those of the civilian sector identified in the IES Lighting Handbook. The space nomenclature cross-references provided in DOD 4270.1-M provide clarification of the

most commonly encountered spaces, and serve as a convenient comparison of such nomenclature. Additional cross-references in table 4-1 will assist in the selection of the proper illumination level for such spaces.

Table 4-1. Military/Civilian Facility Description Comparisons

<u>Military Description</u>	<u>Civilian Description</u>
Club dining rooms	Intimate-light environment
PX-snack bars	Quick service normal environment
Guard houses, stockades	Municipal buildings— fire and police
Military vehicle parking	Attendant parking

b. Space illumination for specific facilities other than indicated in these criteria will conform to the following:

(1) Barracks sleeping areas will be provided with fixed overhead fluorescent lighting, recessed wherever practicable, or ceiling surface-mounted. Where specifically authorized, on a project-by-project basis, incandescent fixtures (resistant to vandalism) may be used. Such permanent fixtures will be switched at each bed or desk location for wall-mounted units or at the room entrance for ceiling-mounted units. Open-bay barracks sleeping areas will be provided with ceiling-mounted fluorescent fixtures, switched for sub-area illumination.

(2) Communications facilities normally will be illuminated by fluorescent fixtures arranged parallel to equipment aisles to provide the necessary illumination and avoid conflict with overhead cable trays. Where manual telephone or other communications switching equipment and consoles are used, fixtures will be selected and positioned to avoid glare on and undesirable reflections from equipment surfaces.

(3) Facilities such as Service clubs, ballrooms, and lounges serving multiple functions, will have the general illumination arranged for multiple switch or manually operated dimmer control. For ballrooms of 2,000 square feet or larger, general illumination may be controlled by solid-state or motorized dimmers having control stations at both the main entrance and bandstand. Convenience outlets will be provided for the connection of portable spotlights, floodlights, or accent lights in coordination with the Using Service.

(4) Illumination for training facilities will conform to the following:

(a) Fixtures in classrooms which are located immediately in front of lecture platforms will be controlled both at the speaker's location and the room entrance.

(b) Fixtures providing general illumination in auditoriums will be switch- or dimmer-controlled to permit a reduced lighting level suitable for note-taking during use of audio-visual aids. Fixture controls will be located both at the entrance and at a control position off-stage.

(c) Fixtures in indoor rifle ranges will be of the

indirect incandescent or low-brightness fluorescent type where located in the firing area to minimize undesirable reflections. Firing lane and target fixtures will be protected from stray bullets by metallic shields.

(5) Fixtures in warehouses will be arranged to suit the warehousing technique employed. For pallet storage of large items, general illumination will be confined to main aisles, and will be supplemented with localized fixtures located in the aisles and directed into the storage areas. Trolley-mounted luminaires may be provided in storage areas where the type of operation changes frequently and shifting of fixtures is desirable and practicable. Fixtures will be controlled from panelboards, except that at aisle intersections and intermediate key points, fixtures may be controlled remotely by low-voltage switches. Adjustable type dock lights will normally be provided adjacent to loading doors to illuminate truck or rail car interiors.

(6) Lighting systems in weapons systems control and launch areas will be designed in coordination with the Using Service for the conditions encountered. Low levels of illumination (30 footcandles or less, generally) are required to permit observation of luminous dials and panels without reflected glare or undesirable contrast in brightness. Separately controlled fixture arrangements will be provided for both normal operations and maintenance activities.

(7) Lighting intensities in maintenance areas, such as utility crawl spaces and tunnels and walk-in pipe chases, will be approximately 1 footcandle for the safety of maintenance personnel. Fixtures will be controlled by switches with pilot lights located in a normally occupied area. Convenience outlets will be provided at various locations for connection of portable fixtures and tools.

