

TSEWG TP-11: UFC 3-500-10N BEST PRACTICES

UFC 3-500-10N was developed by NAVFAC and was used as the starting point for the tri-services development of UFC 3-500-10, Design: Electrical Engineering. UFC 3-500-10N contained Appendix B, Best Practices, which has not been included in UFC 3-500-10. This appendix is provided as an attachment to this Technical Paper.

APPENDIX B BEST PRACTICES
(Obtained from UFC 3-500-10N)

B-1 GENERAL GUIDANCE.

B-1.1 Scheduling and Sequencing Outages.

Include directions for the Contractor to follow concerning outages and downtime when it is required that an activity remain in operation during construction. Do not use vague phrases such as, "The activity will remain in operation during the entire construction period." Include the following as applicable:

- Include a specific and detailed Sequence of Construction.
- Identify required power outages including maximum downtime or duration, specific dates and times.
- Identify preparations and precautions required of the contractor prior to starting specific phases of work or implementing power outages.
- Specify any preliminary operations and testing requirements.
- Specify to provide temporary power either by temporary wiring or portable equipment and identify the Contractor's responsibility for operation, maintenance and repair, and to demonstrate reliability of the equipment provided.

B-1.2 Sustainable Design.

Incorporate systems that will result or aide in developing high-performance, sustainable buildings. This includes:

- Use premium efficiency motors. Efficiencies must meet the minimum requirements of ASHRAE 90.1. Use variable speed drives for motors that are likely to operate continuously at less than 75 percent load.
- Design lighting in accordance with ASHRAE 90.1.
- Maximize the use of indirect lighting.
- In facilities where there may be an abundance of daylight, automatically reduce artificial lighting by dimming or on/off control.
- Reduce general office illumination from 550 lux (50 fc) to 325 lux (30 fc) using dimming ballasts with photoelectric control, manual "on" control, occupancy sensor "off" control and task lights controlled by power strips with occupancy sensors.
- For emergency lighting systems, consider a central power source in lieu of numerous discrete batteries for large systems.

- Design for a power factor of 0.9 or greater. Use electronic ballasts to the extent possible.
- Increase feeder conductor sizes when Life Cycle Cost Analysis results in a reasonable payback period. Refer to UFC 3-520-01 for further guidance, including examples and calculations.
- Refer to LEED Rating System (latest version) for additional information.

B-2 **SITE ELECTRICAL UTILITIES.**

B-2.1 **Overhead Distribution Fuse Protection.**

The purpose of the backup current limiting fuse is to protect the transformer from high-level fault currents that can rupture the transformer tank and result in catastrophic damage. The expulsion fuse link is required for overload and low level fault current protection. The two protective devices must be coordinated to function together; expulsion fuse links must be ANSI Type K to provide this coordination.

Exercise care when using fused cutouts at line taps and at underground terminations. The maximum interrupting rating of a fused cutout is 12,500 symmetrical amperes. Whenever system fault currents exceed this value, protect the fused cutout with a backup current limiting fuse or use an adequately rated power fuse.

B-2.2 **Pad-Mounted Equipment Fault Current Ratings.**

The 200 ampere load-break separable insulated connector normally specified for use on dead-front pad-mounted transformers and switches will accommodate a maximum cable size of No. 4/0 AWG and has a fault-closure current rating of 10,000 amperes and a short-time current rating of 10,000 amperes for 0.17 seconds. On systems that require a primary cable larger than No. 4/0 AWG or that requires a short-time rating in excess of 10,000 amperes, a 600 ampere separable insulated connector would be the preferred alternative. The 600 ampere connector is dead-break and has a short-time current rating of 25,000 amperes for 0.17 seconds. The 600 ampere connector is physically larger than the 200 ampere connector and may require a deeper transformer compartment. Specification UFGS-26 12 19.10 (16272), *Three-Phase Pad-Mounted Transformers*, is based on 200 ampere connectors and will require significant modifications if 600 ampere separable insulated connectors are used. Live-front pad-mounted transformers or secondary unit substations may also be alternatives if the available short circuit current is higher than 10,000 amperes.

The load break oil switches (LBORs) normally specified for use as inherent equipment on pad-mounted transformers are available with a maximum make and latch rating of 10,000 RMS amperes symmetrical. Locating the current limiting fuses ahead of the load break switch as indicated in Appendix D attachment 2 through 5 can limit the available fault current to less than 10,000 amperes.

A 38KV, 300 ampere LBOR switch is available with a 12,000 RMS ampere symmetrical rating. If used, the specification for the LBOR needs to be edited to incorporate all the 38KV switch ratings.

B-3 INTERIOR DISTRIBUTION SYSTEMS.

Locate interior electrical distribution equipment in electrical rooms/closets in central locations close to mechanical equipment and other major loads. Panelboards, backboards or distribution cabinets should serve equipment/devices on the same floor. Locate panels on the floor they serve.

Optimize equipment layout and circuit arrangement. All homeruns (identifying conduit and wiring back to panel) should be shown on the design drawings exactly as they are to be installed. Combine one-pole branch circuits to minimize number of homeruns. Do not show more than a 3-phase circuit; or 3 phase conductors, a neutral conductor and an equipment grounding conductor in a single conduit. When more conductors are required, provide detailed calculations showing compliance with NFPA 70 for derating conductors and conduit fill.

B-3.1 Service Entrance and Distribution Equipment.

Size service entrance equipment early in the design process to ensure that electrical rooms and spaces are sized properly to provide the required working clearances in accordance with NFPA 70

Panelboards for non-linear loads may require 200 percent rated neutral bus and have nameplates marked "Suitable for Non-Linear Loads".

