260510-H: ELECTRICAL GENERAL REQUIREMENTS (16000-H)

Related Sections:
The information expressed herein is unique to UMHHC owned, and operated facilities, and to most leased facilities. Note: When the facility under consideration is leased, review the needs in detail with the assigned UMHHC Design manager and Electrical Engineer.

260500-H – “Basic Electrical Requirements”
263000-H – “Engine-Generator Systems”
263010-H – “Paralleling Gear”

Basic Electrical Requirements

1. University of Michigan Hospitals and Health System (UMHHC) Design Guidelines are applicable to all new buildings and to major and minor alterations projects to existing buildings.

2. Submit copies of all critical electrical engineering design calculations, and assumptions. Those calculations and assumptions shall include:
   a. Projected "normal power", and all "emergency power" loads...peak, connected and demand thermal loads.
   b. Affirm and note capacities of all existing and proposed systems. When appropriate, evaluate the system back to the unit substation and/or the main service.
   c. Define required short circuit ratings (AIC) of strategic parts of the distribution system.
   d. Affirm proper selectivity and coordination of over-current devices at strategic parts of the distribution system.
   e. Provide arc-flash calculations at major points in the distribution system of all new buildings. Also provide this in major renovation projects when significant changes are being made to the distribution system
   f. Ability of proposed system to be properly coordinated "load-side" and "line side" of the service points and at major points in the distribution system.
   g. Lighting levels at typical and critical locations. This also includes point-by-point light level calculations along paths of egress as required by State authorities
   h. Provide other calculations, as requested and/or appropriate for the project.

3. Submit cut sheets of major system's products being used as basis of design. Submit list of sole-sourced items required by design and items that are required for this project, but are deviations from the Guidelines.

4. A/E shall validate system capacities for proposed modifications. The A/E shall provide proposed solutions and costs of required existing systems upgrades required to safely, economically, and reliably provide needed services.

Design Requirements

Use current Codes, Ordinances, Regulations and Standards as listed under SID-F-H, and the items noted below. Contact the UMHHC Design Manager at the beginning of each specific design project to determine any additions or modifications to that list, and the items noted below:

1. IEEE Recommended Practice for Electrical Systems in Health Facilities IEEE Standard 602
2. IES Lighting Handbook for lighting areas not covered by MDCH or these guidelines
3. NFPA No. 110, Emergency Power

Labeling

1. All electrical equipments and materials shall be listed and labeled by a recognized testing laboratory - i.e., UL, ETL, and CSA.
a. The label shall be for the assembled device as delivered by the manufacturer. (Assembled with UL rated devices or components, or equivalent, are not acceptable alternates.)

2. Electrical equipment shall also be Factory Mutual (FM) listed wherever the device is of a type covered by the FM loss prevention sheets.  
   a. Fire alarm systems are a prime example of such systems and devices

Accessibility and Working Clearances

1. Place equipment so that it is easily accessible for maintenance.
   a. Installations that would require the use of lifts or scaffolding, or the removal of other equipment, for routine maintenance, unless specifically accepted by UMHHC Maintenance in advance of installation, shall be avoided.

2. Provide 18” X 18” (minimum) hinged access doors to all maintainable equipment located behind walls or above permanent, non lay-in, ceilings.

3. Maintain safe working clearances as required by NEC, OSHA, MIOSHA, and equipment manufacturer. Use whichever document requires the greatest working clearance.

4. When placing equipment, provide adequate access paths, to allow for the rebuilding or replacement of major pieces of equipment.

5. All floor mounted equipment in non-finished areas will be placed on 4” high concrete housekeeping pads.

6. All light switches, control switches, intercoms, etc., should either be placed near a doorway, or in a location where there is accessibility for disabled persons.

Inspections, Permits, Certificates

Contractor shall obtain all permits, certificates, licenses and certificates of inspection upon completion of electrical work. In general UMHHC directly pays all fees.

Work Involving Other Trades

1. Certain items of equipment or materials specified in the mechanical or architectural divisions may have to be installed, powered, or connected by Electrical Trades.
   a. The A/E shall prepare the contract documents so that all electrical work is installed by the electrical contractor, and all electrical work is in compliance with all electrical design guidelines.

2. In a similar manner, architectural or mechanical work may be specified in the electrical sections.
   a. The A/E shall ensure the electrical contractors include the full cost for completing this work and pay the cost of doing the work to the respective trade he hires to do the actual work, unless indicated otherwise in the Specification.
   b. A/E shall specifically cross-reference the mechanical and architectural sections that include electrical work, etc.

