

# EMERGENCY POWER SYSTEM TESTING

**SUMMARY:** Emergency Power System (EPS) testing within a hospital or ambulatory surgery occupancy is complex and often confusing. The testing of the EPS is often confused with generator testing; generator testing is only one component of the EPS. It is essential that the entire EPS and all its components are understood and tested completely, otherwise an incomplete test of the EPS as a whole can result in a loss of essential loads affecting critical life support equipment. The essential loads of an EPS are divided into three main branches Critical, Life Safety and Equipment Loads. The critical loads are comprised of all loads, which have direct affect on the life of the patients. Life Safety is the loads, which affect the safe egress from the facility during a disaster (fire, earthquake, flooding, etc). Equipment are the loads that help the facility to run in an emergency mode and support those critical and life safety functions defined above. Systems that must be on EPS are identified in Hospital Accreditation Standards.

**EPS ELEMENTS:** The generator produces the power and its associated gear regulates the phase, cycles, amps and voltage produced by the generator. In some cases this gear will synchronize two or more generators together on the same bus or distribution system. The EPS distribution system is comprised of main panels with large circuit breakers. Automatic Transfer Switch (ATS) or switches are usually located in the main electrical room located adjacent to the generator and smaller distribution panels are found throughout the facility. The ATS is the interface switch used to transfer the loads from normal power system to the emergency (alternate) power system. The ATS is the interface management control for all EPS systems; it is the only time both commercial and emergency power is transferred at a single source. A total failure of an ATS can result in loss of both commercial and generator power. In some cases Programmable Logic Controls (PLC) (circuit breakers that are computer controlled for switching) have been used in place of ATS's. PLC's are essentially the same but much more complex and harder to maintain than an ATS due to the computer control and the lack of visually seeing the transfer. A problem in the PLC code will require outside support and result in a lengthy downtime. An ATS can also be equipped with a bypass option which allows a manual transfer which is highly recommended for all loads on critical and life safety branches. MILHBK 1191 requires ATS and bypass options for MILCON funded new construction. However, in some existing facilities, size, complexity, equipment locations, and limited O&M funds may force the use of PLC's and ATS's without bypass options.

**TESTING REQUIREMENTS:** Both JCAHO, NFPA 99, and NFPA 110 provide guidance or testing requirements. NFPA-70B on maintenance and repair of the EPS, and the testing standards for equipment can be found in the International Electrical Testing Association Inc's "Acceptance Testing Specifications" testing book.

**TESTING PROBLEMS:** As required by JCAHO and NFPA complete testing of the entire EPS is required including once a year exercising of the main breakers for the essential systems for both normal and EPS distribution. The use of a load bank for testing does not meet these requirements and should not be done unless required by NFPA or JCAHO due to over sizing of the generator. The diesel engines, which power the most of the generators within the AFMS, need to be loaded to operate properly, avoid premature failure and unreliable operation. All EPS systems should be tested at peak loading periods to insure the system will function under actual peak loads compared to design loads. Each EPS is designed around short circuit and a coordination study, which simply means that all loads have been **calculated/estimated** to make sure the conductors are large enough, the circuit breaker settings will hold the load, and in the event of a short circuit will not cascade through the entire distribution system causing a failure of the EPS. Adding non-essential loads to the EPS to increase loading can have a disastrous effect by overloading the critical, life safety and equipment branch circuits. If you have a generator system which you want to add more load to or requires a load bank you should insure testing is done during the highest load periods of the day. If you still can't load the EPS system enough to meet code, please contact your Health Facilities Engineering Officer to arrange for a site visit. Do not try to develop a project through SABER, Tool Box or any other local sources to correct the problem.

Testing the EPS system by tripping a main breaker should be avoided. This creates a true emergency by shutting off power to the facility and puts the entire facility in the dark while the EPS system starts up. If you are testing this way most Hospital Commanders won't allow testing at peak load periods. Also you have not met the intent of the code by insuring that each ATS or PLC is fully capable of starting the generator and bringing the EPS system on line. The ATS or PLC which is affected needs to be able to start the generator and provide power for the lost EPS branch. If you trip the main breaker it is never known if all the ATS's or PLC's are independently capable of starting the generator.

