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RBG - 21768
File No. G9.5

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

River Bend Station - Unit 1
Docket No. 50-458

Enclosed for your review is Gulf States Utilities Company response to the Staff's Request for Additional Information dated August 2, 1985 regarding the Reactor Protection System. This information supplements that currently in the Final Safety Analysis Report and is not expected to impact the proposed Technical Specifications.

Sincerely,

J. E. Booker

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Manager-Engineering
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JEB/ERG

Enclosure

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RIVER BEND
REACTOR PROTECTION SYSTEM
POWER DISTRIBUTION

1.0 CONCERN

Provide justification to demonstrate that the non-safety related reactor protection system (RPS) power distribution cabinets (C71-P001 and P002) will not degrade the reactor protection system safety function.

2.0 JUSTIFICATION

2.1 POWER DISTRIBUTION (see Fig. 1)

The RPS power distribution system consists of two non-1E MG sets, C71-S001A (Bus A) and C71-S001B (Bus B), each feeding power to power distribution panels C71-P001 and C71-P002 via redundant (in series) safety-related electrical protection assemblies (EPA). RPS divisional power from distribution cabinets C71-P001 and C71-P002 is routed in conduit to the RPS logic cabinets. In addition, power from these power distribution panels is also fed via conduit to the nuclear steam supply shutoff system (NS^4), leak detection system (LDS), neutron monitoring system (NMS), and process radiation monitoring system.

2.2 ELECTRICAL PROTECTION ASSEMBLIES (EPA'S)

2.2.1 REQUIREMENTS

In August 1978, the Nuclear Regulatory Commission (NRC) requested Georgia Power Company (for the Edwin Hatch Plant) to demonstrate the capability of the reactor protection system power supply to accommodate the effects of earthquakes without jeopardizing the capability of the RPS to perform its intended safety function. The NRC Staff further clarified that the sequence of events initiated by an earthquake includes (1) the occurrence of an earthquake that would cause the undetected failure of a voltage sensor, (2) the failure of a motor-generator set resulting in an abnormal output voltage, (3) the persistence of this abnormal output voltage, undetected by visual observations and surveillance testing, for a time sufficient to damage reactor protection system components, and (4) failure of these components in such a manner that results in the loss of capability to scram the plant.

The NRC Staff required that prior to startup following the first scheduled refueling outage, Georgia Power Company install Class 1E systems approved by the staff and capable of de-energizing the reactor protection system power supplies when their output voltages exceed or fall below or their

output frequencies fall below limits within which the equipment being powered by the power supplies has been designed and qualified to operate continuously and without degradation. With such systems, the designs of the reactor protection system power supplies will conform to the applicable requirements of Criterion 2 of Appendix A to 10 CFR Part 50.

2.2.2 IMPLEMENTATION

In response to the above requirement, General Electric presented a conceptual design to the NRC Staff during a meeting at Bethesda, Maryland, in September 1978.

The proposal was that the existing over and under voltage relays and the under frequency relay, together with the output circuit breaker, should be supplemented by an additional set of the same components which would be seismically and environmentally qualified to meet Class 1E requirements. The NRC would accept this proposal only if the additional and existing equipment was identical and the existing MG set equipment could be shown to be seismically adequate for its specific location. If these conditions could not be met, the staff required that two sets of new equipment, suitably qualified, be provided. In response to this, two EPAs, series connected and qualified for Class 1E service, are provided between MG set output and RPS power distribution cabinets.

The EPAs are provided as Class 1E equipment to ensure that the RPS power supply buses are maintained within accceptable voltage and frequency limits thus avoiding degradation of RPS components and in turn an inadvertent scram, or the postulated failure to scram, resulting from component failure. The EPAs are qualified to RBS environmental and seismic requirements.

2.3 RPS FAIL-SAFE CONCEPT

The RPS fail-safe concept is described as follows:

- RPS logic cabinets wiring and components are qualified as safety-related Class 1E.

- The RPS trip logic consists of four divisions (Divisions 1,2,3, and 4) and logic. Each of these divisions is separated in accordance with RG 1.75 Revision 2.

- The scram trip logic is arranged in a one-out-of-two-twice (Divisions 1 or 3 and 2 or 4) configuration. This redundant arrangement provides assurance that a single failure will not prevent or cause a scram.

- o The trip logic and scram solenoids are normally energized. A trip condition results in de-energizing the pilot solenoid valves.

- o Thus, a scram trip condition can be caused by a total loss of power on both RPS buses or a monitored function exceeding its setpoint.

- o Two supplies (RPS MG set Buses A and B) are provided because of plant operability concerns. Scram solenoids A and B are fed from MG set Bus A and Bus B, respectively.

- o During normal operations, scram solenoid valves A and B for each control rod are energized, and it will require loss of power in both C71-P001 and C71-P002 power distribution panels (Bus A and Bus B) to de-energize both the solenoids, which results in a full scram condition.

2.4 SYSTEMS POWERED BY RPS POWER DISTRIBUTION PANELS

The following systems are powered by the RPS power distribution panels C71-P001 and P002.