Electrical Service Design Criteria

1. All inpatient (I2), and larger diagnostic and outpatient, facilities shall have two utility power supplies. In general, these facilities shall have double-ended substations.

2. Every effort should be taken to design the electrical utilities so that a failure of one utility (such as one of the two power feeds to building) does not affect the other utility feed.

3. The thermal load on either end of the substation shall not exceed 50% of the forced-air-rating of either transformer. The primary distribution shall be designed so that a single contingency outage does not cause a longer term loss of normal power to any portion of the facility.

4. Office and smaller outpatient facilities, and clinics may be powered from single-ended substations and from a single utility service.

5. All inpatient facilities and all facilities doing outpatient surgeries, and/or other invasive procedures, diagnostics, or treatments, where the patient is anesthetized, shall all have emergency generator(s). [See SBA-K-H for more details on these types of procedures.]
The installed generators shall pick up the Life Safety Load and Critical Load within 10-seconds.

b. The generators shall have on-site storage of fuel for the number of hours required by code – currently 72-hours for inpatient facilities.

c. The generators, ideally, will be installed inside the building in their own dedicated room. If this is not possible the generator(s) will be installed outdoors near the building. Outdoor generators shall be in sound attenuating enclosures. For more detailed requirements for generators see Section 263000-H – “Engine Generator Systems”.

d. In multiple generator applications where paralleling gear is required, this gear shall be installed in a room other than the generator room. For paralleling gear requirements see Section 263010-H – “Paralleling Gear”.

e. In single generator applications the projected power load shall not exceed 65% of that generator’s rating. (This 65% figure provides for the capacity to start and run the fire pump if a fire pump is present).

f. In multiple generator installations, the total Life Safety and Critical Power (as defined by NEC 517) shall not exceed 80% of the rating of the smallest (and/or any individual) generator.

g. All automatic transfer switches (ATS’s) on the Essential Power (Life Safety Power, and Critical Power) branches shall have full capacity maintenance bypasses to allow safe maintenance to be performed on the ATS, without interrupting these loads. (The bypass shall allow the switching of the loads to, or from, the bypass position without load interruption.) ATS’s, other than Essential Power Branch ATS’s, should also have these bypasses.

h. The ATS for the Life Safety and Critical branches shall be closed transition type to allow generator testing without interruption of these loads. All other transfer switches, if they do not have closed transition switching, shall have in-phase monitoring, to allow safe testing of loads during generator testing without adversely affecting the connected loads.

i. Where fault current levels, or other considerations prevent use of 'normal' closed transition ATS’s, consider use of a Static Transfer Switches (STS) - with 1/4-cycle switching. [When using an STS, is required the specifications shall require the STS to be listed for use for medical facilities and medical loads.]

j. Equipment loads on emergency system shall be planned so all related equipment is also on emergency power. An example is that an exhaust fan for a given air-handling system should be powered with the same type of power as the supply and the return fan.

### Electrical Distribution Design Criteria

1. All inpatient and outpatient Infection Control (IC) Room Types 1, 2, and 3 (operating rooms and invasive procedure rooms) shall have isolated power supplies (IPS). See SBA-K-H for detailed electrical requirements for these spaces.

2. All inpatient facilities shall be designed so that a single point of failure does not cause loss of all power to a vital area of the facility. Examples of these vital areas include, but are not limited to:
   a. In inpatient rooms and ICU rooms provide approximately 50% normal power receptacles, and 50% critical power receptacles to all bedsides. These normal and critical power receptacles shall be fed from circuits dedicated to that bed location. The circuiting to both the normal power, and to the emergency power, receptacles shall both be sized to carry the entire load of the bed location.
   b. As noted above, in IC Room Types 1,2 and 3 (operating rooms and invasive procedure rooms), provide:
      i. Two isolated power supplies (IPS)
      ii. The receptacles served from these IPS’s shall be evenly distributed within the room.
      iii. Provide two feeds to the isolated power supplies. When both of these sources are emergency (critical power) power sources, they shall be fed from different ATS’s.
      iv. The circuiting to both sets of receptacles shall be sized to provide 100% redundancy for all loads
   c. Design Critical and Life Safety systems so that design loads do not exceed 65% of the thermal capacity of the systems. This is to allow for the expected increase in loading on
these systems when normal power is loss for longer than a short period of time. In this regard the ‘system’ is to be defined as associated ATS’s, switchboards, risers (cable or bus duct) and panelboards serving receptacle (208/120-volt) loads.

d. Medical gas systems (medical air, medical vacuum, etc), air handling systems, water services and like critical patient care services; in I2 spaces, and ambulatory surgery centers, shall have power redundancy built into these systems.
   i. If the mechanical design builds in redundant systems, those systems will be fed from different emergency power sources.
   ii. If the mechanical system design does not have built in redundancy, the electrical power to these systems shall be fed from locally mounted (to the equipment) manual transfer switches, with feeds from two different emergency power sources.