c. *Relamping in high-bay areas.* Special provisions will be made for lamp replacement in high-bay areas such as gymnasiums, handball and squash courts, hangars, shops, and indoor swimming pools. In certain instances, judicious location of fixtures, such as by locating directional-beam fixtures beyond pool perimeters as opposed to above the water surface, may improve accessibility. In other instances, additional means to provide the necessary accessibility will be provided as required. In all cases, design responsibility will include investigation to determine whether suitable lamp maintenance facilities such as scaffolding are available on base, determination of the practicability of using such maintenance facilities for the project in question (e.g., can the scaffolding be transported through the small squash court doors), and identification of such facilities and documented coordination with the Facilities Engineer in the design analysis. If suitable maintenance facilities are not locally available, an appropriate and economical means for facilitating lamp replacement will be selected in coordination with the Facilities Engineer and the Using Service. Among the

means to be evaluated will be fixture lowering devices, suspended fixtures, boatswains chair systems, fixed catwalks with handrails, movable telescopic-type lift platforms, movable collapsible-type scaffolding, and truck-mounted collapsible-type derricks or movable arms (cherry pickers). The appropriate selection will be in-

dicated in the design analysis and, where funded by the project, in the contract documents. Portable and movable equipment will be furnished by the Using Service and the design will include provisions for bringing such equipment into and out of the building.

CHAPTER 5

COMMUNICATIONS AND AUXILIARY SIGNALING SYSTEMS

5-1. General.

a. Integrated systems. Communication systems are described as individual entities. For facilities requiring more than one type of similar system, incorporate the appropriate features desired into one integrated feature, such as providing television and radio antenna mounting from the same antenna mast.

b. System cabling. In routing communication and signalling cables, every effort should be made to prevent high level (50 volts or greater) signals from being transmitted within the same cable assembly with low level (10 volts or less) signal lines. Use of shielded cabling is required when there is a potential for inducing electromagnetic energy onto the communications lines.

5-2. Intercommunications systems. Intercommunications systems will be provided when the voice-only communications requirements of the Using Agency cannot be adequately fulfilled by the normal administrative telephone system.

a. Barracks. Intercommunications systems in barracks will conform to the criteria given below:

(1) New barracks complexes will be provided with an intercommunication system to link the company administration areas to the lounges and dayrooms in the housing area as follows, only where specifically authorized:

(a) Intercommunication will be provided between the following functional areas:

- Each company administration area with all other company administration areas of the complex.
- Each company administration area and each lounge and dayroom in the barracks building of the complex.
- Each of the above functional areas will have the capability of generating a call to each of the other areas except as follows:
 1. Communication from lounge to lounge is not to be provided due to possible line tie-up by personal calls.
 2. Communication from dayroom will only be to its associated master station and to lounges in the same building.
 3. Master stations in company administration areas will have the capability of transferring calls to other master stations.

(b) Intercommunication system will consist of

master stations located in the company administration areas and dayrooms. Staff stations will be located in the lounges. Master stations will be of the telephone type and will be furnished with dials or pushbuttons. Staff stations will be a loud-speaker housed in a flush, vandal-proof enclosure, or a non-dial type, wall-mounted, handset. The type of staff station to be used will be coordinated with the Using Agency. Speaker stations will be provided with a two-position call button. One position will generate a call to the master station in the closest dayroom. The second position will generate a call to the master station in the administration space of the company to which the lounge is assigned. A press-to-talk pushbutton will also be provided. In low background noise situations, "hands-free" operation may be provided. This will require a voice actuated loudspeaker at the remote base. The handset type staff station will be furnished with a two-position switch to select either the dayroom or company administration space. Call origination will be accomplished by lifting the handset. Master stations will be equipped with an audible signal to announce incoming calls and annunciator lights to identify the location of the incoming call.

(c) The master control console for the system will be located in the mechanical equipment room or a centrally located area of an administration or storage building.

(d) Conductors for communications and auxiliary signaling systems will be housed in conduit and installed in the duct and manhole system provided for the administrative telephone system.

(2) For other new barracks and for barracks modernization projects, intercommunications functions will be provided with a system consisting of a master station capable of selectively paging through individual loudspeakers in selected areas such as corridors and lounges. Sleeping rooms are not to be included. The loudspeaker stations will be of the slave type. Control office master station will have volume controls on input and output and an all-call feature. Speakers will be flush-mounted type. Speakers and stations will be of the vandal-resistant type, mounted with tamperproof screws. Equipment locations will be as authorized on a project-by-project basis.

(3) New special barracks projects will be provided with an intercommunication system consisting of handset- or speaker-type stations and master stations of the type described in (2) above.

b. Chapels. An intercommunications system consisting of telephone-type desk sets will be provided in each of the following areas:

TM 5-811-2/AFM 88-9, Chap. 2

- Chaplain's office
- Chaplain's assistant's office(s)
- Sacristy
- Choir room
- Activity (family assembly) room
- Narthex
- Education center administrative office, or activities room kitchen, as applicable.

