U.S. NUCLEAR REGULATORY COMMISSION

REGION II

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License Nos:	DPR-38, DPR-47, DPR-55, SNM-2503
Report No:	50-269/98-12, 50-270/98-12, 50-287/98-12
Licensee:	Duke Energy Corporation
Facility:	Oconee Nuclear Station, Units 1, 2, and 3
Location:	P. O. Box 1439 Seneca, SC 29679
Dates:	April 22 - May 20, 1998
Inspectors:	M. Scott, Senior Resident Inspector D. Billings, Resident Inspector R. Carroll, Project Engineer
Approved by:	C. Ogle, Chief, Projects Branch 1 Division of Reactor Projects

Enclosure

EXECUTIVE SUMMARY

Oconee Nuclear Station, Units 1, 2, and 3
NRC Special Inspection Report 50-269/98-12,
50-270/98-12, and 50-287/98-12

The purpose of this special inspection was to review and assess the effects of deficiencies identified with the Oconee Nuclear Station borated water storage tank level instrumentation and emergency operating procedures. [Applicable template codes and the assessment for items inspected are provided.]

Engineering

- An apparent violation of Technical Specifications and 10 CFR 50.46 was identified in all three Oconee units for inoperable borated water storage tank level instruments due to uncompensation for instrument tap height differences. This not only had the potential to render emergency core cooling system pumps inoperable and interrupt long-term core cooling, but could have precluded meeting the required 46 feet (350,000 gallons) of borated water available in the borated water storage tank for emergency core cooling. (Section E.8.1; [4A-Poor])

- An apparent violation of 10 CFR 50 Appendix B, Criterion III was identified in all three Oconee units for failures to appropriately account for the as-built height configuration of the borated water storage tank level instrument taps (in system design drawings and calibration procedures) and the reactor building emergency sump level instrument uncertainties (in emergency operating procedures). This not only had the potential to render emergency core cooling system pumps inoperable and interrupt long-term core cooling, but could have precluded meeting the required 46 feet (350,000 gallons) of borated water available in the borated water storage tank for emergency core cooling. (Section E.8.1; [4A-Poor])

- Considered noteworthy, was the questioning attitude on the part of Self-Initiated Technical Audit team which initially identified the borated water storage tank level instrumentation height discrepancy and the potential emergency operating procedure sump swapover initiation conflict brought on by reactor building emergency sump level instrument uncertainties. (Section E.8.1; [5A-Good])

- Appropriate root cause analysis and short-term corrective actions were taken by the licensee upon identification of the borated water storage tank level instrumentation height discrepancy and the potential emergency operating procedure sump swapover initiation conflict brought on by reactor building emergency sump level instrument uncertainties. (Section E.8.1; [5B-Good])

Report Details

Summary of Plant Status

Unit 1 began and ended the period at 100 percent power.

Unit 2 began the period in a scheduled refueling outage. The unit ended the period in hot shutdown with startup activities in progress.

Unit 3 began and ended the period at 100 percent power.

Review of Updated Final Safety Analysis Report (UFSAR) Commitments

While performing inspections discussed in this report, the inspectors reviewed the applicable portions of the UFSAR that related to the areas inspected. The inspectors verified that the UFSAR wording was consistent with the observed plant practices, procedures, and parameters.

III. Engineering

E8 Miscellaneous Engineering Issues (92903)

E8.1 Borated Water Storage Tank Level Set Point Error and Emergency Operating Procedure Discrepancy

a. Inspection Scope (37551, 92903)

Between November 10, 1997 and December 11, 1997, a licensee Self-Initiated Technical Audit (SITA) of the high pressure injection (HPI) and low pressure injection (LPI) systems identified items requiring engineering followup. Followup to the SITA findings by the licensee identified two concerns involving the borated water storage tank (BWST) level instrumentation and an EOP conflict concerning manual emergency core cooling system (ECCS) swapover from the BWST to the reactor building emergency sump (RBES). It was the scope of the special inspection to review and assess the overall effects of these two concerns.

b. Observations and Findings

Concern number (1): BWST Level Instrumentation

On February 12, 1998, engineering conducted evaluation and followup of the lack of a zero reference on the BWST design drawing. Engineering identified an error on the drawing that affected all of the level transmitters on each unit's BWST. The drawing revealed the BWST level indicator taps to be approximately 1 foot (worst case 1.5 feet) below the value used in the EOP calculations. Since this was not compensated for in instrument scaling, this introduced an error between indicated and actual BWST level. To prevent air entrainment into the suction of the ECCS pumps, the EOPs require the swapover from the BWST to the RBES to be completed (i.e., RBES valves open and BWST valves closed) when BWST level is $\leq$ 6 feet and > 2 feet. The condition of the as-found

instrumentation (i.e., worst case indicating 1.5 feet above actual BWST level) coupled with the EOP guidance, could have led to vortexing in the BWST and ECCS pump air entrainment prior to completion of the swapover.