3. Outpatient facilities that have facilities for IC Room Types 1, 2, or 3 (outpatient surgeries, invasive procedures and the like), shall also be designed so that a single point of failure does not cause loss of all power to such vital areas of the facility - like the Inpatient facility requirements as noted above.

Equipment Placements

1. To facilitate removals and replacements, substations, generators, and other like equipment rooms, should not be placed below grade, in penthouses, or other ‘difficult’ locations. [Given the number of number of floods seen in our facilities, a basement location is the least desirable of all locations, however.]

2. Electrical equipment shall not be placed in telecommunication rooms (TR), unless the electrical equipment serves the TR.

3. In general all electrical distribution equipment will be located in electrical equipment rooms. Exceptions, to this include:
   a. Kitchen panels, in food preparation and distribution areas
   b. Labs panels, located in or near the lab being served,
   c. Operating room (OR) isolate power panels, and the like will be installed in or near the associated operation rooms.
   d. Any others noted in program statement.

Spare Capacity/Existing Conditions

1. When designing new installations provide spare capacity for future growth, as noted in Section 260500-H – “Basic Electrical Requirements”.

2. When designing renovations, or additions to existing installations verify the existence of needed spare capacity before start of detailed design.

3. Field verify existing conditions
   a. Never assume that existing "as-built" drawings are complete and/or accurate.

4. Meter and field verify all existing conditions to confirm that capacity exists. Verify the loads under normal and ‘abnormal’ conditions.

Load Isolation

1. Mechanical and other transient inducing loads shall normally not be served by the substation bus or panel that also serves sensitive computer or other sensitive loads.
   a. Provide needed isolation, power conditioners, or other equipment necessary to ensure proper voltages to sensitive equipment.

2. If small single phase motor loads are added to 208/120-volt panels, the maximum size of said load shall not exceed 1/3-HP.
   a. Larger motors shall be three-phase, and should be served at 480-volts whenever that voltage is present in the facility.
Fault Duties

1. The fault clearing duties shall be calculated by the A/E, before bid, to assure that existing and proposed/specifed systems will safety clear any fault.
   a. The complexity and depth of these calculations will be determined by A/E to confirm adequacy of the specified equipment.
   b. Use low peak fuses at the first level distribution points whenever possible.
   c. Specify AIC ratings that are 125% of calculated fault (fault level is 80% of AIC rating).
2. The A/E shall perform arc–flash calculations as needed to affirm that all areas (except possibly substation locations) do not exceed a PPE Level 2. In substation and other like locations, the PPE shall not exceed Level 4.
3. The A/E shall arrange for the contractor to install Arc Flash Warning labels on all panels.
   a. In public spaces, the label will only be on the inside of the panel cover.
   b. In non-public areas install a label on both side of the cover.
   c. See details on labels elsewhere in the guidelines.
4. AE shall define the arc-flash energy at strategic points in the distribution system so the arc-flash labels will note the appropriate PPE needed at each location.
   a. AE shall also provide an electronic copy of the data and results of their fault and arc-flash study to UMHHC.

Coordination of Protective Devices

1. The protective device coordination shall always be considered before the project is bid.
   a. The A/E during design shall affirm that specified and designed system can be selectively coordinated as required by Code and good practice.
2. The power distribution system shall localize the faulted part of the systems to the smallest possible portion.
   a. Deficiencies in the existing systems, beyond the scope of the project, shall be communicated in writing to UMHHC Electrical Engineer.

Energy Efficiency

1. All lighting systems will be energy efficient in accordance with Michigan Building Code, and SID-D.
2. All major renovations shall include the reworking of the lighting to these new standards.
   a. In existing buildings, there may be an occasional need for the in-place lighting systems to be matched for aesthetics or maintenance reasons.
   b. In renovation projects where T12 fluorescent lamps, mercury vapor lamps, and/or magnetic ballasts are present; these shall be replaced as part of the project.
   c. In renovation projects, where the ceiling is being modified, and the luminaries are old (older than 10-years), replace the luminaries.
   d. If lighting efficiency and lighting controls are not addressed in program statement, contact UMHHC Electrical Engineer.
3. Transformers shall be specified for maximum efficiency at normal loading, i.e., 50% load for a double-ended substation, 20% load for X-ray transformers, 80% load for others.