Additionally, as designated by the Using Agency, desk sets may be installed in the chaplain's secretary's office, orderly room, or finance office. Each desk set will include a handset for voice communication between any of the participating stations, and a built-in loudspeaker which provides for common voice paging. At the organ console location, a wall-type handset will be provided without built-in speaker. Signaling of the organist will be accomplished by a red light operated by a pushbutton at the narthex station. A selector switch will be provided with the organ handset to permit either telephone conversation between the organ station and the narthex station only, or common voice paging and communications between the organ station and any of the other stations.

c. Dining facilities. For dining facilities having a seating capacity of 651 or more persons, an intercommunications system will be provided between the kitchen and support areas such as serving lines and administrative offices.

d. Other facilities. For other permanent facilities, an intercommunications system independent of the administrative telephone system will be provided only where the need can be justified by the Using Agency, or where required by other criteria, such as in hospitals.

5-3. Fire alarm and detection systems. Fire alarm and detection systems will be provided as required by TM 5-812-1. Auxiliary power support for such systems will be provided in accordance with NFPA No. 72A or 72D, as appropriate, except that primary batteries permitted by NFPA No. 72A are not authorized for Army projects. If the facility in which the fire alarm and detection system is installed is equipped with an auxiliary generator for supplying emergency lighting power (such as in a hospital), this emergency system may supply auxiliary power for the fire alarm and detection system. Where a central storage battery provides emergency lighting power, this system may supply auxiliary power for the fire alarm and detection system. The capacities of the auxiliary sources mentioned above will be designed to include the alarm and detection system load imposed.

5-4. Security systems. Guidance for the design and installation of intrusion detection, television surveillance, and other security systems, where authorized, will be obtained from HQDA(DAEN-ECE-E), WASH DC 20314,

and for Air Force projects, from HQ USAF/LEEEU, WASH DC 20332 except as indicated for confinement facilities in appendix B; for Army medical facilities, in TM 5-838-2; and for Air Force medical facilities, in AFM 88-50.

5-5. Television antenna systems. Television antenna systems will be provided for recreational (entertainment) use in barracks, bachelor officer quarters, and service clubs only when adequate reception of nearby broadcasts cannot be obtained with an antenna supplied with individual receivers. Detailed requirements for antennas and cable distribution systems will be coordinated with the local Communications Officer. Antennas will be installed on buildings only when signals are not available from an installation distribution system. Antenna masts will be properly supported, grounded, and guyed. Roof penetrations will be provided with pitch-pockets where appropriate. Lightning protection for antenna installations will be provided in accordance with TM 5-811-3/AFM-9, Chapter 3. Exterior mounted antennas and supports will be located as unobtrusively as possible for minimum aesthetic impact. For multi-outlet systems, amplifiers and splitters will be utilized to obtain uniform and adequate signal strengths at all outlets. Television antenna outlets will be located in recreation areas, dayrooms and lounges of barracks. In bachelor officer quarters, outlets will be located in the living rooms of each quarters and, if applicable, the lobby. Outlets in service clubs will be located in each activity and dining room. Educational closed-circuit television cables, cameras, monitors and head-end equipment normally will not be provided under the project construction funds. However, floor spaces, raceways, cabinets, boxes, wiring closet space and space for head-end studio areas required for a closed-circuit television system may be provided. Closed-circuit television systems used for security surveillance purposes may be provided with project construction funds where specifically authorized.

5-6. Clock systems. Buildings requiring more than 25 clocks will be provided with a complete master and secondary clock system having automatic and manual resetting features. For other facilities, outlets will be provided for synchronous clocks in auditoriums, chapels, offices, lobbies, laboratories, shops, dining rooms, kitchens and recreational areas as required by the Using Agency. Surface-mounted clocks normally are not provided with the project construction contract funds.

5-7. Telephone systems. Planning, design, and construction responsibilities for Army telephone systems are set forth in AR 415-15 and AR 105-22. Design requirements for administrative and public telephone systems will be coordinated with the local

Communications Officer. Telephone system requirements of the Using Agency will be established at the earliest practicable design phase so that proper space for equipment and supporting facilities will be provided and the system extent determined prior to project approval. Surface-mounted cabinets or terminal strips in wiring closets or equipment rooms will be provided to permit future system changes and reconnections without damage to the building finish. Flush-mounted cabinets will be used only in finished areas where limited facilities will be required and major changes in service are not anticipated.

