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

December 20, 1979

Dockets Nos. 50-269/270 & 287

Mr. William O. Parker, Jr.
Vice President - Steam Production
Duke Power Company
P. O. Box 2178
422 South Church Street
Charlotte, North Carolina 28242

Dear Mr. Parker:

SUBJECT: PRELIMINARY DESIGN APPROVAL FOR THE SAFETY-GRADE ANTICIPATORY REACTOR TRIP (ART) ON LOSS OF FEEDWATER AND TURBINE TRIP

We have reviewed your submittals of May 21 and October 5, 1979, in which you forwarded a preliminary design for upgrading the present control-grade ART for loss of feedwater and turbine trip to safety-grade. A copy of the staff safety evaluation (SE) approving your preliminary design is included as an enclosure to this letter.

As summarized in Attachment 1 of this evaluation, additional information will need to be submitted prior to the final design approval. Therefore, insure that this information is submitted for staff review in sufficient time to allow staff approval prior to system operation.

If you have any questions in this matter, please contact the NRR Operating Reactor Project Manager, Mr. Morton Fairtile on (301) 492-7435.

Sincerely,

Robert W. Reid

Robert W. Reid, Chief
Operating Reactors Branch #4
Division of Operating Reactors

Enclosure:
SE

cc w/enclosure:
See next page

MA

8001140110

Duke Power Company

cc w/enclosure(s):
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UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION OF PRELIMINARY DESIGN FOR SAFETY-GRADE ANTICIPATORY REACTOR TRIPS (ARTs) ON LOSS OF MAIN FEEDWATER AND/OR TURBINE TRIP

FOR

DUKE POWER COMPANY
OCONEE NUCLEAR STATION, UNITS NOS. 1, 2 AND 3
DOCKETS NOS. 50-269, 270 AND 287

SACRAMENTO MUNICIPAL UTILITY DISTRICT
RANCHO SECO NUCLEAR GENERATING STATION
DOCKET NO. 50-312

ARKANSAS POWER & LIGHT COMPANY
ARKANSAS NUCLEAR ONE, UNIT 1
DOCKET NO. 50-313

FLORIDA POWER CORPORATION
CRYSTAL RIVER NUCLEAR GENERATING STATION
UNIT NO. 3
DOCKET NO. 50-302

I. BACKGROUND

Following the accident at Three Mile Island Unit 2, an assessment of feedwater transients in the Babcock and Wilcox (B&W) designed pressurized water reactors was performed. The results of that review were reported in NUREG-0560. This report highlighted a concern regarding the challenges to the power-operated relief valves (PORV) in the B&W design. In response to I&E Bulletin 79-05B, the licensees lowered the existing setpoint for the high pressure reactor trip and raised the setpoint of the PORV. By inverting these setpoints the challenge rate to the PORV and thus the chance of it not reseating following actuation was reduced.

To provide additional margin to the automatic opening setpoint, the licensees proposed design provisions for direct reactor trip on loss of main feedwater or turbine trip. This design modification was approved and incorporated as part of the required actions of the Commission's Confirmatory Shutdown Orders issued in May 1979. In order to achieve a timely implementation it was determined that a "control-grade" design was sufficient for the short-term. In the short-term the licensees implemented hardwired, control-grade trips independent of the reactor protection system (RPS). For the long-term, the trips were to be upgraded to safety-grade and become part of the RPS.

As part of the long-term requirements, each licensee submitted their proposed designs for safety-grade reactor trips to be incorporated in the existing RPS.

These submittals are listed as References 1 through 8 of Attachment 2 to this evaluation. The following evaluation is applicable to Oconee Units 1, 2 and 3; Arkansas Nuclear One, Unit 1, Rancho Seco and Crystal River Unit 3.

II. EXISTING RPS

The existing plant RPS includes four redundant and independent channels. Each channel has its own independent input sensors that are physically and electrically separated from the sensors of the other channels. The present trip conditions that are monitored by these sensors and channels include:

1. Nuclear power/flux (high)
2. Nuclear power based on flow (high)
3. Nuclear power based on reactor coolant pump status (high)*
4. Reactor coolant system pressure (high)
5. Reactor coolant system pressure (low)
6. Reactor coolant system pressure based on temperature (low)
7. Reactor coolant temperature (high)
8. Reactor building (containment) pressure (high)

Within the RPS cabinets each of the four channels contain a logic string of the above inputs. Any individual actuation will cause the logic string to trip and actuate a trip relay. The trip relays of the four channels form a two-out-of-four coincident logic to open the reactor trip breakers.

