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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

October 29, 1980

Docket No. 50-155

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Mr. David P. Hoffman
Nuclear Licensing Administrator
Consumers Power Company
212 West Michigan Avenue
Jackson, Michigan 49201

Dear Mr. Hoffman:

RE: SEP TOPIC VII-3 - SYSTEMS REQUIRED FOR SAFE SHUTDOWN (Big Rock Point)

Enclosed is a copy of our evaluation of Systematic Evaluation Program Topic VII-3, Electrical, Instrumentation, and Control Features of Systems Required for Safe Shutdown. This assessment compares your facility, as described in Docket No. 50-155, with the criteria currently used by the regulatory staff for licensing new facilities. Please inform us if your as-built facility differs from the licensing basis assumed in our assessment within 60 days of receipt of this letter.

This evaluation will be a basic input to the integrated safety assessment for your facility unless you identify changes needed to reflect the as-built conditions at your facility. This topic assessment may be revised in the future if your facility design is changed or if NRC criteria relating to this topic is modified before the integrated assessment is completed.

Sincerely,

Dennis M. Crutchfield

Dennis M. Crutchfield, Chief
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Enclosure:
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cc w/enclosure:
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SEP TECHNICAL EVALUATION

TOPIC VII-3
ELECTRICAL, INSTRUMENTATION AND CONTROL FEATURES OF SYSTEMS REQUIRED FOR SAFE SHUTDOWN

BIG ROCK POINT NUCLEAR STATION

Consumers Power Company

S. E. Mays
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SEP TECHNICAL EVALUATION

TOPIC VII-3
ELECTRICAL, INSTRUMENTATION AND CONTROL FEATURES OF
SYSTEMS REQUIRED FOR SAFE SHUTDOWN

BIG ROCK POINT NUCLEAR STATION

1.0 INTRODUCTION

This report is part of the Systematic Evaluation Program (SEP) review of Topic VII-3, "Systems Required for Safe Shutdown." The objective of this review is to determine whether the electrical, instrumentation, and control (EI&C) features of the systems required for safe shutdown, including support systems, meet current licensing requirements.

The systems required for safe shutdown have been identified by the NRC SEP staff. The systems were reviewed to ensure the following safety objectives are met:

1. Assure the design adequacy of the safe shutdown system to automatically initiate operation of appropriate systems, including reactivity control systems, such that fuel design limits are not exceeded as a result of operational occurrences and postulated accidents, and to automatically initiate systems required to bring the plant to a safe shutdown

2. Assure that required systems, equipment, and control to maintain the unit in a safe condition during hot shutdown are appropriately located outside the control room, and have the capability for subsequent cold shutdown of the reactor using suitable procedures

3. Assure only safety grade equipment is required to bring primary coolant systems from a high pressure to low pressure cooling condition.

The scope of this review specifically includes an evaluation of the electrical, instrumentation, and control features necessary for operation of the identified safe shutdown systems.

The review evaluates the systems for operability with and without offsite power and the ability to operate with any single failure. The EI&C review of safe shutdown systems only includes those features not covered under other SEP Topics. Specific items which will be covered under other SEP reports are identified in Section 4.0, Review Guidelines.

2.0 REVIEW CRITERIA

Current licensing criteria for safe shutdown is contained in the following:

1. IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations"
2. GDC-5, "Sharing of Structures, Systems, and Components"
3. GDC-13, "Instrumentation and Control"
4. GDC-17, "Electric Power Systems"
5. GDC-19, "Control Room"
6. GDC-26, "Reactivity Control System Redundancy and Capability"
7. GDC-34, "Residual Heat Removal"
8. GDC-35, "Emergency Core Cooling"
9. GDC-44, "Cooling Water."