5-8. Radio and public address systems. Radio and public address systems will be provided in dining and activity areas of Service clubs, hospitals, and elsewhere as authorized. Public address systems will be provided in training facilities and elsewhere as required to provide mass voice-only communications on a regular basis. Radio systems will provide for both AM

and FM signal reception. Antenna installations will conform to the requirements for television system antennas.

5-9. Watchmen's reporting systems. For structures which will be patrolled by night watchment, watchmen's reporting systems will be provided. Specific locations of clocks, stations, and central equipment will be coordinated with the Using Agency and the local Provost Marshal.

5-10. Medical facility communications systems. Communications systems for medical facilities will be provided as set forth in TM 5-838-2 (for Army) and in AFM 88-50 (for Air Force).

5-11. Energy Monitoring and Control Systems (EMCS). EMCS will be installed where energy conservation requirements analyses, as defined in TM 5-815-2, are met. Design and installation will be in accordance with TM 5-815-2.

APPENDIX A

REFERENCES

Government Publications

Department of Defense (DOD)

DOD 4270.1-M Department of Defense Construction Criteria Manual

Department of the Army and the Air Force

<ul style="list-style-type: none"> ■ AFM 88-15 ■ AFM 88-50 ■ AR 105-22 ■ AR 310-34 ■ AR 415-15 ■ AR 420-43 ■ AR 420-90 ■ TM 5-811-1/AFM 88-9, Chap. 1 ■ TM 5-811-3/AFM 88-9, Chap. 3 ■ TM 5-812-1 ■ TM 5-815-2/AFM 88-36 ■ TM 5-838-2 	<ul style="list-style-type: none"> Criteria and Standards for Air Force Construction Criteria for Design and Construction of Air Force Health Facilities: Air Force Telecommunications Requirements Planning, Developing and Processing Equipment Authorization and Utilization Policies and Criteria and Common Tables of Allowances Military Construction, Army (MCA) Program Development Electric Services Fire Prevention and Protection Electrical Design: Electric Power Supply and Distribution Electrical Design: Lightning and Static Electricity Protection Fire Prevention Manual Energy Monitoring and Control System Army Health Facility Design
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Non-Government Publications

American National Standards Institute, Inc. (ANSI), 1430 Broadway, New York, NY 10018.

<ul style="list-style-type: none"> ■ C2-1981 ■ Y32.2-1975 ■ Y32.9-1972 	<ul style="list-style-type: none"> National Electrical Safety Code Graphic Symbols for Electrical and Electronics Diagrams Graphic Symbols for Electrical Wiring and Layout Diagrams Used in Architecture and Building Construction
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Illuminating Engineering Society (IES), 345 E. 47th St., New York, NY 10017

Lighting Handbook (Sixth Edition, 1981)

National Fire Protection Association (NFPA), 470 Atlantic Avenue, Boston, Massachusetts 02210

<ul style="list-style-type: none"> ■ No. 70-1984 ■ No. 72A-1979 ■ No. 72D-1979 ■ No. 101-1981 	<ul style="list-style-type: none"> National Electric Code Local Protective Signaling Systems for Guard's Tour, Fire Alarm and Supervisory Service Proprietary Protective Signaling Systems Code for Safety to Life from Fire in Buildings and Structures
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APPENDIX B

CONFINEMENT FACILITIES

B-1. Purpose. This appendix provides design criteria for electrical systems for confinement facilities. These criteria will also apply to correctional training facilities and disciplinary barracks having similar functional areas. The criteria in the basis text of this manual will apply except as modified herein.

B-2. Power supply. Power supply for confinement facilities will conform to TM 5-811-1/AFM 88-9, Chapter 1, Electrical Power Supply and Distribution, except as modified below.

a. Primary power. One primary feeder will be extended from the existing on-base system, either overhead or underground, to a point not less than 50 feet outside the perimeter fence. From that point, the feeder will run underground to a pad mounted transformer located near the mechanical room but outside the secured area or to a transformer installation within the equipment room. Where no fence is provided or exists, the primary feeder will be extended to the mechanical equipment room.

b. Service entrances. Service entrances supplied by an exterior transformer will be run underground in coated, rigid steel conduit or coated intermediate metal conduit (IMC).

c. Auxiliary power. Each facility will be provided with an auxiliary power source consisting of one diesel-engine-driven electric generator with auxiliaries as required and a residential-type exhaust silencer. Controls for the engine will conform to the criteria given in chapter 10 of TM 5-838-2 for Army hospitals, and in AFM 88-50 for Air Force hospitals, except that parallel operation and automatic load shedding provisions will not apply. The fuel tank will be sized to the nearest standard capacity for a 3-day supply.