III. DESCRIPTION OF PROPOSED DESIGN

The licensees have proposed ARTs which will actuate on turbine trip and/or main feedwater pump trip. These anticipatory trips provide additional protection and conservatism beyond that provided by the existing RPS. No credit is taken for these trips in the FSAR Chapter 15 analyses. Previously existing and diverse parameters will cause a reactor trip should these proposed trips fail to function.

The proposed trips are to be incorporated into the existing RPS. They each contain four redundant and independent inputs to interface with the four RPS channels.

The turbine trip is to be sensed by four independent pressure switches. The feedwater pump trip is similarly sensed (for each pump) by four independent pressure switches. The logic is arranged such that <u>both</u> main feedwater pumps must be tripped to cause reactor trip.

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* The trip system in Crystal River 3 does not monitor for this condition.

A reactor flux level premissive (bypass) is provided to facilitate startup and shutdown of the plant. This permissive automatically blocks the reactor trip upon turbine trip or main feedwater pump trip when reactor power is decreased below 20% power. During power escalation, as reactor power increases to above 20%, the bypass is automatically removed and the reactor trips are reinstated. This flux signal is part of the existing RPS and therefore, is implemented in the RPS four channel arrangement.

The pressure switch inputs are routed to the RPS cabinets for interface in the present logic trip strings through added RPS modules. The flux bypass is also implemented through a new RPS module. The RPS modules will contain contact buffers, bistables, and auxiliary relays as required. All additional equipment will be designed in accordance with the design bases of the existing RPS and will conform with the acceptance criteria and design requirements of the RPS.

The licensees have stated that the cabinet mounted equipment to be supplied by B&W will be fully testable from the RPS cabinets. The equipment will have provisions for simulating input signals and verifying the proper response of the RPS channel. This testing will be similar to that presently performed on the RPS and will be integrated into the periodic testing of the cabinets.

With respect to environmental qualification, all equipment associated with the ARTs is located outside containment. In addition, the licensees have stated that the new RPS modules to be used have been qualified for use in B&W safety systems. Also, the pressure switch sensors will be equivalent to switches presently used in other plant safety applications.

With respect to seismic qualification, the licensees have stated that all equipment will be seismically qualified (with the exception of some equipment located in non-seismic Category I areas - See Section IV).

Existing RPS power supplies, flux signals, interlock circuits, and indicators will be used as required by the added equipment.

IV. EVALUATION

In performing our evaluation of the licensees' proposed designs, we utilized information provided by the licensees listed as References 1 though 8 of this evaluation.

The information presented in these submittals addressed only the preliminary design for the safety-grade ARTs. Included in the information is a brief description of the system and simplified logic and schematic diagrams.

We have concluded that the licensees have identified the design bases and criteria for this additional equipment, as well as provided a preliminary design description; however, the design details are not sufficiently complete to make a determination that the design satisfies the identified criteria. Therefore, as additional design details are developed and prior to operation of the new equipment, we will require that the licensees submit the final design for our review and approval. The final design shall include final logic diagrams, electrical schematic diagrams, piping and instrumentation diagrams and location layout drawings.

In our evaluation of the ARTs, we concentrated on the adequacy of the design approach as it pertains to the existing RPS. That is, we determined whether the trip would meet the requirements of a safety-grade system and whether its addition would in any way degrade the existing RPS.

The "Design Basis" and "Requirements" of the ARTs as required by IEEE 279-1971 are to be equivalent to those of the existing RPS with the exception that the input sensors will not conform to seismic requirements. We conclude that this is acceptable based on the anticipatory nature of these trips and that other fully qualified trips serve as back up protection. There is a related concern with the location of these inputs, which needs to be addressed in more detail by the licensees. Specifically, for those sensors located in non-seismic areas which have previously not contained RPS inputs, we will require that their installation (including circuit routing) be analyzed to demonstrate that the effects of credible faults (i.e., grounding, shorting, application of high voltage, or electromagnetic interference) or failures in these areas will not be propagated back to the RPS and degrade the RPS performance or operability. This will require that specific provisions (e.g., conduit) be utilized to keep the circuits sufficiently separated. Therefore, we will require that the licensees submit such an analysis, along with the final design, prior to the operation of the ARTs.