Accordingly, operations declared the BWST level instrumentation inoperable on all three units, entered Technical Specification (TS) 3.0 for all three units, and initiated a one hour non-emergency notification to the NRC. Maintenance personnel commenced calibrations of the level transmitters simultaneously on all three units. Each unit exited TS 3.0 and entered TS 3.3.4 for instrumentation when the calibration of the first train of level instrumentation was completed. On February 13, 1998, maintenance completed the calibration of the second train of BWST level instrumentation for each unit and exited TS 3.3.4 at 2:30 a.m. for Unit 1, 3:09 a.m. for Unit 2, and 3:05 a.m. for Unit 3.

Licensee investigation identified that the BWST level instruments did not have a height difference calculation included in the instrument calibration from initial design. The 1986 safety analysis error calculations, which became the "Emergency Procedure Guidelines Set Point" document in 1988 (and revised in July 1989), did not identify the height differences. The licensee replaced the level transmitters in 1989 to conform to Reg Guide 1.97 criteria, but did not identify the height difference during that modification either. Another missed opportunity to discover and correct the problem was during the licensee's evaluation of Information Notice 91-75, Static Head Corrections Mistakenly Not Included in Pressure Transmitter Calibration Procedure.

Concern number (2): EOP Conflict

During outages from December 1984 - December 1986, the current reactor building (RB) level instruments were installed. On February 19, 1998, during a review of the aforementioned SITA findings, engineering identified that the RB wide range level instruments have large uncertainties (+8.8 inches/-18.1 inches). These uncertainties could create a conflict with EOP guidance for mitigation of Loss of Coolant Accidents (LOCAs).

The guidance in the EOPs from June 1995 - February 1998 required initiation of the swapover of the suction for the Building Spray (BS) and the LPI pumps from the BWST to the RBES when BWST level $\geq$ 6 feet and RB level $\geq$ 4 feet. [Note: Implemented in 1985 to assure adequate RBES inventory for beyond design basis accidents, the required EOP RB level was changed from $\geq$ 2 feet to $\geq$ 3.5 feet in April 1988; and then again to $\geq$ 4 feet at the end of May 1994. (The required EOP BWST level from 1985 to June 1995 was $\leq$ 6 feet.)] The licensee determined that actual RB water level at the time of swapover initiation would be 4.5 feet (worst case 3.07 feet from April 1986 - November 1997 if trapped water issue initially identified in Licensee Event Report 50-269/97-10 is considered); thus, indicated sump levels could range from ~ 3 feet to ~ 5 feet (worst case ~ 1.5 to ~ 3.8 feet). Considering the uncertainties

in the RB level instrumentation, the EOP required BWST and RB level conditions may not have indicated simultaneously (if at all). This could have caused a delay in swapover initiation, resulting in possible air binding of the pumps as described in concern number (1) above.

Following licensee review, operations management provided interim guidance to the operators to address the procedural deficiency and completed a revision to the EOPs in late February 1998, which requires swapover initiation when BWST level ≥ 6 feet and RB level is increasing. (Also a NOTE was added indicating that wide range RB water level should be 3 feet and increasing at the time of swapover.) Additionally, engineering initiated a Failure Investigation Process (FIP) team to assess the root cause, corrective actions, and past operability of the systems. The licensee made a 10 CFR 50.72 notification to the NRC. The licensee issued a preliminary report in Licensee Event Report (LER) 269/98-04, dated March 14, 1998, which was revised on April 7, 1998.

As indicated above, the licensee installed the current RB level instruments from December 1984 - December 1986. Revised RB level instrument uncertainty calculations in February 1988 (+8.8 inches/-21 inches) did not identify an EOP conflict since the RB level for a design basis LOCA was 5.3 feet at the time. Similarly, an EOP conflict was not identified in April 1988 when the RB level set point was changed to ≥ 3.5 feet. However, in July 1989 (when the "Emergency Procedure Guidelines Set Point" document was revised) and in May 1994 (when the RB level set point was changed to 4 feet) the EOP conflict existed, but was not recognized. Another opportunity to identify the EOP conflict was missed in November 1997 when the trapped water issue (i.e., potential blocking of installed reactor cavity flange drain and fuel transfer canal drain strainers traps ~ 100,000 gallons of water) resulted in an actual RB water level determination of 3.07 feet (to which the 1996 revised RB level uncertainties of +8.8 inches/-18.1 inches should have been applied). Due to previously unaccounted for water allowances (i.e., reactor coolant system shrinkage, pressurizer refill, BS piping refill, and vapor content maintaining RB pressure), actual calculated RB water level only increased to 4.5 feet after the trapped water issue was resolved.