B-3. Interior distribution. Fluorescent lighting loads and building power loads will be supplied by a 480Y/277-volt system. Incandescent loads and receptacles for small portable equipment will be supplied by a 208Y/120-volt system provided by dry-type transformers located in secured areas. All panel boards and service equipment will be of the circuit breaker type.

a. Interior wiring. All interior wiring systems will consist of insulated conductors installed in concealed, rigid steel conduit.

b. Exterior wiring. Wiring for exterior security lighting will be installed underground. Security lighting will be arranged so that adjacent fixtures and adjacent

lamps of two-lamp fixtures are connected to different branch circuits supplied from a panelboard in the control room. Each guard tower will be supplied by separate, single-phase, 277-volt feeder.

c. Roadway and parking area lighting. Where roadway and parking area lighting is authorized by the project scope, all necessary controls will be located in the control room.

d. Outlets. All outlets will be flush mounted. Receptacles will not be installed in detention cells. Receptacles will be provided for clothes washers and dryers where required by and in locations indicated by the Using Service. Receptacles for television sets will be switched from the panelboard in the control room.

(1) Floor maintenance receptacles will be provided in corridors and halls so that no area of any floor surface will be more than 45 feet from a maintenance receptacle. Current and voltage ratings, and receptacle types will be selected in coordination with the Using Service. All such receptacles on each floor will be connected to one branch circuit of adequate rating to supply one floor maintenance machine.

(2) One 20-ampere, 125-volt, two-pole, three-wire, grounding-type receptacle will be provided in each corridor of each cell wing for electrically heated food carts. Joint use of floor maintenance receptacles will be made for this purpose to the fullest extent practicable.

(3) A clock outlet will be provided in each of the following areas, at locations designated by the local Provost Marshal:

- Commander's office
- Provost sergeant's office
- Administrative office
- Visitor-guard room
- Multipurpose room
- Guard's office
- Control room
- Dining rooms
- Dispensary

B-4. Lighting. Lighting will consist of fluorescent and incandescent sources only. Long-restrike times associated with high-intensity discharge (HID) sources render their use unsuitable for application in conjunction with confinement facilities.

a. Intensities. Average maintained lighting intensities will be provided in conformance with table B-1.

Table B-1. Lighting Requirements by Area

Location	Footcandles	Location	Footcandles
Guard-visitor room	30	Lobby	15
Control room	*	Social workers' area—booths	50
Offices	50	Social workers' area—waiting	30
Kitchen storage	30	Consultation-interrogation area-booths	50
Dining rooms	30	Consultation-interrogation area-waiting	30
Cafe counter	50	Photographic room—normal	30
Arms room	30	Photographic room—developing	0.1
Dormitories	30	Administrative area	50
Prisoner processing	75	Interior sallyport	50**
Storage/supply	5-20	Sallyport, receiving yard	20-25
Dispensary	50	Mail room	50
Laundry	30	Multipurpose room	50
Janitors closet, with lavatory	10	Health and comfort	30
Janitors closet, without lavatory	5	Building exterior walls	3
Dayroom	15		
Individual cells		Security areas 50 feet beyond security fencing and gates, and	
Close confinement: One 150-watt incandescent lamp		between security fencing and buildings.	
Holding, and other: Two 150-watt incandescent lamps			1

* Control room lighting will be of the ceiling recessed incandescent type supplied by two branch circuits having a manual dimmer in each circuit. One circuit will provide approximately 50 footcandles intensity on the floor. The other circuit will provide approximately 20 footcandles intensity on counters at windows.

** Interior sallyports adjacent to control room will have a supplemental floodlight to provide a minimum of 150 footcandles on the room side of each electrically controlled sallyport door. Floodlight controls will be located in Control room.

b. Security lighting. Security lighting will be provided when perimeter fencing, gates and guard towers are authorized by the project scope. Security lighting will cover all exterior confinement areas and areas 50 feet outside of perimeter fence. Exterior walls of confinement buildings, the exterior exercise yards, and exterior sallyport receiving yards will be floodlighted.

c. Lighting fixtures. Exact locations of fixtures in security areas and exit lights will be coordinated with the local Provost Marshal.

(1) Fixtures in prisoner detention areas will be of the ceiling recessed, vandalproof type with high-impact lenses.