With respect to equipment qualification, the licensees have supplied "Seismic and Environmental Qualification Summary Reports" for the equipment to be supplied by B&W. The balance of the qualification information is not yet available. Therefore, we require that the information for the remaining equipment be submitted when available. In addition, as part of the final design package, we require information which demonstrates that the envionmental test conditions bound the actual worst case accident conditions expected at the installed locations. The detailed test procedures and test data will be examined as part of the review of the final design.

The ARTs testability, particularly with respect to the sensors (paragraph 4.9 of IEEE 279-1971), is not sufficiently addressed for us to conclude that adequate provisions are being incorporated to accomplish the RPS channel tests. Therefore, we will require that the licensees include provisions to perform channel functional tests at power on a periodic basis (i.e., during RPS monthly surveillance tests).

As part of the final design submittal, we will require that the licensees provide the RPS check-out procedure which will demonstrate both the operability of the new trips and the continued operability of the previous RPS.

V. CONCLUSION

The licensees have identified the design bases and design requirements for the "Anticipatory Reactor Trips". They have also provided a preliminary design description. We have concluded that this identification along with the preliminary design description provides sufficient bases for approval of the preliminary design.

In order to approve the final design, as soon as possible, we shall require the licensee to submit the above identified information as soon as it is available. In addition, a site visit may be required and would be coordinate with our Office of Inspection and Enforcement.

Attachments:
1. Summary of Information Needed for Final Design Approval
2. References

SUMMARY OF INFORMATION NEEDED FOR FINAL DESIGN APPROVAL

Page number in SER	Requirement
3/4.	The final design submittal should include the final logic diagrams, electrical schematic diagrams, piping and instrumentation diagrams and location layout drawings.
4.	For sensors located in non-seismic areas which have not previously contained RPS inputs, perform and submit an analysis which shows that the installation (including circuit routing) is designed such that the effects of credible faults (i.e., grounding, shorting, application of high voltage, or electromagnetic interference) or failures in these areas could not be propagated back to the RPS and degrade the RPS performance or operability.
4.	Submit "Seismic and Environmental Qualification Summary Reports" for the equipment which has not been previously submitted. In addition, we require that you demonstrate that the environmental test conditions bound the actual worst case accident conditions expected at the installed locations.
4.	Assure that the ARTs testability includes provisions to perform channel functional tests at power. Testing of this circuitry is to be included in the RPS monthly surveillance tests.
5.	Include in the final design submittal the RPS check-out procedure which will demonstrate both the operability of the new trip circuitry and the continued operability of the previous RPS.

Attachment 2

REFERENCES - ANTICIPATORY REACTOR TRIP

OCONEE Units 1, 2 and 3

1. Letter from W. O. Parker (DUKE) to H. R. Denton (NRC), dated May 21, 1979
   Subject: Response to IE Bulletin 79-05B.

2. Letter from W. O. Parker (DUKE) to H. R. Denton (NRC), dated October 5, 1979
   Subject: Response to NRC letter dated September 7, 1979 (Request for Additional Information).

ARKANSAS NUCLEAR ONE, Unit 1

3. Letter from D. C. Trimble (AP&L) to K. V. Seyfrit (NRC), dated May 21, 1979
   Subject: Response to IE Bulletin 79-05B.

4. Letter from D. C. Trimble (AP&L) to R. W. Reid (NRC), dated October 8, 1979
   Subject: Response to NRC letter dated September 7, 1979 (Request for Additional Information).

RANCHO SECO

5. Letter from W. C. Walbridge (SMUD) to R. H. Engelken (NRC), dated May 21, 1979
   Subject: Response to IE Bulletin 79-05B.

6. Letter from J. J. Mattimoe (SMUD) to R. W. Reid (NRC), dated October 5, 1979
   Subject: Response to NRC letter dated September 7, 1979 (Request for Additional Information).

CRYSTAL RIVER, Unit 3

7. Letter from W. P. Stewart (FPC) to J. P. O'Reilly (NRC), dated May 21, 1979
   Subject: Response to IE Bulletin 79-05B.

8. Letter from W. P. Stewart (FPC) to R. W. Reid (NRC), dated October 2, 1979
   Subject: Response to NRC letter dated September 7, 1979 (Request for Additional Information).