Evaluation of Safety Significance

10 CFR 50.46 requires that the ECCS must be designed to be capable of long-term cooling of the reactor core. In conjunction with this: TS 3.3.4 requires that the BWST have operable two level instrument channels and contain a minimum level of 46 feet of borated water; TS 3.3.1 requires two independent HPI trains capable of taking suction from the BWST and LPI system to be operable; TS 3.3.2 requires two independent LPI trains capable of taking suction from the BWST and RBES to be operable; and TS 3.3.6 requires both BS trains capable of taking suction from the LPI system to be operable.

The time to exhaust the BWST inventory and manually swapover the ECCS

pumps to the RBES varies, depending on the size and location of the break and the operating times of the pairs of ECCS suction valves from the BWST and RBES. To prevent air entrainment into the suction of the ECCS pumps, the EOPs require swapover to be completed (i.e., RBES valves open and BWST valves closed) when BWST level is ≤ 6 feet and > 2 feet. Original EOP guidance indicated that swapover to the RBES should occur upon receipt of a low-low level alarm that was set at a BWST level of 3 feet (for which actual level would have been 1.5 feet if worst case instrument tap height of 1.5 feet were applied); there was no conditional RB level. Subsequently, EOP swapover guidance was changed to: BWST level ≤ 6 feet AND RB level ≥ 2 feet (1985); BWST level ≤ 6 feet AND RB level ≥ 3.5 feet (April 1988); BWST level ≤ 6 feet AND ≥ 4 feet (May 1994); and BWST level ≥ 6 feet AND RB level ≥ 4 feet (June 1995 - February 1998).

For all LOCA scenarios where indicated RB level would have been less than that specified in the EOP at the time for swapover initiation, the licensee determined that long-term cooling would be achieved. As discussed in associated LER 50-269/98-04 (revision 1), this conclusion was predicated on: personnel (operators, Shift Technical Advisor, Technical Support Center) diligence; LPI and BS pump durability; availability of the spare C LPI pump; and EOP recovery guidance. The incremental core damage potential was estimated by the licensee to be 9.2E-7 for this event, compared to the nominal core damage probability of 8.9E-5 per reactor.

Regardless, a conflict would have existed and the EOP could not have been performed as written in all LOCA scenarios where RB level instrument uncertainties would have resulted in indicated RB level being less than that specified in the EOP at the time for swapover initiation. Consequently, a resultant delay (coupled with an actual BWST water level lower than indicated) could have led to vortexing the BWST in a time limited LOCA scenario; thereby, causing possible ECCS (LPI, HPI and BS) pump inoperability and interruption of long-term core cooling due to air entrainment prior to completion of the swapover from the BWST to the RBES.

The inspectors determined that from initial construction until correction in February 1998, the BWST level instrumentation in all three Oconee Units did not have a height difference calculation included in their instrument calibration; thereby making them inoperable due to indicating as much as 1.5 feet higher than actual BWST level. This not only had the potential to render ECCS pumps inoperable and interrupt long-term core cooling as discussed above, but could have precluded meeting the required 46 feet (350,000 gallons) of borated water available in the BWST for emergency core cooling. Accordingly, this is being identified as apparent violation (EEI) 50-269,270,287/98-12-01: Failure to Meet TS and 10 CFR 50.46 for Long-Term Cooling Requirements.

The inspectors also determined that the failures to appropriately account for the as-built height configuration of the BWST level

instrument taps (in system design drawings and calibration procedures from initial construction until February 1998) and the RBES level instrument uncertainties (in EOPs since instrument installation in December 1986 until February 1998) did not meet the design control requirements of 10 CFR 50 Appendix B, Criterion III. This not only had the potential to render ECCS pumps inoperable and interrupt long-term core cooling as discussed above, but could have precluded meeting the required 46 feet (350,000 gallons) of borated water available in the BWST for emergency core cooling. Accordingly, this is being identified as EEI 50-269,270,287/98-12-02: Failure to Meet Design Control Requirements of 10 CFR 50 Appendix B, Criterion III.

Root Cause Analysis and Corrective Actions

The licensee's root cause investigation team concluded that the root cause of the BWST level instrumentation problem was deficient documentation (deficient written procedure). The root cause of the RBES wide range water level EOP Set Point conflict was attributed to design deficiency (inadequate design analysis). These failures to account for the as-built height configuration of the BWST level instrument taps and the RBES level instrument uncertainties could have led to the ECCS being seriously degraded or inoperable.