(2) Fixtures in individual cells will be of the cast metal, back-access type for wall mounting above lavatory at ceiling. Fixtures in close-confinement cells will have one 150-watt incandescent lamp. Fixtures in holding and other detention cells will have two 150-watt incandescent lamps.

(3) Fixtures in dormitory-type detention areas will be of the ceiling-recessed, fluorescent type.

(4) Night lighting fixtures will be provided in prisoner confinement areas. Fixtures shall be of cast metal with louvered front, flush mounted, approximately 18 inches above floors, having incandescent lamps of orange color.

(5) In other areas within the building, fluorescent

fixtures will be used except in closets, storerooms, mechanical rooms, detention cells, exterior entrances and such other spaces requiring only intermittent use.

(6) Exterior security lighting fixtures will consist of two-lamp units or two adjacent one-lamp units, with incandescent lamps of the general service type, having 130-volt rating for use at 120-volts. Fixtures illuminating exterior walls of the buildings and sallyports will be mounted as near the roof as practicable, or will be mounted on yard lighting standards not less than 14 feet above the ground. Perimeter road and exterior security area floodlighting units will be located at sufficient height to prevent objectionable glare in the eyes of guards in towers.

(7) Each guard tower will be provided with a search light having a motor-operated drum, to permit observers to quickly spot an object within the security-fenced area. The searchlight will be mounted on top of the tower, and provided with a remote foot-operated control at the guards' position in the tower. Searchlights will be of the narrow-beam, 120-volt incandescent type, furnishing a minimum of 10 footcandles at the maximum distance specified by the local Provost Marshal.

d. Security lighting controls. Security lighting controls will be provided as indicated below:

(1) Interior security lights for areas normally accessible to prisoners will be controlled only from the Control Room. Areas and functions to be included are:

- Prisoner confinement areas
- Prisoner kitchen and dining areas
- Health, comfort and mail rooms
- Interior sallyports
- Multipurpose rooms
- Dayrooms
- Classrooms
- Night lights

(2) Exterior security lights will be controlled only from the Control Room. When authorized by the local Provost Marshal this lighting may be arranged for photoelectric or astronomic time clock control having a bypass switch in Control Room.

B-5. Auxiliary power source loads. The following loads will be supplied from the auxiliary power source through an automatic transfer switch:

a. Exterior security lighting. All lighting fixtures and guard tower circuits.

b. Interior security lighting. A sufficient number of fixtures to provide the following minimum average footcandles:

- Areas normally available to any prisoner, except detention cells: 2 footcandles
- Detention cells: All fixtures
- Corridors, stairs and exits: 2 footcandles
- Control room: All fixtures
- Commander, and Provost Sergeant offices: 5 footcandles
- Arms storage: All fixtures
- Processing area: 5 footcandles
- Dispensary: All fixtures
- Dining rooms: 3 footcandles
- Kitchens: 5 footcandles

c. Other loads:

- Kitchen: Minimum cooking and food refrigerator units, as determined by the Using Agency.
- Dispensary: All receptacles.
- Fire alarm system.
- Electric door lock control system.
- Security public address system.
- Security intercommunications system.
- Security audio monitoring system.

B-6. Telephone system. A complete empty raceway system will be provided for installation of wiring and equipment. Sizes of raceways and cabinets for main and sub-terminal wiring will be coordinated with the local Communications Officer. Exact locations of telephone outlets will be coordinated with the local Provost Marshal.

Telephone outlets will be provided in all offices, control rooms and dispensary. Outlets in administrative areas will be provided on a basis of one for each 150 square feet of office space. One public pay station outlet will be provided in the lobby. No telephone outlets will be provided in consultation and social worker interviewing areas.

B-7. Master antenna television distribution system. A master antenna television distribution system will be provided complete including antenna, amplifiers, distribution facilities and antenna outlets, having capability of receiving all local television channels. Where cable distributed signals are available from other sources on the post, the building antenna may be omitted and a cable system substituted, where authorized by the local Communications Officer. Each television antenna outlet will be complete with recessed box and flush metal wall plate, having built-in 75-ohm coaxial cable connector and matching plug. The outlet plate will be marked "75 ohm TV." A standard convenience receptacle will be located adjacent to each television antenna outlet. Outlets will be located in the following rooms and will be coordinated with the installation Provost Marshal:

- Dormitories: one each, at toilet end of wings.
- Multipurpose room: one in each section of room.
- Dining room and mess hall: one each.
- Guard-visitor room: one each.
- Holding wings: one in each dayroom.
- Office of correctional officer: one each.

