DMB 016

NOV 23 1983

DISTRIBUTION
Docket File
NRC PDR
L PDR
ORB#4 Rdg
DEisenhut
OELD
CMiles
LHarmon
ACRS-10
TBarnhart-12
EJordan
JTaylor
WJones
DBrinkman
RDiggs
JSuermann
RIngram
Gray File

Docket Nos. 50-269, 50-270, 50-287

Mr. Hal B. Tucker
Vice President - Steam Production
Duke Power Company
P. O. Box 33189
422 South Church Street
Charlotte, North Carolina 28242

Dear Mr. Tucker:

Subject: NUREG-0737 Item II.F.2.3 - Inadequate Core Cooling Instrumentation

We have completed our pre-implementation review of your submittals dated March 10 and August 25, 1983 in reference to the above subject NUREG-0737 action. The enclosed staff Safety Evaluation Report (SER) presents the results of our review and also incorporates the review material provided to us by Oak Ridge National Laboratory. The SER is provided for your information and action.

Based on our review of the Duke Power Company (DPC) response to our concerns, we conclude that (1) the design concept for an inventory tracking system, as described by DPC in its August 25, 1983 submittal and preceeding submittals, is acceptable to the staff and DPC can proceed with confidence that its final design will be acceptable if it conforms in essential features to the proposed concept and meets the staff's error limit stipulations (detailed design information will be required to confirm such conformance); (2) the staff concurs that the subcooling margin monitor is in essential conformance with the requirements of NUREG-0737 Item II.F.2 and the design is acceptable; and (3) the core exit thermocouple system, upon completion of the upgrading described in the March 10, 1983 submittal, will be acceptable.

We request that you initiate the necessary actions to meet the 1985 installation schedule for the system. Additionally, we request that you provide us with a schedule for submission of the additional information requested herein; the schedule should be provided to us within 90 days of receipt of this letter. The information to be submitted in response to our request will be considered in the context of a post-implementation review and will be evaluated by the staff on the basis of a plant specific action.

OFFICE							
SURNAME							
DATE							

The additional information requested in the enclosure to the SER affects fewer than ten respondents, therefore OMB clearance is not required under P.L. 96-511.

Sincerely,

"ORIGINAL SIGNED BY
JOHN F. STOLZ"
John F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing

Enclosure: As stated

cc w/enclosure:
See next page

OFFICE	ORB#4:DL	C-ORB#4:DL					
SURNAME	JSuermann:cf	JStolz					
DATE	11/22/83	11/23/83					

Duke Power Company

cc w/enclosure(s):

Mr. William L. Porter
Duke Power Company
P. O. Box 33189
422 South Church Street
Charlotte, North Carolina 28242

Office of Intergovernmental Relations
116 West Jones Street
Raleigh, North Carolina 27603

Honorable James M. Phinney
County Supervisor of Oconee County
Walhalla, South Carolina 29621

Mr. James P. O'Reilly, Regional Administrator
U. S. Nuclear Regulatory Commission, Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

Heyward G. Shealy, Chief
Bureau of Radiological Health
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Regional Radiation Representative
EPA Region IV
345 Courtland Street, N.E.
Atlanta, Georgia 30308

Mr. J. C. Bryant
Senior Resident Inspector
U.S. Nuclear Regulatory Commission
Route 2, Box 610
Seneca, South Carolina 29678

Mr. Robert B. Borsum
Babcock & Wilcox
Nuclear Power Generation Division
Suite 220, 7910 Woodmont Avenue
Bethesda, Maryland 20814

Manager, LIS
NUS Corporation
2536 Countryside Boulevard
Clearwater, Florida 33515

