

MEMORANDUM

TO: Memo for Record

FROM: James Harvey PE
Manager of Electrical Engineering

APPROVED

By Jim Harvey at 9:14 am, Aug 15, 2014

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SUBJECT: Types of Electrical Power in UMHC
Relative Reliability of Each Type of Power and Its Appropriate Uses

This document is to define the different electrical power systems, and the terms used to describe them. The basic configuration, relative level or reliability, and the appropriate uses of each, will be described and defined below. Please note that not all power system types are available at all locations. Variances from the below noted, appropriate typical uses shall be reviewed and approved by the FP&D engineer.

I. Normal Power:

Description of System and Typical Configuration

The normal power system serves the UMHC equipment not otherwise defined below. It is also the only power source, in most residential, commercial, and industrial facilities.

Advantages of System

- This is the lowest cost system to install
- It is the best understood and is the easiest to expand
- Can most easily accommodate all kinds of loads

Disadvantages of System

- There is no back up if the utility source is lost

Permissible Uses for System

This power source can be used to serve any equipment not otherwise noted below. In buildings without generators, it serves all electrical loads.

II. Static Switch Power

Description of System and Typical Configuration

This type of electrical distribution system has two electrical power sources and the ability to switch from one source to the other within .0005 seconds. This transfer will occur if the one (the normal) source is lost or is degraded; and if the alternate source is available and is not degraded. The transfer in these cases is, fast enough that computers and most other electronic devices do not see a disruption this short and therefore do not re-boot, and/or the data and control equipment are not lost.

If the second source is not available as in a major utility outage, however, and/or that other source is also degraded, the transfer will not occur and the loads will be de-energized. If the second source of the static switch has a generator back up, when the generator power is available, the connected loads will be re-energized.

Advantages of System

- a. Lower cost than UPS systems for the increased reliability
- b. Better able to handle 'dirty' loads, or widely varying loads
- c. Allows testing of more of the main electrical power systems, like the generator systems, without power interruptions to the clinical and other loads

Disadvantages of System

- a. Is not as reliable as UPS power
- b. Does not condition (smooth-out) the power like a power conditioner, or a UPS will

Permissible Uses for System

Diagnostic clinical and other equipment not defined under the UPS, the Power Conditioner and/or Critical Branch power sections below. may also be used in other user/owner selected equipment.

III. Local Battery-Backed Power

Descriptions of Systems/Typical Configurations

This type of power has a local battery to provide back-up in case there is a power outage in the normal power system. Upon return of normal power the equipment operates on the normal power and the battery recharges. The most common use for local battery backed power are battery backed-up lighting fixtures.

Note: While UPS systems, as note below, also commonly use batteries, the systems described here do not necessarily provide 'uninterruptible power' to the load.

Advantages of System

- a. Less expensive than higher levels of power
- b. Normally does not require building square footage (space)

Disadvantages of System

- a. Batteries need to be replaced frequently – every three to five years. The cost of batteries is often high
- b. Systems commonly are not centrally monitored. A failure may occur in the system and this failure may only become apparent when back-up power is not there when it is needed

Permissible Uses for System

This power source can be used in:

- a. Lighting in OR's and select procedure rooms to provide lighting during the '10-second' gap until generator power becomes available
- b. To provide code required illumination in buildings without generators
- c. To provide back-up power for critical data storage systems

- d. To provide the code mandated back-up power for fire alarm systems, security systems, and/or as otherwise required by codes or good practices

IV. **Emergency and/or Generator Power**

Description of System and Typical Configuration

Emergency generator power supply is a redundant system that starts operation on the loss of normal power. In general, the generator systems are designed to restore power within 10 seconds of the loss of normal power.

Equipment that is served by the generator will typically have one or more Automatic Transfer Switches (ATS) that monitor the normal power. Upon loss of normal power, the ATS(s) will signal the generator to start and when the generators are ready to accept load will transfer the connected loads to the generator..

Advantages of System

- a. Generator power provides an on-site, reliable secondary source of power with the loss of normal power

Disadvantages of System

- a. Generators have limitations on the maximum size of loads that can be safely started and/or have more stringent limits on the amount of power that is available.
- b. The generator being a mechanical device, even when well maintained, could fail during an emergency
- c. The ATS is a mechanical device but however well maintained it may fail during an emergency
- d. Increasing the size of the generator and its distribution systems is costly
- e. The on-site fuel storage can cause fire and/or environmental problems or concerns.
- f. The noise of their operation, and/or the smells from the exhaust can be disrupting factors

Permissible Uses for System

Generator power allows a health care facility to continue patient care, but often at a reduced level, when the normal power is not available. Generator power is typically separated into the 'Life Safety Branch', the 'Critical Branch' and the 'Equipment' Branch (these power system branches are as defined by the NEC 517 and other code authorities, these branches are listed in more detail below).

Please note that some UMHHHC facilities have two types of 'Equipment' branch power – one called 'Essential Power Branch', and the other called 'Purple Power Branch.' These are also defined below.

A. **Life Safety Power (as defined by NFPA and other codes)**

Description of System and Typical Configuration

Power on this branch of the emergency/generator distribution has the highest emergency power priority. Codes require these loads to be restored within 10 seconds of normal power.

