16315-H: PARALLELING GEAR

Applicability:
The Design Professional (A/E) shall adhere to UMHHC Design Guidelines for all work at UMHHC facilities. Any requested deviations from these guidelines, shall be sent, in writing, to UMHHC’s Facilities Planning and Development (FP&D). Address the correspondence to the assigned FP&D engineer for the given project. The deviation shall not be incorporated into the construction documents until written approval of the deviation is received by the Design Professional.

The Design Professional is fully responsible for the professional quality, technical accuracy, code compliance, and overall coordination of the contract documents. Compliance with these guidelines shall not be construed so as to relieve the Design Professional of any of that responsibility.

General
The paralleling gear shall have capability to be expanded for future growth planned of its respected building.

The first generator is to be online within 10 seconds of the loss of power. Configure gear to have the largest available generator start first.

Paralleling gear shall be in a separate room from the generators. Rooms or vaults for paralleling gear shall be adequately ventilated for equipment cooling.

Provide rear access to all paralleling main distribution sections.

Do not have sprinkler heads mounted directly above units. Do not install duct work and/or piping above the electrical gear. Do not run piping and/or duct in electrical that does not serve the room.

Provide red acrylic mimic bus affixed with machine screws.

Manual paralleling controls located at paralleling gear should always be present to support auto controls.

Provide provisions to rotate the generators if N+1 scheme is used.

Construct paralleling gear to be phased X-Y-Z (or A-B-C) from top to bottom, front to back and left to right when viewed from the front. All buses, bonding jumpers, and termination lugs shall be silver plated copper and shall be connected using at least two bolted (or more for higher currents) connectors at each bus joint, and/or at all insulators. Bolted connections shall use hex head bolts and split lock washers made of stainless steel or grade 5 steel with yellow zinc dichromate finish.

Bus bars shall be silver plated before final assembly. The NEMA specified minimum (current carrying) cross sectional area of the bus should not be compromised by the holes needed to make connection.

Paralleling gear is to be made of metal clad construction.

All lugs within the parallel gear shall be of the long barrel two hole (minimum) type. No mechanical lugs shall be accepted.

Power Limitations
Size the bus amperage and AIC rating of the paralleling gear to support the ultimate number of generators to meet the scope of work, plus an addition of a future expansion generator of the same size.
Automatic Transfer Switches serving hospital equipment shall not have non-hospital loads.

Size the paralleling gear in such a way that the bus is capable of handling all generators running at 100% capacity and also have room for future generator at 100%.

**Incoming Section Requirements**

Provide generator connections in dedicated sections.

Provide silver plated copper bus bar connection for generator connections.

Provide each generator section with analog voltmeter (4-1/2", 1% accuracy, 600V scale), ampere meter (4-1/2", 1% accuracy, scale as required), frequency meter (4-1/2", 1% accuracy, 55 – 65 Hz scale), Wattmeter (4-1/2", 1% accuracy, scale as required) for each generator connection.

Ampere meters and voltmeters to have four position phase selector switch.

These provisions are to be made for future generator incoming sections. When the future generator is added the section, all provisions shall be in place so only the trip unit is to be put in place.

**Distribution Section Requirements**

Allow physical space so gear can be expanded by at least one section in both directions. Ends of bus bar are to be prepped for future expansion.

Provide 20% spare positions in the gear for future loads. All sections designated as spaces are to be identically prepped and bussed as occupied breakers.

Feeder breakers shall be:

1. Individually mounted, draw out, metal-clad, mechanically operated, stored energy type, quick-make and quick-break air circuit breakers.
   a. Unless noted otherwise, the breakers shall be manually 'charged'.
   b. Electrically operated (electrically charged) breakers shall be supplied where called for on the drawings. Each electrically operated breaker shall be powered by a dedicated, charging motor.
2. Breakers shall be equipped with removable arcing contacts and operation counters.
3. Breakers shall be rated for 100 percent continuous duty, with frame and trip (sensor) ratings as shown on the drawings. Sensor size (and design application) will typically be 75%, or more, of the frame size.
4. Breakers shall be capable of being manually racked into three positions; “connected”, “test” and “disconnected”. The breaker frames shall be grounded in all positions.
5. The compartment front doors shall be closable in all breaker positions and shall permit breaker operation with door open or closed. The doors shall be capable of being opened without tripping breakers in the “connected” position.
6. A breaker shall be tripped open and the stored energy in the breaker mechanism shall be discharged as the breaker is moved from one position to another.
7. Breaker compartments shall be deadfront. Shutters shall close automatically as a breaker is racked out of the 'connected' position. Control contacts shall be 'made' when breaker is in test or connected positions.
8. Breakers shall have a minimum of two spare “Form C”, isolated contacts brought out to an accessible terminal strip in the compartment. The contacts shall be rated 120 volts, 10 amperes, 60 Hz.
9. Each breaker shall be equipped with three-phase and one neutral current sensor, and a microprocessor-based trip unit.
10. Where shown on the drawings, breakers shall be equipped with a flux transfer shunt-trip. The flux transfer shunt trip wiring shall be terminated on an accessible terminal strip in the compartment.
11. Breakers shall be capable of being padlocked in the “open” position.
12. Breakers shall not be less than 10% of the rated bus.

Each breaker shall be equipped with RMS sensing trip units as noted below.