J. Michael McGarry, III, Esq.
DeBevoise & Liberman
1200 17th Street, N.W.
Washington, D. C. 20036

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REGULATION

TMI ACTION ITEM (NUREG-0737

II.F.2.3 INADEOUATE CORE COOLING INSTRUMENTATION

DUKE POWER COMPANY

OCONEE NUCLEAR STATION, UNITS NOS. 1, 2, AND 3

DOCKETS NOS. 50-269, 50-270 AND 50-287

I. INTRODUCTION

The staff evaluation (Ref. 1) of the Duke Power Company (DPC) response (Ref. 2) to NRC "Order for Modification of License" dated December 10, 1982 concluded that the proposed DPC conceptual design of a wide range hot leg level/reactor vessel head level monitoring system was acceptable, but should be modified during final design engineering if necessary to resolve cited staff concerns (Ref. 1). In response, the licensee has transmitted a letter (Ref. 3) dated August 25, 1983 to address those concerns and to request NRC final acceptance of the proposed design. The staff in conjunction with our contractor, Oak Ridge National Laboratory (ORNL), has reviewed the DPC submittals (Ref. and 3) in response to the subject order for Oconee Nuclear Station, Units 1, 2, and 3, which have B&W nuclear steam supply systems. In these submittals, DPC has proposed a system for detecting and monitoring inadequate core cooling (ICC) conditions including a subcooled margin monitor (SMM), core exit thermocouples (CET), a wide range hot leg level monitor system (HLLMS-WR), a reactor vessel head level monitor (RVHLM), and reactor coolant pumps motor current monitors (PCM). Staff evaluation of Ref. 3 is provided in Enclosure 1.

II. EVALUATION

A. Reactor Coolant Inventory Tracking System

The HLLMS, as modified in the revised proposal, has one differential pressure transmitter per reactor coolant hot leg. The transmitters are spatially separated and the sensing lines for each hot leg pipe are routed within the respective steam generator compartment and physically separated to achieve effective redundancy. The lower taps for each transmitter are located on separate taps on the decay heat drain line and are also physically separated.

The HLLMS will monitor hot leg water level during natural circulation or during periods when natural circulation is interrupted. For transients involving possible approach to ICC, symmetrical voiding in both hot legs is expected. Some recovery and long term cooldown scenarios, for example following one steam generator isolation, are likely to cause asymmetric hot leg voiding. Monitoring of both hot legs provides not only needed redundancy, but also the capability to track asymmetric voiding. The proposed design of the HLLMS, as modified, is acceptable.

The RVHLM, as modified in the revised proposal, now has the two measurement trains returned to separate taps in the decay heat line. Each tap will have a reactor vessel head level and hot leg level sensing line together forming a single train. The two decay heat line taps are separated so that a single event is unlikely to produce a break in both taps. Complete severance of the decay heat line would be a large break outside the range where level measurement would provide timely information to the operator. Location of the lower taps off the same reactor vessel nozzle is not expected to adversely affect redundancy or accuracy because of the low hydrostatic head drop across the upper plenum with the coolant pumps off. The proposed design of the RVHLM, as modified, is acceptable.

DPC plans to use existing reactor coolant pump current monitors (PCM) to trend void content of the primary coolant system. The monitors are not safety grade. DPC is justifying the high quality commercial grade of the PCM as consistent with the pump availability and pump trip criteria and hence the need for the PCM.

The licensee has provided an analysis of the correlation between pump current and voiding. Although the basis of a correlation is shown, the experimental results obtained are not entirely conclusive. Nevertheless, we believe that some useful void trending information will be interpretable from pump current and the proposal is acceptable.

Therefore, we conclude that the design concept for an inventory tracking system, as described by DPC in its August 25, 1983 submittal and preceeding submittals, is acceptable to the staff and DPC can proceed with confidence that its final design will be acceptable if it conforms in essential features to the proposed concept and meets the staff's error limit stipulations. Additional detailed design information (Enclosure 2) will be required when available to confirm such conformance. The milestones relating to implementation of the system, as provided in Enclosure 3, should be incorporated in the Oconee schedule.

B. Saturation Margin Monitor

The staff concurs that the SMM design is in essential conformance with the requirements of NUREG-0737 Item II.F.2 and the design is acceptable.

C. Core Exit Thermocouples

The CET system, upon completion of the upgrading described in the March 10, 1983 submittal, will be acceptable. An upgrading schedule should be provided.

III. CONCLUSIONS

Based on our review of the DPC response to our concerns, we conclude that (1) the design concept for an inventory tracking system, as described by DPC in its August 25, 1983 submittal and preceding submittals, is acceptable to the staff and DPC can proceed with confidence that its final design will be acceptable if it conforms in essential features to the proposed concept and meets the staff's error limit stipulations; (2) the staff concurs that the SMM design is in essential conformance with the requirements of NUREG-0737 Item II.F.2 and the design is acceptable; (3) the CET system, upon completion of the upgrading described in the March 10, 1983 submittal, will be acceptable.

