3.7 AUXILIARY ELECTRICAL SYSTEMS

Applicability

Applies to the availability of electrical power for the operation of plant auxiliaries.

Objective

To define those conditions of electrical power availability necessary (1) to provide for safe reactor operation, and (2) to provide for the continuing availability of engineered safeguards.

Specification

3.7.1 The reactor shall not be made critical without:

a) The 110 KV-4160 Volt start-up transformer in service;

b) 480-Volt buses E1 and E2 energized;

c) 4160-Volt buses 2 and 3 energized;

d) Two diesel generators operable with a supply of 19,000 gallons of fuel available in the diesel generator fuel oil storage tank and an additional 6,000 gallons available in the I-C turbine fuel oil storage tank or in the diesel generator fuel oil storage tank, and with the following protective trips for each diesel generator bypassed:

1) Low lube oil pressure
2) Low coolant pressure
3) High coolant temperature
4) High crankcase pressure
5) Start failure - Governor Shutdown

e) Station batteries A and B, a battery charger, A or A-1 and B or B-1, on each battery and their DC distribution systems are operable.

3.7.2 During power operation the following components may be inoperable:

a) Provided both diesel generators are operable, power operation may continue with the start-up transformer out of service for 24 hours without reporting to the NRC.

b) Power operation may continue with the start-up transformer out of service beyond 24 hours provided both diesel generators are operable and the reporting requirements of Specification 6.6.1 are followed.

c) Power operation may continue if the start-up transformer and one diesel generator is inoperable provided the reporting requirements of Specifications 6.6.1 and 6.6.2 are followed.

d) Power operation may continue for seven days if one diesel generator is inoperable provided the remaining diesel generator is tested daily to ensure operability and the engineered safety features associated with this diesel generator shall be operable.

e) During periods when a diesel generator is being operated for testing purposes, its protective trips listed in Specification 3.7.1.d need not be bypassed after the diesel generator has properly assumed the load on its bus.

f) Power operation may continue with one battery inoperable provided the inoperable battery is restored to operable status within 2 hours or be in at least hot shutdown within 8 hours and in cold shutdown within the next 30 hours.

g) Power operation may continue with one battery charger inoperable provided the inoperable charger is restored to operable status within 2 hours or the battery's backup charger is placed in service within 2 hours.

h) With both battery chargers for a battery inoperable restore a battery charger to operable status within 2 hours or be in at least hot shutdown within 8 hours and in cold shutdown within the next 30 hours.

3.7.3 Backfeeding the E1 and E2 safety related buses through the main and unit auxiliary transformers will only occur during cold shutdown, unless nuclear safety considerations require it to be done during hot shutdown.

Basis

The electrical system equipment is arranged so that no single contingency can deactivate enough safety features equipment to jeopardize the plant safety. The 480-volt equipment is arranged on 9 buses. The 4160-volt equipment is supplied from 5 buses.

Multiple outside sources supply station service power to the plant.

The plant auxiliary equipment is arranged electrically so that multiple items receive their power from the two different sources. For example, the charging pumps are supplied from the 480-volt buses No. DS, E1 and E2; the four containment fans are divided between 480-volt buses No. E1 and E2; and the two residual heat removal pumps are on separate 480-volt buses No. E1 and E2. Valves are supplied from motor control centers.

One outside source of power is required to give sufficient power to run normal operating equipment. One transmission line can supply all the plant auxiliary power. The 110-4.16 KV start-up transformer can supply all the auxiliary loads.

The bus arrangements specified for operation ensure that power is available to an adequate number of safety features auxiliaries. With additional switching, more equipment could be out of service without infringing on safety.

Two diesel generators have sufficient capacity to start and run at design load all of the engineered safety features equipment. The safety features operated from one diesel generator can adequately cool the core for any Loss-of-Coolant accident, and they also maintain the containment pressure within the design value. The minimum diesel fuel oil inventory at all times is maintained to assure the operation of both diesels carrying design load of all the engineered safety features equipment for at least 48 hours(1), or minimum safety features equipment (one diesel) for at least 96 hours with fuel oil available from the Unit No. 2 diesel generator fuel oil storage tank.

Additional supplies of diesel oil are available in the Hartsville area and from port terminals at Charleston, S.C. and Wilmington, N.C.; and inland terminals at Columbia, S.C., Charlotte, N.C., Greensboro, N.C., Fayetteville, N.C., and Raleigh, N.C. Ample trucking facilities exist to assure deliveries to the site within eight hours. Diesel fuel is also available from the I-C turbine diesel fuel oil storage tanks (50,000 gallon total capacity) located at the site and connections are provided for fuel oil transferral to the Unit No. 2 diesel fuel oil storage tank. An additional minimum capacity of 6,000 gallons will be available from either the I-C turbine diesel fuel oil storage tank or the diesel generator fuel oil storage tank. Therefore, total onsite diesel fuel storage capacity shall not be less than seven days for minimum safety feature equipment operation.

At least one battery charger for each station battery shall normally be in service so that the batteries will always be at full charge in anticipation of a loss-of-AC power incident. This ensures that adequate DC power will be available for emergency uses.

The plant can be safely shut down without the use of offsite power since all vital loads (safety systems, instruments, etc.) can be supplied from the emergency diesel generators.

The two diesel generators, each capable of supplying safeguards loads, and the start-up transformer provide three separate sources of power immediately available for operation of these loads.