B-8. Fire alarm system. A fire alarm system will be provided complete, with supervisory panel located in the Control Room. Manual stations and detectors will be located in areas not normally accessible to prisoners and will include control rooms, administrative, and other secure areas. Transmission of alarms to a central source will be in conformance with AR 420-90, Fire Prevention and Protection.

B-9. Security control systems. Equipment for the security control systems will be Government-furnished for installation by the construction contractor. Exact locations of all system components will be coordinated with the local Provost Marshal. Wiring between components and control console will be installed by the construction contractor in accordance with details and diagrams furnished by the Federal Prison Industries.

a. A single control console will be floor mounted in the Control Room and will have separate sections for the security door and gate surveillance, intercommunication, public address and audio monitoring systems. All control switches will be of the heavy-duty type. Raised guards will be provided for switches controlling drop doors. Spare circuits will be provided as follows:

- One for each category of security doors and gates.
- Two for intercommunications system slave stations.
- Two for public address system speakers.

b. Security doors and gates will be provided with electrical surveillance. Components will be procured commercially with the doors and gates and will be identified as electrically interlocked, electrically locked and unlocked, or key operated. Open and closed positions of each door, gate and lock will be indicated on the console.

c. Intercommunication system will be provided as part of the administrative telephone system wherever practicable. Otherwise, the intercommunication will be of the dedicated type, and will have a master station in the control console. Master station will have power on-off switch, switch with pilot light for each slave station and necessary volume controls. Slave stations will be for desk or flush wall mounted, and will have a master station call switch. Slave stations, whether dedicated systems or telephone-type, will be located as follows:

- All offices, including group administration areas, exclusive of social worker, consultation and interview rooms.
- Dormitories, close confinement and holding wings, sallyports, and adjacent corridors.
- Lobby.
- Dayrooms.
- Multipurpose room.
- Dispensary.
- Sallyport, processing.
- Mail room.
- Health and comfort room.
- Storage and supply.
- Library.
- Guard dining area.
- Receiving platforms.
- Guard towers and sentry houses.
- Arms room.

d. Public address system will have a master station in the console with power on-off switch, volume controls and switch for each speaker plus an all-call feature. Remote stations will be ceiling-recessed 8-inch speakers located in the following areas:

- Guard's and visitor's room.
- All dormitories, and corridors of holding, and close confinement wings.
- Main corridor.
- Prisoner dining area.
- Multipurpose room.
- Processing area.
- Exercise yards (weatherproof).
- Emergency assembly yards (weatherproof).
- Enclosed service area.

e. Audio monitoring system will provide concealed

microphones in individual cells and dormitory wings. In large areas, a plurality of microphones will be provided to obtain adequate coverage of such areas. The master station in the control console will have power on-off switch, separate circuit for each cell or wing microphone, recessed monitor speaker, jack and head set, volume controls and all-circuit monitor switch.

f. Procurement requests for Government furnished equipment from Federal Prison Industries (FPI), Inc., will be directed to—

Associate Commissioner
Federal Prison Industries, Inc.
ATTN: Marketing Specialist, Electronics
REF: 3EP 3213
US Department of Justice
101 Indiana Avenue, NW
WASH, DC 20537

Procurement requests will include the requirements for the following:

- Delivery date.
- Estimated system cost, to be furnished prior to fabrication of system, to permit cost comparison in conformance with ASPR Section V, Part 4.
- Estimated cost for the services of an FPI technical specialist at the project site for a specified number of days during the period of final connections and testing by the construction contractor.
- Estimated cost for the services of an FPI technical specialist for a specified number of days during the construction period for advisory and troubleshooting purposes, only if critical problems develop.
- Installation manuals, detailed wiring diagrams of each system component, and interconnection diagrams between console and components.
- Shop drawings and/or specification data sheets, as appropriate, of the system components and accessories.
- Warranty for 1 year for all materials and equipment against defects and fabrication.

g. Scale drawings of floor plans and riser or block diagrams will be furnished the FPI for all systems. The number and location of all components and installation details will be shown.

h. Specifications furnished the FPI will be complete, and will include detailed requirements for all system components.

The proponent agency of this publication is the Office of the Chief of Engineers, United States Army. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to HQDA (DAEN-ECE-E), WASH DC 20314.

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