1. Solid-state trip units shall be true RMS sensing, with trip ratings adjustable by removable rating plugs. The trip units shall be magnitude and time adjustable, and shall include a local indication of the cause of a trip. The trip units shall be rated as shown on the drawings.
2. The trip units shall coordinate with the primary fuses, main breaker and largest downstream feeder breakers.
3. The trip units shall allow adjustment without breaker trips and routine testing without removing the breakers from service.
4. The trip units (sensors) shall be rated for 100 percent continuous duty.
5. Trip units shall provide the following ranges and functions as a minimum. See drawings for specific requirements that vary from this configuration:
   a. Long time (L) current settings of at least 50-100 percent of the current sensor rating, divided into seven or more steps, and time delays of at least 2-22 seconds, at 600 percent of the long time current setting, divided into seven or more steps.
   b. Short time (S) current settings of at least 250-1000 percent of the long time current setting, divided into seven or more steps, and time delays of at least .1-.5 seconds, divided into seven or more steps, to include "flat response" and "I2T response" characteristics.
   c. Instantaneous (I) settings of at least 200-1000 percent of current sensor rating.
   d. Ground fault (G) current settings of 25-100% of current sensor rating, with a 1200 ampere maximum, divided in seven or more steps, with ground fault time delay settings of at least .1-.5 seconds, divided into five or more steps, to include "flat response" and "I2T response" characteristics.
6. Power for operating the solid state trip unit shall be obtained from within the circuit breaker assembly itself, or it shall be provided by a separate control circuit connected to the secondary bus ahead of the main breaker. The solid state trip units shall have nonvolatile memory to maintain all settings, trip indications and fault data during a power outage. Batteries to maintain the memory are not acceptable.

The system shall be capable of initiating manual or automatic load testing with specified load bank. If normal utility power fails during a load test, the generator paralleling control system shall open the trip unit providing power to the load bank and initiate emergency procedures.

The A/E shall design the over current protective system so the paralleling gear trip units are coordinated with the down stream fuses and down stream devices to minimize the disruption from any given fault, to as small an area as possible. The A/E shall also prepare, and/or approve the settings for the over current protective system to insure proper selectivity and coordination. The contractor shall provide test reports showing that the over current system has been set and tested, before the system is commissioned.

Provide ground fault warnings, not trips, for all breakers. Avoid providing unnecessary ground fault protection that may cause nuisance outages.

Bus bars shall be braced for the calculated short circuit current.

Provide an analog voltmeter with selector switch, and an ammeter with selector switch. Selector switches shall have also off position.

**Engine Generator Set Monitoring and Control**

The generators, automatic transfer switches, and paralleling switchgear shall operate as a complete and integrated system to provide the necessary power to the building’s electrical distribution in the event of normal utility source failure. **Note:** Systems that use paralleling controls that are mounted on the engine generator are not acceptable.

The system shall be capable of manually adding and shedding loads from the paralleling gear in the event that the interface or automatic controls are lost.
The system shall be designed to interface with the existing or planned power monitoring system within the building.

Paralleling switchgear shall have a "Bus Optimization" program that will automatically add loads if there is sufficient capacity in the generator system with all or one of the generators running. Bus Optimization is to be activated or deactivated via a hardwired toggle switch located on the paralleling control panel. When Bus Optimization is active a hard-wired LED light and the touch screen shall indicate that the feature is working and automatically controlling loads.

Bus optimization will add loads automatically based upon a table of KW values associated with the next priority load, including start up requirements to be added, and determine if there is sufficient head room to add that load. Once the new load is added and after a field adjustable stabilization time delay, a new demand KW reading shall be taken and the next priority load evaluated to see if it can be added without overloading the bus. The program shall compare the peak of the start-up for each load and update the tables only if the value goes up.

When the bus has been loaded to a level such that the next load would exceed 90% of bus capacity, a hard wired light and a warning in the control touch screen will activate to alert the operator that the next load is expected to overload the generator system.

The system will continuously monitor the generator demand and evaluate if the next load can be added to the bus. If the building demand decreases and the next load can be added without overloading the system beyond 90%, then the load will be added. This evaluation process will continue and safely add as many loads as possible automatically to the generating system.

The number of priorities is not to be limited by the number of generators. Priorities, other than Critical and Life Safety, shall be determined by loads that required to be grouped together in order to function, such as dampers with air handlers. The amount of time to add all of the Equipment loads shall be less than one minute from time of outage.

In the event a generator fails, or increase in building load, or there is a bus under-frequency, the lowest priority load or loads will be shed to keep the remaining higher priority loads running. The system must be designed to prevent stalling or failing of the remaining generator(s).

Priority one (Life Safety and Critical) non shed-able loads must be maintained in any bus optimization system design.

**Digital and Manual Control**

Provide a Master Control and Monitoring Panel, with a touch screen interface, which displays the position and load of each trip unit and ATS. Also, display the power provided by each generator and total load of system.

The Master Controller shall have redundant processors. It shall be designed in such a way that the paralleling gear will not fail upon the loss of one processor.

The interface shall allow designated personnel to set priority levels to loads and shall display the status and value of each priority as it is loaded and shed.

Provide the ability to bring on all generators on line manually at the paralleling gear. Each generator shall have its own dedicated section. Each section is to include an analog ampere meter, analog volt meter, and synchronizer.