

## DIVISION 16 - ELECTRICAL

### Section 16000 - General Discussion

**Introduction** Consultant shall incorporate the material in the DSS into the project specifications.

Refer any questions, clarifications regarding Division 16 to UA Planning Design & Construction.

The electrical system is very important to the operation of many of the aspects of the operations of the University of Arizona. Many of the buildings have testing which need to go on continuously and if the electrical power goes out during the testing then millions of dollars of work and equipment can be destroyed. For this purpose it is very important to supply the most reliable electrical equipment system that can be designed. It is for this reason that many of the systems and specifications enclosed herein exceed the requirements of the National Electrical Code. In addition it must be understood that:

The National Electrical Code is a minimum standard of the quality of work that can be used and shall not be used as a maximum for the quality of the electrical system.

The DSS is a standard each Consultant, Builder and Project Manager needs to study as a standard for ALL University of Arizona renovations and new work.

The local lighting ordinances are exceeded.

The University of Arizona is itself a small utility which maintains all of the secondary power distribution to all of the buildings on its' campus at both 13.8KV and 4.16KV. The standards specified herein reflect the requirements of this "utility". Note that at some other locations interface with standard utility requirements will be required. In those cases only will these standards be overruled. Attention to fault current and how it affects systems must be observed. The system energy capacity increases on an ongoing basis, as the result of ongoing campus utility modifications.

### MINIMUM REQUIREMENTS

All electrical, mechanical, server and telephone rooms shall have smoke/heat detection. If, for any reason, electrical and mechanical rooms are equipped with liquid fire sprinklers, electrical equipment shall be NEMA 1 with sprinkler shields.

### ELECTRICAL SWITCHBOARD ROOMS

Whenever the design for a new building or major expansion of an existing building is to take place special consideration shall be made for providing an electrical distribution switchboard room which is sized adequately to house all of the major electrical switchboard items which would need to be installed on the project. This shall include the primary distribution switchboard (usually 480 volt), the Fire alarm panel, some of the secondary transformers and 120/208 volt distribution panelboards, the automatic transfer switch, the generator status panel, and the motor control center (where required). This room shall have built in at least 40% spare capacity to allow for installation of future equipment as necessary and storage of pertinent electrical maintenance items. There shall be a minimum of two exits from the room with at least a 6' aisle between rows of electrical equipment or between electrical equipment and the wall. In addition a separate area shall be made to house the primary distribution transformer, the standby / emergency generator, and any primary distribution switchgear required (such as a PMH switch). This area shall be located in an equipment yard just outside of the main building walls.

### SERVICES

#### Existing Services

Existing electrical services will require specific attention with respect to replacement and expansion. Projects where the existing service equipment is not to be replaced, need to be evaluated for fault current, overload, deterioration, grounding and safety violations. Where this work is designed by consultants, reports will be required at the Schematic Phase and addressed with UA Electrical Engineer.

### New Services

All new services shall be designed by a Registered Professional Engineer.

### Services, 1200 Amperes and Below

Services, 1200 amperes and below shall utilize stationary mounted power circuit breaker main breaker. Feeder breakers shall be electric, LSI, with communications capability.

### Services Over 1200 Amperes

Services over 1200 amperes shall utilize draw out power circuit breakers.

### All services shall

- Provide 13.8kv primary protection using a vacuum circuit breaker, 50/51 relay and snubber.
- Provide, 50/51 relays on the bus between the transformer and the main breaker
- Provide zone selective interlock between the 13.8kv- 50/51 relays, secondary relays and feeder breakers
- Provide arc flash calculations and PPE labeling for all electrical equipment, including panelboards.
- All main breakers shall be 100% rated.
- Shall be NEMA 3R Gasketed Construction outdoors.

## SINGLE LINE DIAGRAM MINIMUM REQUIREMENTS

Single line diagrams shall be complete representations of the designed electrical systems. The goal is to allow the bidding and constructing contractor to bid the job using the correct equipment. The reviewer will require clear indications that all electrical parameters have been considered. Bidding and review shall not require tedious deciphering of keynotes. Nor shall the reader be burdened in flipping feverishly from sheet to sheet.