3.0 RELATED SAFETY TOPICS AND INTERFACES

The following list of SEP topics are related to the safe shutdown topic with respect to EI&C features, but are not being specifically reviewed under this topic:

1. SEP III-10.A, "Thermal Overload Protection for Motors of Motor-Operated Valves"
2. SEP VI-7A3, "ECCS Actuation System"

3. SEP VI-7C1, "Independence of Onsite Power"

4. SEP VI-10A, "Testing of RTS and ESF Including Response Time Testing"

5. SEP VI-10B, "Shared ESF, Onsite Emergency Power, and Service Systems for Multiple Unit Facilities"

6. SEP VII-1, "Reactor Trip System"

7. SEP VII-2, "ESF Control Logic and Design"

8. SEP VIII-2, "Onsite Emergency Power Systems—Diesel Generators"

9. SEP VIII-3, "Emergency DC Power Systems"

10. SEP IX-3, "Station Service and Cooling Water Systems"

11. SEP IX-6, "Fire Protection."

Where safe shutdown system EI&C response is affected by the above-mentioned topics, that particular SEP review has been consulted for determination of overall safe shutdown system performance. Where the SEP topic review is not available, the affect on safe shutdown system performance has been identified as being based on an assumed operating condition of the affecting system. The safe shutdown review will be considered preliminary until resolution of the affecting topic is completed and found to be in accordance with assumptions made in this review.

The completion of this review impacts upon the following SEP topics, since capabilities relating to safe shutdown is required in the topic:

1. SEP VIII-1A, "Potential Equipment Failures Associated with a Degraded Grid Voltage"

2. SEP VIII-2, "Onsite Emergency Power Systems—Diesel Generators."

4.0 REVIEW GUIDELINES

The capability to attain a safe shutdown has been reviewed by evaluating the systems used for normal shutdown (onsite power not available) and emergency shutdown (offsite power not available). SRP 7.4 was applied to each system to ensure the following guidelines were met:

1. They have the required redundancy (SRP 7)
2. They meet the single failure criterion (RG 1.53, ICSB BTP 18)
3. They have the required capacity and reliability to perform intended safety functions on demand (SRP 7).

Additionally, SRP 5.4 requirements contained in BTP RSB 5-1 were reviewed to determine if the systems required for residual heat removal met the following guidelines:

1. The systems are capable of being operated from the control room with only offsite or only onsite power available
2. The systems are capable of bringing the reactor to cold shutdown with only offsite or only onsite power available within a reasonable period, assuming the most limiting single failure.

The electrical equipment environmental qualification and physical separation are being reviewed under other topics, as is the seismic equipment qualification, and are not reviewed in this report. Section 7.0 consists of a list of safety related EI&C equipment necessary for safe shutdown to be used in resolving SEP Topic III-1, "Classification of Structures, Components, and Systems."

5.0 DISCUSSION AND EVALUATION

5.1 Instrumentation. The NRC SEP Staff Review of Safe Shutdown Systems identified the instrumentation available in the control room necessary to bring the reactor from the hot shutdown to cold shutdown condition. This review evaluates the nuclear instrumentation, since this parameter must be monitored to ensure the reactor achieves and maintains shutdown conditions. Various system parameters, such as pump running or valve position indications, are not included in the list of safe shutdown instruments. This is due to the fact that indication is provided by the control/operate circuitry. Availability of control/operate circuitry to run the system also means availability of the required indication. Similarly, if the control/operate circuitry is unavailable such that system operation is not possible, the system indication is not mandatory.

The nuclear instrumentation consists of three independent reactor protection buses providing redundant indication of each range of power level. Two buses are powered by their own motor generator set or a transformer. The third bus is powered by either a transformer or a static inverter (DC powered). Thus, there are no single failures which would disable all nuclear instrumentation.

The reactor parameter indicators (level, pressure/temperature) available in the control room are powered from the Sphere Instrument and Control Power Panels or the Turbine Building Instrument and Control Power Panels. Both systems are supplied by an automatic transfer device fed from Instrument and Control Transformers 1A and 2B. These panels also provide process indications such as flow, temperature, pressure, etc. for the other safe shutdown systems. Any failure or fault of the transfer device would result in a loss of power to the power panels. Therefore, a single failure could result in a loss of vital instrumentation of the reactor and safe shutdown systems in the control room.

The indications for power to the various AC and DC buses is supplied by lights, meters, or alarms powered from the bus being monitored. Loss of power to the bus would be indicated in the control room, and no single failures of indications would effect the ability to monitor any other bus.

5.1.1 Evaluation. The instrumentation necessary for reaching and maintaining cold shutdown at Big Rock Point does not meet current licensing requirements since potential single failures could render vital indications necessary for maintaining plant control inoperable.