As indicated in LER 50-269/98-04 (revision 1), the licensee's corrective actions included: revising the BWST drawing and level instrument calibration procedure to add a zero reference for calibration; recalibrating BWST level indicators; changing EOPs to resolve the conflict; reviewing installed instruments used in surveillances and periodic tests which might require head corrections (none impacted); surveying Unit 2 reactor coolant system narrow and wide range pressure instruments and revising calibration procedures to include head correction (bounding evaluation performed for Units 1 and 3, revealing no impact); plans to review all EOP set points for accuracy, minimum, and maximum values; plans to obtain precise elevations for Units 1 and 3 reactor coolant system narrow and wide range pressure instruments and revise calibration procedures; plans to ensure directives/procedures used to perform SITAs assure relevant operating experience is appropriately addressed; plans to perform risk-informed review of operating experience; and plans to develop a process to identify, control and maintain Oconee-specific calculation inputs.

c. Conclusions

Licensee-identified failures to appropriately account for the as-built height configuration of the borated water storage tank level instrument taps (in system design drawings and calibration procedures) and the reactor building emergency sump level instrument uncertainties (in emergency operating procedures)could have potentially rendered emergency core cooling system pumps inoperable and interrupted long-term core cooling during a loss of coolant accident in any of the three Oconee Units. Accordingly, two apparent violations were identified for failure

to meet design control requirements of 10 CFR 50 Appendix B, Criterion III and failure to meet the requirements of Technical Specifications and 10 CFR 50.46 for long-term core cooling.

Noteworthy was the questioning attitude on the part of Self-Initiated Technical Audit team which initially identified the borated water storage tank level instrumentation height discrepancy and the potential emergency operating procedure sump swapover initiation conflict brought on by reactor building emergency sump level instrument uncertainties. The root cause analysis and short-term corrective actions taken by the licensee upon identification of the issue were considered appropriate.

E8.2 (Closed) Unresolved Item (URI) 50-269,270,287/98-02-10: Inaccurate BWST and RBES Instrumentation

Following initial inspection of identified deficiencies with the borated water storage tank level instrumentation and emergency operating procedures for all three Units of the Oconee Nuclear Station, this URI was opened pending an in-depth review of associated LER 50-269/98-04 (revision 1). Based on such a review and the resultant apparent violations identified in Section E8.1, this URI is considered closed.

V. Management Meetings and Other Areas

X1 Exit Meeting Summary

The inspectors presented the inspection results to members of licensee management at the conclusion of the inspection on May 21, 1998. The licensee acknowledged the findings presented. The inspectors asked the licensee whether any materials examined during the inspection should be considered proprietary. No proprietary information was identified.

PARTIAL LIST OF PERSONS CONTACTED

E. Burchfield, Regulatory Compliance Manager
T. Curtis, Operations Superintendent
T. Saville, Primary Systems Supervisor
W. Foster, Safety Assurance Manager
C. Little, Electrical Systems/Equipment Engineering Manager
W. McCollum, Vice President, Oconee Site
M. Nazar, Manager of Engineering
J. Forbes, Station Manager
J. Smith, Regulatory Compliance

Other licensee employees contacted included operations, engineering, and maintenance personnel.

INSPECTION PROCEDURES USED

IP 37551: Onsite Engineering
IP 92903: Followup - Engineering

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-269,270,287/98-12-01	EEI	Failure to Meet TS and 10 CFR 50.46 for Long-Term Cooling Requirements (Section E8.1)
50-269,270,287/98-12-02	EEI	Failure to Meet Design Control Requirements of 10CFR 50 Appendix B, Criterion III (Section E8.1)

Closed

50-269,270,287/98-02-10	URI	Inaccurate BWST and RBES Instrumentation (Section E8.2)

Discussed

50-269/98-04 (rev 0 & 1)	LER	ECCS Outside Design Basis Due To Instrument Errors/Deficient Procedures (Section E8.1)

LIST OF ACRONYMS USED

BS	Building Spray
BWST	Borated Water Storage Tank
CFR	Code of Federal Regulations
EA	Enforcement Action
ECCS	Emergency Core Cooling System
EEI	Apparent Violation
EOP	Emergency Operating Procedures
ES	Engineered Safeguards
HPI	High Pressure Injection
LER	Licensee Event Report
LPI	Low Pressure Injection
LOCA	Loss of Coolant Accident
RB	Reactor Building
RBES	Reactor Building Emergency Sump
SITA	Self-Initiated Technical Audit
STA	Shift Technical Advisor
TS	Technical Specification(s)
TSC	Technical Support Center
UFSAR	Updated Final Safety Analysis Report
URI	Unresolved Item
USNRC	United States Nuclear Regulatory Commission