Number circuits by pole number on single pole breakers and by the first pole number on two and three pole breakers such that the numbering scheme of the panel will remain intact if two or three pole breakers are replaced by single pole breakers in the future.

B-3.2 Dry Type Transformers.

To the extent possible, minimize the size and quantity of dry-type transformers throughout the facility. The total capacity of dry-type transformers should not be larger than 40 percent of the service transformers.

B-3.3 Lightning Protection Systems.

When considering a lightning protection system for an addition, or modification to an existing building, or when special conditions such as connections to existing buildings occur, in order to comply with UL requirements, the designer must obtain a ruling from UL at <http://www.ul.com/lightning> in order to determine the extent of work required to obtain a master label. This may require updating the existing systems to be in compliance with UL requirements.

B-3.4 Instrumentation and Controls Systems.

Instrumentation and Control Systems are generally designed by the engineer owning the process. The electrical engineer is responsible for providing power to control panels throughout the system. Coordinate all power requirements with the process systems and ensure proper connections for equipment.

B-3.5 HVAC Systems.

The mechanical engineer will determine which equipment will have integral magnetic contactors and/or disconnect switches and which equipment will require separate magnetic motor controllers and disconnect switches. In general, packaged refrigeration equipment has integral magnetic contactors and in some instances will have an integral disconnect switch also. Air-handling units and pumps usually require separate magnetic motor controllers and disconnect switches.

The electrical engineer, in conjunction with the mechanical engineer, will determine the location of motor controllers and disconnect switches. Place motor controllers and disconnects in readily accessible locations as defined by NFPA 70.

The electrical engineer must not provide any magnetic motor controller information for mechanical equipment on the electrical drawings, but must determine the type of controller required (full voltage, reduced voltage, reversing, multi-speed, NEMA size, and NEMA enclosure type) and furnish it to the mechanical engineer for incorporation in mechanical equipment schedules. Mechanical equipment schedules must also include electrical characteristics of motor and packaged equipment; e.g., voltage, full load amperes or minimum circuit amperes, number of phases, horsepower, and frequency. Note integral disconnects, if provided, in the mechanical equipment schedules and coordinated with the electrical drawings. Require integral disconnects be furnished with thermal overloads where appropriate for small fractional horsepower motors. The mechanical specifications must be coordinated with the mechanical equipment schedules and mechanical plans.

B-3.6 Motor Control Equipment.

Use Motor Control Centers (MCC) only when there is a centralized location for the control of a large number of motors. Use individual motor starters for all other applications.

MCC should be factory assembled, dead front units, totally enclosed, free-standing type, with structures joined to form one assembly but designed so that the units may readily be removed and other structures added as required in the future. List and brace the entire assembly for maximum fault available, with equipment busing connections, and with the following minimum provisions:

- Means for locking each circuit separately.
- Class A, factory wired, complete including breakers, contactors, starters, relays, transformers, and other required items.
- Lifting angles or eyebolts to facilitate hoisting and placing.
- Each structure with two horizontal wiring spaces, one at the top and one at the bottom, which will line up with the adjacent units to convenient wiring raceways the entire length of the control center.

- Copper bus throughout with a separate ground bus bar the entire length of the motor control center.

Provide controllers with 120-volt controls including accessories and auxiliary contacts for automatic or remote operation. Controllers must have thermal overload protection in each phase and must have one spare normally open and one spare normally closed auxiliary contact. Magnetic-type motor controllers must have under-voltage protection when used with momentary-contact pushbutton stations or switches and must have under-voltage release when used with maintained-contact pushbutton stations or switches. When used with pressure, float, or similar automatic-type or maintained-contact switch, controller must have Hand/Off/Automatic selector switch. Control circuit connections to Hand/Off/Automatic selector switches or to more than one automatic regulatory control device must be made in accordance with manufacturer's approved wiring diagram.

Provide controllers for 3-phase motors rated 1 HP and above with phase voltage monitors designed to protect motors from phase loss and over/under voltage. Provide means to prevent automatic restart by a time-adjustable restart. For packaged equipment, the manufacturer must provide controllers with the required monitors and timed restart.

Multiple-Speed And Reversible Motor Controllers must be across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers must have compelling relays and must be multiple-button, station-type with pilot lights for each speed.

Provide reduced voltage starters for motors 25 horsepower and larger. Reduced-voltage starters must be single-step, closed transition either autotransformer or solid state-type, and must have adjustable time interval between application of reduced and full voltages to motors. Wye-delta reduced voltage starter or part winding increment starter having adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced-voltage starters for starting of centrifugally operated equipment, or reciprocating compressors provided with automatic unloaders.

Use Manual Motor Starters for fractional horsepower motors 1/8 hp and larger. Starters must be single or double pole designed for flush or surface mounting as required with overload protection. Include pilot lights when used with motors above ceilings and controller is located at floor level. Typically, manual starters should be located adjacent to the motor they serve.

Provide VFD to control the speed of induction motors when required or indicated by the mechanical design. Use separate enclosures for VFD that are not integral to Motor Control Centers.

B-4 COMMUNICATIONS AND SECURITY.**B-4.1 Intercommunications Systems.**

When required, provide Intercom and Public Address/ Paging systems for intercommunications systems. With the exception of a stand-alone intercommunications system, intercommunications systems may, and in most cases should, interface and utilize telephone handsets for announcements. When utilizing the telephone system, designer must specify the interface device and ensure it is compatible with the telephone system.

B-4.1.1 Stand Alone Intercommunication Systems. A stand-alone system must stand alone and be completely independent from the telephone system. Provide zone and volume control for all areas. The system must not utilize telephone handsets for announcements. Two way hands free operation speakers should be utilized for spaces such as locker rooms.