Single line representations shall include, but not be limited to, display of voltage levels, wye and delta configurations, bus sizing, sizes and types of main and feeder overcurrent devices, vertical bus sizes, horizontal bus sizes, pull sections, metering sections, grounding, spare bussing, bus extension provisions, transformer sizes, main breaker or lug locations for panelboards and switchboards, (bottom, top or feed through) fault levels, overcurrent device frame sizes and trip ratings, TVSS connections, TVSS overcurrent protection, feeder sizes, transformer sizes and housekeeping pads, primary cable conductor sizes and any other information necessary to provide a complete representation of the system.

The use of keynotes shall be minimized in the labeling of equipment and system components.

Switches, pull stations and automatic door closers in areas where the construction requires glass walls, glass doors and similar construction, shall require the architect to design mullions to accommodate orderly installation. Consultant shall coordinate these devices with the architect.

## LIGHTNING PROTECTION

Lightning protection shall meet and exceed the requirements of NFPA 780 and the NEC.

Protection shall be provided where NFPA 780 calculation shows MODERATE conditions OR whenever directed by UA Facilities Design & Construction.

If available, UL MASTER LABELING shall be included.

Design shall be performed by the electrical registrant for the project, put on plan and sealed. It shall not be done as a requirement specification. The Consultant may feel free to seek the expertise of Lightning Protection Companies in preparing their (the Consultant's) design.

Attention shall be given to the Suppression Requirements of NEC for data, power and phone. Attention needs to be given to the material types and quality of lightning specific components and how they are fastened to the building. Mastics shall not be the primary method of attachment. Components shall be copper or bronze. Wire shall be copper. Down conductors shall be the braided UL approved copper product specifically designed for the application. Ground plates are allowed for existing buildings where grounding by other methods is not practical.

Examine the job site prior to completing your fee. Contact CCIT for suppression needs and methods. Determine such things as RF antenna on roofs, walls or parapets, "Add on" suppression for power shall be either APT OR CURRENT SYSTEMS products, not less than 180 ka per phase.

All firms shall provide graphic presentation of the system isometrically.

Consultants shall evaluate the need for lightning protection on all new buildings and building additions. Utilize the assessment criteria in NFPA 780. Risk factors in the highly moderate to severe category shall require lightning protection.

Cranes over 75 ft. high shall be bonded to ground with #115,000cirmil copper cable to the foundation UFER ground. Use the same cable for the UFER ground.

Consultants are urged to consider use of Early Streamer Emission Air Terminal Systems vs. the conventional Franklyn System.

#### COORDINATION OF PROTECTIVE DEVICES AND STUDIES

Coordination studies, protective relay studies and adjustments shall be performed by registered electrical engineers skilled in this area of expertise.

The consultant shall submit selectivity curves in the design document and final construction documents show clean coordination of the devices aforementioned.

The consultant shall write the specifications to reflect the following:

Contractor shall submit equipment based on the basis of design or one of the approved equals. The contractor shall provide with the submittal, a coordination study based on the equipment submitted. The contractor shall be required to submit equipment equal in characteristics to the basis of design. That is to say the selectivity of the overcurrent devices shall be as clean in coordination as the basis of design devices. The consultant shall clearly display this requirement on the DRAWINGS where the switchboards and service equipment is identified.

Should the contractor submit a study, including related equipment submittal, that does not give clean coordination, the contractor shall be obligated to change components to allow clean coordination and selectivity, prior to getting approval for releasing equipment for manufacture at no cost to the Owner.

The contractor may utilize factory trained coordination engineers to prepare the study. However curves must be plotted on standard log-log paper, 11 in x 17 in.

References to Clean Coordination and selectivity shall be as defined in IEEE STD 192, as interpreted by the University of Arizona Electrical Engineer.

Coordination shall reflect all intentions of system planning per IEEE Std. 192.

- Selectivity curves shall be labeled with plain English nomenclature that identifies the devices on the project single line diagram, not some dapper reference file name. Each curve set shall have a I-line on the same page.

Consultants shall provide fault current levels for all new equipment required to have ARC FAULT labeling as required in NFPA 70E. ARC Fault calculations and equipment labeling shall be identified to be a requirement for the electrical contractor to have performed.

#### TEMPORARY STANDBY POWER

Temporary standby power used to power existing critical (research not life safety) building loads shall require the presence of an approved generator technician for the duration of the outage.

New buildings equipped with standby engine generators shall be equipped with a "legally required" standby power

transfer switch and distribution panelboard. Connect all telephone, communications and server room systems to this distribution panelboard. Similarly, provide a transfer switch and distribution panelboard for optional standby loads (NEC Art 702). Connect Blue Light Phones to available standby power.