5.2 Safe Shutdown Systems. The SEP Staff review of Safe Shutdown Systems identified the systems required for short-term cooling (immediately after reactor shutdown) and long-term cooling (when the reactor is cooled to the Shutdown Cooling System (SDCS) pressure limit) with only offsite and only onsite power available.

Normal short-term cooling is provided by dumping steam from the reactor to the main condenser via the turbine bypass valves. Circulating water removes heat by condensing the steam. The feedwater system then returns the water to the reactor. This cooling method is only available when offsite power is available. Failure of the feedwater control system, turbine control system, or loss of cooling flow to the condenser can render this method of cooling inoperative. The systems in this method are not class 1E but are being considered as an available means to remove decay heat.

Emergency or alternate short-term cooling involves operation of the emergency condenser (EC) or operation of the Reactor Depressurization System (RDS) in conjunction with the Core Spray (CS) system.

The EC consists of two steam lines from the steam drum immersed in a large tank of water which is vented to the atmosphere. The lines return from the tank to the reactor. Flow through the system is initiated by opening a single MOV in each line which allows the reactor to be cooled by boiling the water in the tank and returning condensed steam to the reactor by natural circulation. Failure of the DC power to the MOVs would disable the system although the valves may be manually operated provided the sphere atmosphere will support manned entry. Failure of the control circuits for other normally-open MOVs could also cause system isolation. The EC is not a class 1E system, but is being considered as an available means to remove decay heat and can provide long-term as well as short-term cooling.

The RDS operates to depressurize the reactor by dumping steam directly to the sphere atmosphere through four separate lines. Valves in each line are controlled by a Class 1E 120V AC vital bus supplied by a static inverter from a battery/charger combination. Each line has a separate vital supply for its valves. There are no EI&C single failures which could prevent the RDS system from operating.

The CS system is used in conjunction with the RDS to remove decay heat. An electric pump powered from the emergency generator or a completely independent diesel-driven pump can supply water to the CS header from the fire water system. Two spray lines provide water to the reactor. One spray line requires that two AC MOVs open to provide cooling water. The other line uses two DC MOVs powered from the station battery. The CS system can cool the reactor by continuing to inject cold water to the reactor and removing water via the RDS lines or by using the recirculation mode to pump water from the sphere sumps back to the reactor via a heat exchanger cooled by the fire water system. The pumps for this mode are electric pumps and must be manually loaded onto the diesel generator since the buses powering them are isolated on loss of offsite power.

The SDCS is the system normally used for long-term cooling. It consists of two parallel loops with a suction line, pump, heat exchanger, and a discharge line. There are multiple single failures which can render SDCS inoperable, including failure of any of the suction and discharge line normally-closed MOVs. Also, the SDCS pumps are powered from buses which are isolated on a loss of offsite power.

After approximately 14 hours, the Reactor Water Cleanup System (RWCS) can provide enough cooling to remove decay heat using the non-regenerative heat exhanger which is cooled by the Reactor Cooling Water System (RCWS). This method can be used at any reactor pressure but the pumps necessary are powered from buses isolated on a loss of offsite power.

The Control Rod Drive (CRD) system can be used to inject water to the reactor at a rate of 50 gpm. In conjunction with relief valves, this system can maintain the reactor at hot shutdown until the decay heat rate is within the capacity of the RWCS. However, the CRD pumps and the air compressors necessary to operate the CRD valves are powered from buses isolated on a loss of offsite power.

5.2.1 Onsite Power Unavailable (offsite power only). Big Rock Point normally operates with all of its buses supplied by the main generator through an auxiliary transformer. Loss of the main generator power during operation will result in a reactor scram and turbine trip. The buses normally powered by the generator will automatically transfer to the reserve auxiliary transformer.

The most limiting EI&C single failure when only offsite power is available is loss of the station 125V DC system. This would disable the EC MOVs motive and control power. Under these conditions, the RDS and CS system would still be available to provide cooling necessary to reach and maintain cold shutdown conditions.

5.2.1.1 Evaluation. The systems required to reach and maintain cold shutdown conditions at Big Rock Point are capable of providing the required cooling assuming no onsite power is available and a single EI&C failure.