Dated: November 23, 1983

The following NRC staff personnel have contributed to this Safety Evaluation:
T. Huang, L. Phillips, R. Karsch, and J. Suermann.

References

(1) USNRC letter to Duke Power Company, dated June 8, 1983.

(2) Duke Power Company letter to USNRC, dated March 10, 1983.

(3) Duke Power Company letter to USNRC, dated August 25, 1983.

ENCLOSURE 1

EVALUATION OF RESPONSES TO REQUESTS FOR CLARIFICATION
(August 25, 1983 SUBMITTAL)

A. (1)

The proposed design of the HLLMS has been modified to provide differential pressure level measurements on both hot legs. The systems are not completely separate for redundancy. Two taps will be installed on the decay heat line. Two separate trains, each including one hot leg level, and one reactor vessel head level measurement, will be installed. We find this modification to the original design satisfies our reservations about the original design as expressed in the request for clarification and this design configuration is acceptable.

A. (2)

There has been substantial concurrence among the reactor vendors that the function of the coolant inventory system should be to warn the operator of an approach to ICC. It follows, therefore, that measurement uncertainties in the coolant inventory system should not be so great as to impair this function. Consider the effect of measurement uncertainties on the margin of warning the operator receives from the measurement system for the case of a 0.04 sq. ft. break (adapted from the analysis supplied in Document Number 77-1126635-00). The bank of uncertainty about the values calculated from the analysis can result in a delay in warning the operator about a decreasing water level by 400s for a ±25% uncertainty mentioned in response E.1.

Errors as large as 25% could lead to misinterpretation between completely covered core or completely uncovered core and hence potentially lead to inappropriate action or inaction. An acceptance limit of ±6% uncertainty in level measurement is recommended, unless a larger uncertainty can be justified by appropriate analysis. All manufacturers have indicated that ±6% is achievable using straight-forward techniques and equipment.

B. (1)

We agree with Duke that requiring safety grade components in the pump current monitor circuit would be unnecessary if the equipment being monitored is not safety-grade. However, we do believe that there should be reasonable assurance that the pump current monitors will remain operable under environmental conditions where the pumps are capable of continued operation or restart. The current transformers used to measure the pump motor current are passive devices located in an environment that will not be seriously different from normal in the event of a design basis accident. From a seismic standpoint, current transformers are normally "potted" and are thus of essentially solid construction. They would not be expected to be affected by a seismic event except perhaps as a result of a failure of the mounting. On this basis we conclude that the proposed use of existing pump current monitors as a part of the ICC detection system is acceptable.

B. (2)

Although it is comforting that two different approaches to modeling the pump current versus void fraction resulted in essentially the same equations, it is not clear how this information is to be used by the operator. Second, it appears that the equations can only be used over a limited range where the pump efficiency is essentially constant. Under current operating procedures this is highly likely.

C.

NUREG-0737 does not require that CRT display systems be seismically qualified, nor 1E. Process sensor inputs are required to be safety-grade and to be buffered from the non-1E display systems. The Duke SMM appears to meet these requirements.

D. (1)

The same 16 CETs are used as inputs to both the primary and backup display systems. The signal channels are isolated from both display systems, however, and this meets the requirement of NUREG-0737 for signal channel separation. Thus, this feature of the ICC system design is acceptable.

D. (2)

Further information on CET testing is required in the final design description to be supplied later.

1. Describe how the weekly surveillance checks of the CETs are made and how they show the CETs are responding properly.

2. Describe the calibration procedure used to verify CET calibration during startup after refueling.

E. (1)

See A. (2). Acceptance limits for level measurement accuracy are ±6%.

E. (2)

Installation of redundant taps on the decay heat line on the same nozzle is acceptable.

E. (3)

Later submission of detail on how broken impulse lines will be detected is acceptable.

E. (4)

Specifications for Dp Transducers should be adequate to assure ±6% overall uncertainty in level. Later submission of detail is acceptable.

E. (5)

This is the first mention of a sealed capillary system. If used, we agree that the likelihood of flashing in the impulse lines is negligible.

E. (6)

Installation of transmitters outside of containment is acceptable.