Advantages of System

1. Power restored in 10 seconds

Disadvantages of System

1. More expensive than normal power
2. Permitted uses are restricted by codes
3. Requires a separate distribution system

Permissible Uses for System (Highly restricted by Codes)

1. Egress lighting
2. Exit signs
3. Alarm systems such as fire alarms
4. Emergency communication systems
5. Lighting and power for generator set, emergency power equipment, locations
6. Elevator lighting, communication, signal systems
7. Critical security systems

B. Critical Power (as defined by NFPA and other codes)

Description of System and Typical Configuration

Power on this branch of the emergency/generator distribution has a priority only one-step below Life Safety. Even so, UMHHC considers both Life Safety Power and Critical Power systems as both Priority 1. These loads are also restored within 10 seconds of loss of the normal power.

Advantages of the System

1. Power restored in 10 seconds
2. User/owner can define which loads are connected to system

Disadvantages of System

1. More expensive than normal power
2. Requires a separate distribution system

Permissible Uses for System

1. Patient care area illumination and select receptacles
2. Operating room illumination and associated support equipment to allow completion of operations
3. Emergency department patient care area and associated equipment needed to maintain operation during the power outage
4. Patient care related computer work stations (work stations affecting multiple patients only)
5. Fire, Security and BMS monitoring systems, support room and associated HVAC systems
6. Sump pumps and other 'critical' systems needed for continued building operations
7. Smoke control and stairway pressurization
8. Select air-handling systems such as those serving isolation operating rooms and isolation rooms
9. Heating equipment for patient areas

10. Additional illumination and receptacle power
11. Additional security systems
12. Fume and bio-safety cabinets exhaust
13. Selected diagnostic and treatment equipment
14. Other owner/user selected equipment

C. **Equipment Power Systems Level 1 ('Essential Service Power' at UMHC)**

Description of System and Typical Configuration

Distribution of the equipment/Essential Service Power is either transferred automatically or manually, based upon system configuration and relative needs of the equipment served. The loads that may be automatically transferred will be picked up in 60 to 180 seconds. Manually transferred loads will require a considerable amount of time to distribute and activate.

Essential Service Power has a lower level of priority than Life Safety and 'Critical' power and Essential Service Power may be removed from the generator/emergency power system if the Life Safety and/or Critical loads would be compromised.

Advantages and Disadvantages of System

1. Power restored usually within 180 seconds
2. User/owner selected loads

Disadvantages of System

1. More expensive than normal
2. Requires separate distribution system
3. May be de-energized if critical and Life Safety loads would be compromised.

Permissible Uses for System

1. Other owner selected air handling and exhaust systems
2. Elevators
3. Cooling systems
4. Other owner/user selected equipment

D. **Equipment Power System Level 2(Non-Essential "Purple Power")**

Description of System and Typical Configuration

Note: Currently only UH has this type of power.

Power on this branch of the emergency/generator distribution has the lowest priority of all 'Emergency and/or Generator Power' loads. This power to be distributed via Manual Transfer Switches if allowed by system architecture; otherwise, Automatic Transfer Switches will be used

Advantages of System

1. Power distributed through automatic distribution is restore within minutes.
2. Power distributed through manual back-fed distribution is restored usually within a few hours

3. User/owner selected loads

Disadvantages of System

1. More expensive than normal
2. Requires separate distribution system
3. May be de-energized if 'Life Safety', 'Critical', or 'Essential' loads would be compromised

Permissible Uses for System

1. Cooking and food service equipment
2. Laundry and housekeeping equipment
3. Other owner/user selected equipment
4. Lighting not on Life Safety or Critical power
5. Receptacles not on Life Safety or Critical power

Existing Purple Power System in UH:

Equipment in UH, that is automatically switched to purple power include the majority of the non-Life Safety/Critical lighting, and the non-Critical receptacles.

Each UH substation also has a back-fed option from the generator system to allow manual transfer of any remaining Emergency and/or Generator Power to remote devices not included in other emergency/generator distributions. The devices that back-fed from the generator is initiated and transferred manually and requires a considerable amount of time to distribute and activate.

V. Central Uninterruptible Power Systems (UPS)

Description of System and Typical Configuration

A power system that usually has two power sources, one of which is a generator (if a generator is present), the other is normal power. The battery, which is an integral part of the system, maintains power for a limited period of time until generator is up and running.

Advantages of System

- a. This is the most reliable system type. In most cases, the connected load sees no change and operates normally.
- b. Equipped with serviceable batteries that have much longer life than maintenance-free batteries that are used in 'Local Battery-Backed Power!'

Disadvantages of System

- a. The locally or centrally located UPS are the most expensive option to install. These systems take much floor space; require ventilation, cooling, and a large amount of maintenance.
- b. A UPS system, being a mechanical device even when well maintained, could fail and interrupt power to the loads being served.
- c. Since systems will fail, including UPS. To more closely approach 100% availability a redundant UPS is often required in applications like data centers of higher reliability communication rooms. This already expensive power source will have its cost increase significantly.

- d. 'Electrically dirty' (impulse loads, widely varying loads, loads with high harmonics, etc.) and/or other non-linear loads may cause problems for UPS.

Permissible Uses for System

- a. Computer and communications systems, serving many users, that cannot tolerate power outages. Examples include OMS and Radiology 'head-ends.'
- b. Computer and communications systems that will sustain substantial labor/maintenance costs to restart and/or systems where a significant delay will be experienced after power is restored.
- c. Systems that store and process the patient records that are needed to maintain ongoing patient services.
- d. With diagnostic and treatment equipment where the loss of power will compromise a patient's health (Angiography, Cath Labs, some Nuclear Medicine, etc.), the entire system may be powered by UPS.
- e. With diagnostic and treatment equipment where loss of power will not compromise a patient's health (MRI, CT's, X-ray) only the data storage portion of the equipment may be on UPS. The balance of the load will be on generator.