5.2.2 Offsite Power Unavailable (Onsite Power Only). Shutdown and cooldown without offsite power requires the use of the emergency diesel generator. Under this condition, the normal cooldown method (dumping steam to the main condenser) is unavailable.

The most limiting single failure in this case is loss of the DG. This would result in the loss of the SDCS, RWCS, RCWS, SWS, and CRD system. The EC would be available to cool the reactor to cold shutdown as would be the RDS/CS system method of cooling.

5.2.2.1 Evaluation. The systems required for reaching and maintaining cold shutdown conditions at Big Rock Point are capable of providing the required cooling assuming only onsite power is available and a single EI&C failure.

5.3 Shutdown and Cooldown Capability Outside the Control Room. The capability to shut down and cool down the plant from outside the control room exists at Big Rock Point. Communications between operators is by radio units. There are inadequate means to determine reactor parameters such as level, pressure, and the temperature outside the control room. Local control stations exist for the pumps and valves of the systems required for safe shutdown described in Section 5.2. Procedures for taking the plant from hot to cold shutdown from outside the control room exist.

5.3.1 Evaluation. The capability exists to shut down and cool down the reactor from outside the control room at Big Rock Point. However, reactor and safe shutdown systems instrumentation outside the control room is inadequate.

6.0 SUMMARY

The systems required to take the reactor from hot shutdown to cold shutdown, assuming only offsite power is available or only onsite power is available and a single EI&C failure are in compliance with current licensing guidelines and the safety objectives of SEP Topic VII-3. Single failures of EI&C equipment cannot render all short and long-term cooling systems inoperable.

The instrumentation available to control room operators to reach and maintain the reactor in cold shutdown conditions does not meet current licensing criteria since a single failure can cause a loss of vital indication such as reactor temperature, pressure and level, as well as process instrumentation for safe shutdown systems.

The capability to shut down and cool down the reactor from outside the control room exists and is in compliance with the safety objectives of SEP Topic VII-3, except that instrumentation to verify shutdown and cooldown conditions from outside the control room is inadequate. Procedures exist to take the plant to cold shutdown from outside the control room to satisfy the safety objectives of SEP Topic VII-3.

7.0 SAFE SHUTDOWN EI&C FEATURES FOR CONSIDERATION BY SEP TOPIC III-1

ELECTRICAL DISTRIBUTION (including support structure, but not individual loads)

1. AC BUSES (2400V Bus, 1, 1A, 1E, 1C, 2, 2A, 2B, 2C, 2P) --including all feeders, incoming or outgoing, control circuits, indicating circuits, bus work and support structures
2. ALL DC BUSES--including batteries, chargers, breakers, bus work, and support structures
3. DIESEL GENERATOR--including control and indicating circuitry, and control and indication of vital DG auxiliaries such as lube oil, fuel, and cooling.

INSTRUMENTATION (including support structures)

1. REACTOR LEVEL
2. REACTOR PRESSURE
3. REACTOR TEMPERATURE
4. REACTOR PROTECTION SYSTEM
5. NEUTRON MONITORING (including in-core monitoring)
6. AREA AND SYSTEM RADIATION MONITORING.

SYSTEMS (includes pumps, valves, control, indication, and support structures)

1. SHUTDOWN COOLING SYSTEM
2. SERVICE WATER SYSTEM
3. REACTOR DEPRESSURIZATION SYSTEM
4. RELIEF VALVES
5. EMERGENCY CONDENSER
6. CONTROL ROD DRIVE SYSTEM
7. REACTOR WATER CLEANUP SYSTEM
8. REACTOR COOLING WATER SYSTEM
9. FIRE WATER SYSTEM
10. CORE SPRAY SYSTEM.

8.0 REFERENCES

1. Final Hazards Summary Report, Big Rock Point Nuclear Power Station.
2. Code of Federal Regulations, 10 CFR 50, Appendix A, "General Design Criteria for Nuclear Power Plants."
3. IEEE Standard 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations."
4. NUREG 75/087, Nuclear Regulatory Commission Standard Review Plan 7.4, "Systems Required for Safe Shutdown" and 5.4, "Residual Heat Removal."