E. (7)

The method of temperature compensation for the Dp system will be supplied later. Description of this system, when supplied, should include uncertainties of the temperature measurements and temperature compensation, uncertainty of the level measurement without temperature compensation, and whether the correction will be applied by means of an analog circuit or made digitally.

E. (8)

Location of the pump on/off indication near the Dp level indicators would be acceptable. The design is not yet final.

E. (9)

Use of the plant computer and strip chart recorder to record level measurement system trends is acceptable.

E. (10)

The Duke submission of 10 March 1983 stated that the cabling and connectors in the reactor building containment will be upgraded to safety-grade. Four T/Cs in each quadrant of the core will be upgraded. Final documentation should describe the distinguishing differences between existing CETs and the upgraded CETs that are proposed.

E. (11)

The description of how the SMM is used to monitor and control venting is acceptable.

E. (12)

Description of the level system errors during venting is acceptable.

E. (13)

The clarification of nomenclature is acceptable.

ENCLOSURE 2

REQUEST FOR ADDITIONAL INFORMATION RELATING TO
FINAL DESIGN OF PROPOSED COOLANT INVENTORY SYSTEMS
DUKE POWER COMPANY
OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

1. Provide a description of the final design and a detailed analysis of the measurement errors in the hot leg measurement. This analysis should include besides the overall estimate of the measurement uncertainty, a table with estimates of error, including limits of uncertainty for each contributing factor, i.e., temperature of the impulse lines, common mode pressure effects on the differential pressure transducer, and uncertainties associated with the transducer. Explain how the individual errors were combined for the estimate of overall error. Include the specifications for the transducer used.

2. If sealed capillaries are not used, provide an analysis to show the effects of flashing or dissolved gases in the impulse lines.

3. Describe the final locations of the differential pressure transmitters. If they are located in containment, verify their ability to withstand a LOCA environment within the containment and be available for post-accident monitoring.

4. Describe how a broken impulse line that would tend to drive the dp transducer full scale would be detected.

5. Describe the method of temperature compensation for the dp system, including uncertainties of the temperature measurements and temperature compensation, uncertainty of the level measurements without temperature compensation, and how the correction will be applied.

6. Describe the upgraded core exit thermocouple system, including how the weekly surveillance checks of the CET's are made and how they show that the CET's are responding properly, and the calibration procedure used to verify CET calibration during startup after refueling.

7. Provide a schedule for upgrading of CETs. If this cannot be completed during the next refueling, provide justification including information on the suitability of existing CETs for ICC monitoring in an accident environment.

ENCLOSURE 3

MILESTONES FOR IMPLEMENTATION OF INADEQUATE CORE COOLING INSTRUMENTATION

1. Submit final design description (by licensee) (complete the documentation requirements of NUREG-0737, Item II.F.2, including all plant-specific information items identified in applicable NRC evaluation reports for generic approved systems).
2. Approval of emergency operating procedure (EOP) technical guidelines - (by NRC).

   Note: This EOP technical guideline which incorporates the selected system must be based on the intended uses of that system as described in approved generic EOP technical guidelines relevant to the selected system.
3. Inventory Tracking Systems (ITS) installation complete (by licensee).
4. ITS functional testing and calibration complete (by licensee).
5. Prepare revisions to plant operating procedures and emergency procedures based on approved EOP guidelines (by licensee).
6. Implementation letter* report to NRC (by licensee).
7. Perform procedure walk-through to complete task analysis portion of ICC system design (by licensee).
8. Turn on system for operator training and familiarization.
9. Approval of plant-specific installation (by NRC).
10. Implement modified operating procedures and emergency procedures (by licensee).

    - System Fully Operational -

*Implementation Letter Report Content

(1) Notification that the system installation, functional testing, and calibration is complete and test results are available for inspection.

(2) Summary of licensee conclusions based on test results, e.g.:

- (a) the system performs in accordance with design expectations and within design error tolerances; or
- (b) description of deviations from design performance specifications and basis for concluding that the deviations are acceptable.

(3) Description of any deviations of the as-built system from previous design descriptions with any appropriate explanation.

(4) Request for modification of Technical Specifications to include all ICC instrumentation for accident monitoring.

(5) Request for NRC approval of the plant-specific installation.

(6) Confirm that the EOPs used for operator training will conform to the technical content of NRC approved EOP guidelines (generic or plant specific).