**TESTING PROCEDURES:** Each ATS's is required by MIL-HDBK 1191 (<http://hfpa.otsp.amedd.army.mil/res/1191/index.asp>) to have a testing switch that interrupts the power to the sensing circuit. A momentary contact switch is not acceptable in this application. You must have a switch that will stay open. (If you are missing the switch or have the wrong type, place a work order to have Power Pro install one, make sure they get with the manufacture to insure they have installed it correctly). Once the switch is toggled the generator will start and the ATS will transfer once the generator is on line, commercial power is never lost to the areas not on emergency power and most people will never notice the transfer. Note the transfer will occur so quickly there will only be a slight flicker to the lights affected by the ATS. These types of outages occur frequently during normal operations of any medical facility due to variable quality of commercial power and do not cause any operational problems within our hospitals. Most critical equipment has some type of backup to allow it to ride through momentary power glitches. If a problem is present within the ATS or if the generator does not provide power the transfer to emergency power will not occur and the operations of facility will

not interrupted. The use of the ATS testing switch can avoid potentials for most emergencies while testing the EPS.

### **MONTHLY TESTING:**

1. Develop a spreadsheet or form that lists each month, ATS/PLC its name and EPS branch (critical, Life Safety, Equipment) you may have multiple ATS's or PLC's list each one with a unique identifier (Critical 1, Critical 2), time to transfer and a check box for load initiated.
2. Each month start with a different ATS/PLC, check the box load initiated so you know which ATS/PLC you started with last month. Toggle the switch, start timing and quickly go to the next ATS/PLC until all ATS switches are on. Listen and record the time it takes for the first ATS to transfer, you will hear a loud clunk, which indicates it has transferred you, should also be able to see the status lights. Remember only the Critical and Life Safety ATS's are required to transfer in 10 seconds. This is easier if you use more than one person.
3. Once all the loads have transferred record your run time and loads as you would normally do.
4. After you have reached the normal run time required by code turn off all switches on the ATS'/PLC's. (There is no special order this needs to be done in). The loads will transfer back to normal power as soon as you reset the switch. The generator will continue running until it reaches its cool down period. If you forget to take an ATS out of test mode the generator will not shut down.

### **YEARLY TESTING:**

This is a much more detailed type of testing that tests both your EPS system and allows inspection and exercises most of your main breakers as required by code NFPA 99. If you do not have the right support staff or are uncomfortable with the level of support you have **DO NOT PERFORM THIS TEST**. Call and ask your Regional Health Facilities Engineer for support (a contracted service might be required)

1. Once a year plan on an extended outage and schedule this on a weekend or after hours. Make sure you have Power Pro and electrical support capable of repairing/replacing breakers on hand for this test Use a different testing sheet that shows all the main breakers and all the required generator testing information run time loads,

2. Start the breaker inspection/exercise by tripping and resetting all breakers upstream (lineside) of the ATS not down stream (loadside), these breakers are not under load (no power is going to them until the generator is running. Remember both normal and emergency power go through the ATS/PLC's . The ATS/PLC's are always hot and so is everything down stream from them. If all breakers above the ATC reset than proceed to the next step, otherwise stop the test and repair the breaker.
  
3. Start the generator by tripping the main commercial breaker record the start time and see if the critical and life safety loads transfer within 10 seconds. If the entire EPS system transfers correctly, priority loads will transfer first followed by mechanical. Record all loads. Once the generator starts and has transferred all loads you can trip and reset all the main commercial down stream (loadside) of the main breaker that was tripped for the test breakers, up to the point of the ATS/PLC's replace/repair all breakers that don't reset.

### **FIVE TO SIX YEAR TESTING:**

All breakers require some form of preventive maintenance and testing. Plan ahead (will require O&M funding) and call your Health Facilities Engineering Officer to arrange to have a detailed breaker test and preventative maintenance program done on your main and primary breakers. This is a very detailed process and cannot be done locally. The Health Facilities Engineering maintains an IDIQ for this service.

Note: Due to the variation ages and types of PLC's that could be on you EPS system, it is impossible of us to give advice on how to physically test this type of system. In some cases control is provided at a central computer in other the breakers may have a test switch. It is advisable that you contact the manufacture of your PLC system to learn how to test your specific system.

\*Clinics/Business Occupancies do not require EPS. If you have one it still needs to be maintained and tested but not to the levels described above. The monthly testing procedure listed above is adequate for this type of occupancy. Inspection/ exercising of critical breakers are not required for business occupancies.