4.6 EMERGENCY POWER SYSTEM PERIODIC TESTS

Applicability

Applies to periodic testing and surveillance requirements of the emergency power system.

Objective

To verify that the emergency power system will respond promptly and properly when required.

Specification

The following tests and surveillance shall be performed as stated:

4.6.1 Diesel Generators

4.6.1.1 Manually-initiated start of the diesel generator, followed by manual synchronization with other power sources and assumption of load by the diesel generator up to the nameplate rating. This test will be conducted monthly on each diesel generator. Normal plant operation will not be affected.

4.6.1.2 Automatic start of each diesel generator, load shedding and restoration to operation of particular vital equipment, initiated by a simulated loss of all normal A-C station service power supplies together with a simulated safety injection signal. This test will be conducted at each refueling interval, to assure that the diesel generator will start and assume required load within 50 seconds after the initial starting signal. During this test, the diesel protective

bypasses listed in Specification 3.7.1.d shall be demonstrated to be operable by simulating a trip signal to each of the trip devices that is bypassed and observing that the diesel does not trip.

4.6.1.3 Each diesel generator shall be inspected at each refueling.

4.6.1.4 Diesel generator electric loads shall not be increased beyond the long term rating of 2500 kW.

4.6.2 Diesel Fuel Tanks

A minimum fuel oil storage of 19,000 gallons will be maintained at all times in the diesel generator fuel oil storage tank and an additional 6,000 gallons available in the I-C turbine fuel oil storage tank or in the diesel generator fuel oil storage tank.

4.6.3 Station Batteries

4.6.3.1 The voltage and temperature of a pilot cell in each battery shall be measured and recorded daily, 5 days/week.

4.6.3.2 The specific gravity and voltage to the nearest 0.01 volt, the temperature reading of every fifth cell, the height of electrolyte and the amount of water added to each cell shall be measured and recorded monthly.

4.6.3.3 Each battery shall be subjected to an equalizing charge annually. The requirements in 4.6.3.2 above shall be performed after each equalizing charge.

4.6.3.4 At each time data is recorded, new data shall be compared with old to detect signs of abuse or deterioration.

4.6.3.5 The batteries shall be subjected to a performance test once every five years.

4.6.3.6 A battery shall be subjected to a service test whenever it is replaced or its loads are significantly changed.

4.6.4 Pressurizer Heaters' Emergency Power Supply

The emergency power supply for the pressurizer heaters shall be demonstrated operable each refueling shutdown by transferring power from the normal to the emergency power supply and energizing the heaters.

4.6.5 Battery Chargers

Demonstrate the in-service battery charger is operable by monitoring the output voltage daily, five days per week, and during normal equalizing charges.

Basis

The tests specified are designed to demonstrate that the diesel generators will provide power for operation of equipment. They also assure that the emergency generator system controls and the control systems for the safety features equipment will function automatically in the event of a loss of all normal 480 V AC station service power.(1)

The test to ensure proper operation of engineered safety features upon loss of AC power is initiated by tripping the breakers supply normal power to the 480 volt buses and initiating a safety injection signal. This test demonstrates the proper tripping of motor feeder breakers, main supply and tie breakers on the affected bus, operation of the diesel generators, and sequential starting of essential equipment. The test of the diesel protective bypass circuits is performed to verify their operability.

The testing frequency specified will be often enough to identify and correct any mechanical or electrical deficiency before it can result in a system failure. The fuel supply starting circuits and controls are continuously monitored and any faults are alarm indicated. An abnormal condition in these systems would be signaled without having to place the diesel generators themselves on test.

On-site emergency power is available from two emergency diesel-generator sets. Each engine-generator set consists of a Fairbanks-Morse Model 38TD8-1/8 engine coupled to a Fairbanks-Morse 3125 kva, 0.8 power factor, 900 RPM, 3 phase, 60 cycle, 480 volt generator. The units have a continuous rating of 2500 kW with a 2-hour overload capability of 2750 kW in any 24-hour period.

Each unit as a backup to the normal standby AC power supply is capable of sequentially starting and supplying the power requirement of one complete set of safety features equipment. It can accept full load within 35 seconds after the initial starting signal,[1] and will sequentially start and supply the power requirements of one complete set of safety features equipment in 50 seconds.[2]

A supply of 19,000 gallons of fuel will ensure a minimum full power capacity of at least 96 hours for minimum safety features operation. An additional 6,000 gallons will be available to assure an adequate fuel supply for at least seven days of operation.

Station batteries will deteriorate with time, but precipitous failure is extremely unlikely. The surveillance specified is that which has been demonstrated over the years to provide an indication of a cell becoming unserviceable long before it fails.

The equalizing charge, as recommended by the manufacturer, is vital to maintaining the ampere-hour capability of the battery. As a check upon the effectiveness of the equalizing charge, the battery should be loaded rather heavily and the voltage monitored as a function of time. Experience has shown that this test should be repeated at intervals to detect deterioration of cells.[3][4] If a cell has deteriorated or if a connection is loose, the voltage under load will drop excessively indicating replacement or maintenance.

References

(1) FSAR Section 8.2
(2) FSAR Table 8.2-4
(3) AEC Information Letter ROE: 67-1, January 31, 1967.
(4) FSAR Section 8.3.2