- o Nuclear Steam Supply Shutoff System

- o Leak Detection System

- o Neutron Monitoring System

- o Process Radiation Monitoring System

These systems are not required for safe shutdown following any design basis event including a safe shutdown earthquake. Therefore, availability of power to these systems is not required after a seismic event.

2.4.1 NUCLEAR STEAM SUPPLY SHUTOFF SYSTEM

The RPS power distribution effect on NS[4] is described as follows:

- o This fail-safe designed system (i.e., loss of power) provides isolation signals (safety signal).

- o It controls the main steam isolation valves (MSIV) and other inboard and outboard containment isolation valve logic.

- o A loss of power from C71-P001 (Bus A) or C71-P002 (Bus B) will not close the MSIV inboard or outboard valves because there are two solenoids (solenoid A and B) on each MSIV valve. Both are required to de-energize for closure of the valve. Closure of an MSIV or other isolation valve is a safe condition.

2.4.2 LEAK DETECTION SYSTEM

The RPS power distribution effect on LDS is described as follows:

- o The LDS system sends an input signal to the NS^4 logic.
- o Loss of power in the LDS will initiate a safety trip signal.

2.4.3 NEUTRON MONITORING SYSTEM AND PROCESS RADIATION MONITORING SYSTEM

These systems provide input signals to the scram trip logic from the source range monitor (SRM), intermediate range monitor (IRM), average power range monitor (APRM) and main steam line radiation monitor to scram the plant when required. These systems are designed as fail-safe. Loss of power in these systems provides de-energization of the relays in these systems and thus initiates a safety signal trip in the RPS.

The need for portions of the NMS to function during and following a design basis seismic event has been discussed in the RBS submittal of its RG 1.97 Revision 3 compliance report under the neutron flux variable. (RBG-21378, 06/24/85)

3.0 FAILURE MODES ANALYSIS

A seismic event may cause the following conditions in the RPS power distribution cabinets C71-P001 and C71-P002:

- o Open circuit condition,
- o Short to ground condition,
- o Failure of the circuit breaker to overcurrent trip function,
- o Degraded voltage condition on either bus.

3.1 OPEN CIRCUIT CONDITION

Power distribution panels (C71-P001 and P002) consist of an enclosure and circuit breakers. Faults that cause opening of these breakers cannot introduce any unsafe condition (failure mode). One or more open circuits will provide an RPS trip signal on each affected channel.

3.2 SHORT-TO-THE-GROUND CONDITION

A short circuit condition to equipment ground will cause the circuit breaker to open and will result in loss of bus voltage and, therefore, a channel(s) trip will be initiated. If the circuit breaker in the RPS power distribution panel fails to

open, then the circuit breaker in the Electrical Protection Assembly will open and cause the loss of bus voltage. This condition will not introduce an unsafe condition.

3.3 FAIL TO TRIP CONDITION

- If a cable inside the power distribution panel (C71-P001 and C71-P002) shorts directly to RPS Bus A or Bus B, a condition of not having a breaker in the circuit will exist. The manual or automatic scram function is unaffected by this fault condition.

3.4 DEGRADED VOLTAGE CONCERN

- If the voltage drops below the holding voltage for relays and/or pilot scram solenoids, then the relays and/or pilot scram solenoids would de-energize to produce a trip condition.

- A loose connection to one of the breakers or points inside the power distribution cabinet that results in an increased resistance may cause an undervoltage condition at the scram pilot valve solenoids (A or B). If the undervoltage condition exists at both the pilot scram solenoids A and B, this undervoltage condition may cause the pilot scram solenoid valves to cycle, which in turn may cause degradation of the valves resulting in a subsequent drift of the control rods into the core causing a shutdown. If such a condition exists, scram can be achieved via manual or automatic action which remains unaffected utilizing the scram pilot solenoid valves or backup scram solenoid valves.

- Two backup scram solenoid valves are provided. Each is powered by separate divisional ESF dc power. Either backup scram valve can accomplish the scram function upon receipt of a scram signal. These solenoid valves and associated trip logic are Class 1E components which are seismically and environmentally qualified for use at RBS Unit 1.

- Also, a fault of this nature would be confined to a small area (e.g., the loose connection point) which would cause rapid degradation of the connection until some trip or fault indication did occur.

- The occurrence of an undervoltage condition causing degradation of multiple pilot scram solenoids is considered incredible because:

  a) both RPS distribution panels must exhibit a high resistance condition,

b) the high resistance condition must occur at a particular (incoming feeder) point to affect multiple scram solenoids,

c) the degraded voltage condition must be within a narrow voltage band.

4.0 MAINTENANCE

Preventive maintenance will be performed on the RPS distribution panels and breakers in the same manner as safety-related panels and breakers.

5.0 CONCLUSIONS

- A seismic event may cause a loss of power at C71-P001 and P002 which results in a trip signal (safety signal). Restoration of power is not necessary to the RPS bus after a seismic event because continuity of power is not required to maintain plant safety.

- GSU is unable to identify any credible event that is a safety concern for RBS Unit 1 involving the use of non-Class 1E RPS power distribution panels.

NOTES

FIG-1