## **Elevator Rooms**

Consultant shall coordinate the size of elevator equipment rooms such that they have 20% space clear wall space or 48", whichever is larger, upon completion of construction. All new construction drawings shall have riser diagrams, to scale, for each wall of the elevator machine room.

### **Part 1 – General**

- These electrical standards represent the minimum quality of workmanship and the minimum quality of equipment which are required for the projects which are to be constructed on this site. The general attitude about the equipment and materials to be supplied is that this University will be here for many years to come and the projects which we construct now shall be able to be in service for 10, 15, 20, or more years without needing to be renovated due to the lack of quality of the electrical equipment or workmanship. In addition renovations will need to be made in the future to many of the areas which are under design today and for that reason spare capacity is to be built into the design to allow for a certain amount of flexibility for the future. Where the design engineer has some areas where he prefers to see an even higher level of quality than what is set by these standards he shall make the design to meet that level of quality as long as that design provides a cost effective design. Sometimes even though the design costs are considerably higher the actual costs including maintenance over the life of the product make it cost effective.
- Working In Confined Spaces
  - Whenever work is required within a confined space, e.g., utility vaults, utility tunnels, sumps, pits, sewers, etc., contact UA Risk Management and Safety Department for details and procedures on UA Confined Space Entry Program.
- As-Builts
  - As-Builts shall be prepared by the Contractor and professionally hand drafted in a clear legible manner. These As-Built annotations will then be drafted on the reproducible Record Drawing by the Consultant. See Tab B-9.
- Details
  - Consultant shall provide GRAPHIC SCALES AND PROJECT NUMBERS ON ALL SHEETS.
- Misc.
  - When panel boards are replaced, replace respective feeders and feeder breakers.
  - Designers shall coordinate motor service factors and efficiencies with mechanical trades and mechanical designers and bring this to the attention of the contractors.
  - The consultant shall make it clear to the contractor that deviations in design of major equipment shall not be a liberty that will be accepted. All equipment specified and supplied shall have been in the market place for a minimum of 2 years prior to bid date.

### **Part 2 - Products**

- Specify the highest quality, best made type of equipment which is manufactured today. Balance this with maintaining quality while conserving cost. If there are materials which you know from working with them in the past which you know will not meet the requirements of this area of the specifications, then word your specifications to delete those items from being considered for use. Any types of material which by their very nature need to be looked at for meeting the quality that will be specified, needs to be specified to be submitted upon prior to installation for review by both the Design Engineer and the Facilities Engineer at the University of Arizona. Single sourcing of a certain type of material shall be made only when other materials would not meet either the standard of the University or the required operation of the system for which it is specified. In most

cases single sourcing will not be permitted. The use of one or two manufacturers which supply equipment which is known to meet the standards which are required for the particular operation which is specified shall be utilized. Other manufacturers which may not be known at the time of design or who in the past have manufactured equipment which is not the same quality as that which is specified then will have the ability to submit their equipment in accordance with the requirements of specification section 1300.

- When specifying equipment, attention shall be given to assure that if a particular manufacturer is specified, that all related equipment is specified with regards to the same manufacturer. For instance, if GE were specified for panelboards, regards should be given that disconnects, switchboards, motor starters and transformers be GE. Single sourcing already has been officially justified for fire alarm equipment, intrusion detection equipment, telephone/data hardware, primary cable, primary pad mounted switches and variable frequency drives. Prior approval is required for engine generators, transfer switches and primary cable deviations. There is no or equal to be considered after bidding where prior approval is required.

### **Part 3 - Execution**

- It is the intent of the University to have all new work installed in a quality manner and in a way that it is accessible for future maintenance and expansion. The installation shall comply with both the requirements of OSHA, ADA Guidelines, NFPA, NESC and the NEC. In complying with OSHA regulations we wish to comply especially with the requirements of the lockout/ tagout regulations, and provide the personnel who have to work on the mechanical equipment serviced by the new electrical system with a completely maintainable system based on those regulations. As far as the quality of workmanship, we would like to have the electrical system installed in such a way that it both is functional, and looks like it has been installed in a professional manner.
- Contractors shall be required to label all equipment with ARC FAULT labels as outlined and required in NFPA 70E.

**End of Section 16000**