Interconnection of Fire and Security Systems to Facility Control Center

1. All fire and security systems shall report to Facility Control Center (FCC) in University Hospital (Room 1A201D) on a device-by-device basis.
   a. i.e., alarm states ‘Smoke Detector, Room 2A203C’.
   b. All required work, programming and testing, to integrate new project scope into FCC systems, shall be included in the contract documents.
**Design Drawing Requirements**

1. When designing minor renovations to an existing installation, A/E shall match the existing installation whenever possible and practical.
   a. A/E shall, however, notify UMHHC Electrical Engineer of any significant deviations that may result in matching existing.

2. Drawings shall show locations for future panels, transformers, and like equipment.

3. The specifications shall also strongly direct contractor to judiciously use mounting space on the walls in equipment rooms.
   a. This is to maximize available space, in future, for additional owner’s equipment relate to future renovation projects or equipment additions.

4. Coordinate with the other disciplines to avoid interference with the installations of other trades, especially above ceilings.
   a. Ensure that the required working spaces and entrances for electrical equipment, that clearance to install cables into cable trays, and like clearance issues, are all provided.
   b. On the drawings, shade or label required equipment working spaces.
   c. Review directions of door swings, locations of recessed equipment, and locations of furnishings, to ensure access to electrical equipment.
   d. Provide cross-sections at typical, and at projected problem, locations and at architectural, structural, mechanical and electrical equipment.

5. Coordinate with Mechanical to ensure adequate cooling and ventilation of electrical spaces, including, as applicable to the project, the spaces for the following equipment:
   - Unit substations
   - Distribution transformers
   - Variable speed drives
   - Large motors (over 10 HP)
   - Telecommunications equipment
   - Lighting dimmer systems
   - UPS systems
   - Elevator controllers
   - Computers and network servers
   - Power conditioner systems

6. List the mounting heights of electrical devices – typically the centerline of the mounting box.

7. Verify adequate wall thicknesses for items being recessed in walls – i.e., many panels need more depth in wall than that provided by standard 2” by 4” stud wall.

8. Verify adequate mechanical, working, and cooling air clearances above ceilings for items recessed in ceilings.

9. Clearly identify the project scope and show all Contractor furnished electrical equipment on the drawings.
   a. Do not rely solely on the specification to identify the Contractor’s scope.
   b. Provide sufficient information so that the quantities of devices including required disconnect switches, smoke detectors, can be determined from the drawings.

10. Have Contractor:
    a. Coordinate with the other trades to assure that access to equipment requiring calibration and maintenance is not obstructed.
    b. Correct, at their own expense, any obstructions to equipment access.
    c. Support electrical items independently of the supports provided by the other trades. Also, Contractor shall not use one electrical device (i.e., a conduit) as a support point for another electrical device.
    d. Provide temporary power, lighting, communications, fire detection and any other temporary service as required for construction of the project. Any temporary power circuits connected to existing permanent distribution systems shall have ground fault-circuit interrupter protection to prevent a construction ground fault from affecting the permanent distribution system.
        i. Any permanent electrical systems or equipment used during construction shall be refurbished prior to acceptance by the University.
    e. Maintain an operable fire alarm system in workplace during demolition and construction. Change out smoke detectors for heat detectors or install dust boots over smoke detectors during working day.
        i. Boots, if used, shall be removed during non-working hours.
f. Coordinate temporary and permanent utility connections, phasing and switching of power circuits and the removal and installation of telecommunications equipment through the UMHHC Project Manager.

**Additional Drawings Required**

1. In addition to normally required drawings, also prepare the following drawings as applicable to the project:
   a. Detailed demolition plans showing all details and specific work required.
   b. 1/4” scale plans of all communication rooms showing equipment placements, risers, power circuits/receptacles, relay racks, door swings, working clearances, etc.
   c. 1/4” scale plans of all electrical power and generator rooms showing equipment placements, door swings, working clearances, exit paths, etc.
   d. Schedules of all nurse call, intercom, fire alarm, security, and such special systems.
   e. Updated or new single-line diagrams and power risers shall clearly show the interconnections of new work into existing systems.
   f. Risers of communications system raceways, and other interconnected systems covering more than one floor or one building.
   g. Plan drawings showing cable routing, from work areas, to FCC for fire, security and some clock systems, Systems Monitoring Room, for BMS, medical gas alarms, etc., power source substation or room, paging computer room in UH for nurse call and Code Blue pages, to confirm availability of space in existing raceway systems. Add additional if needed.
   h. Applicable schematic and wiring details, mounting heights, etc.
   i. Sequence of operation for:
      i. Fire alarm systems.
      ii. Security Systems,
      iii. Fire and Smoke Control Systems... Note the responsible contractor for all equipment, interfaces, interconnecting wiring certification and warranties of the control system(s).
      iv. Lighting control systems
      v. Electronic door hardware, and auto door operators, and when appropriate, their interaction with the fire alarm systems and the security systems.
   vi. All special systems.
   j. Equipment and panel schedules.
   k. In situations where phased reconstruction of critical systems is required, show phase by phase riser diagrams. These risers should clearly note equipment to be removed in that phase, equipment being added, and also show how the existing loads are to be fed including any required temporary re-feeds. An example of this might be the reconstruction of a Critical Power riser.

2. Require that the contractor shop drawings shall indicate the specific equipment being proposed, including all options, alterations and interfaces with other equipment or systems. Typical shop drawings showing an entire product line are not acceptable.

3. Within the scope defined by the program Documents, A/E shall review the Contractor's shop drawings for compliance with the specification requirements until they are approved. Incorporate the University's comments and return the shop drawings to the Contractor as approved, approved as noted, or rejected. The Contractor shall continue to submit each shop drawing until it is approved.

4. Since many items are interrelated, they need to be checked concurrently. A/E shall instruct Contractor that partial shop drawing submittals (such as the components of a substation) will be returned as incomplete.

5. Review list of required shop drawings, for each project, with UMHHC Electrical Engineer. Each shop drawing submittal shall be reviewed by the UMHHC Electrical Engineer. A/E shall incorporate these comments into their formal response.
Maintenance and Operating Instruction Manuals

1. The Contractor shall provide two sets of operations and maintenance manuals in three ring binders, plus electronic pdf file, for all major electrical systems and equipment, including as applicable to the project the following:
   - Primary equipment
   - Unit substations
   - Motor control centers
   - Motor starters and contractors
   - Variable speed drives
   - Dimmers and dimming systems
   - Generator & Automatic Transfer System
   - Access control systems
   - Nurse call system
   - UPS and IPS systems
   - Fire alarm systems
   - Clock systems
   - Security systems
   - Intercom systems
   - Public address systems
   - CCTV systems
   - Sound systems
   - A/V systems

2. For more information on this, see the General Conditions and Special General Conditions.

3. The operating and maintenance instructions shall include a brief, general description for all electrical systems and shall also include:
   a. Manufacturer's maintenance procedure manuals.
   b. Manufacturer's trouble-shooting repair manuals.
   c. Manufacturer / suppliers operating instruction manual.
   d. Contractor's telephone numbers for warranty repair service.
   e. Shop drawings.
   f. Recommended spare parts list.
   g. Names and telephone numbers of major material suppliers and subcontractors.
   h. System schematic drawings on 8 1/2" X 11" or 11" X 17" sheets.
   i. Sequence of operation.
   j. Overall capacity and space available in unit.

Special Submittal Requirements

1. Within the scope defined by the Program Documents, develop the electrical portion of a manual on the major building systems.
   a. For specific instructions, refer to the Systems Description Manual Section of the Special Design Instructions.

2. For new or substantially revised electrical distribution systems, provide time-current curves and coordination study of the protective devices.
   a. All coordination curves shall be provided to the UMHHC Project Manager for approval prior to energizing of the distribution system.

Training Requirements

1. Arrange for the manufacturers of electrical systems and electrical equipment to train the maintenance and operations staffs of UMHHC.
   a. Training sessions shall be provided for different times so that personnel on all shifts can be trained.
   b. Certain other systems may require training of other staff...i.e. nurses for nurse call systems.
      i. Training shall include operations, trouble shooting, preventive maintenance, and basic component replacement/repairs.

Acceptable Suppliers

See E-PML or individual guideline sections.
Memo for Record on Power Uses

The following memo for record was written so staff in UMHHC could better understand the various levels of available power, and where each should be used. It is not written for engineers, but should prove informative to A/E working on UMHHC project: Memo for Record