UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
SAM NUNN ATLANTA FEDERAL CENTER
61 FORSYTH STREET SW SUITE 23T85
ATLANTA, GEORGIA 30303-8931

September 10, 2004

EA-02-243
EA-03-145

Duke Energy Corporation
ATTN: Mr. R. A. Jones
Site Vice President
Oconee Nuclear Station
7800 Rochester Highway
Seneca, SC 29672

SUBJECT: OCONEE NUCLEAR STATION - NRC SUPPLEMENTAL INSPECTION REPORT 05000269/2004011, 05000270/2004011, AND 05000287/2004011

Dear Mr. Jones:

On August 13, 2004, the NRC completed a supplemental inspection at your Oconee Nuclear Station. The enclosed report documents the inspection findings which were discussed on August 12, 2004, with you and other members of your staff.

This supplemental inspection was an examination of your problem identification, root cause evaluation, extent of condition determination, and corrective actions associated with two White findings. The two findings, which were in the Mitigating Systems Cornerstone, placed the performance of Oconee Unit 3 in the Degraded Cornerstone Column of the NRC's Action Matrix for the third quarter 2003. The first White finding involved the inadequate installation of electrical connectors on the Unit 3 high pressure injection pump emergency power supply cable from the auxiliary service water switchgear. This finding was evaluated and closed in Supplemental Inspection Report 05000269,270,287/2003008. The second White finding involved pressurizer ambient heat losses in all three Oconee units exceeding the capacity of the pressurizer heaters powered from the standby shutdown facility (SSF). This supplemental inspection also included an independent extent of condition review of issues related to the White findings and the resultant Degraded Mitigating Systems Cornerstone.

Based on the results of this inspection, the NRC determined that your corrective actions (both planned and already completed) are appropriate to resolve the deficiencies related to the Degraded Mitigating Systems Cornerstone. As such, the inspection objectives of Inspection Procedure 95002, "Inspection for one Degraded Cornerstone or any Three White Inputs in a Strategic Performance Area," have been satisfied. Therefore, the remaining open White SSF pressurizer heater finding (including associated violation 05000269,270,287/2003012-01 and licensee event report 50-269/2002-001) is considered closed. However, it is important to note that this inspection also revealed a lack of thoroughness in your corrective action process for the White findings, which limited your response to the findings and the associated Degraded Mitigating Systems Cornerstone. Accordingly, it is requested that you be prepared to discuss in the upcoming Regulatory Performance Meeting, those actions you have taken and/or planned

to assure a more thorough response for any future risk significant (>1E-6) finding(s) or performance indicator(s).

In accordance with 10 CFR 2.390 of the NRC's "Rules of Practice," a copy of this letter and its enclosure will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records (PARS) component of NRC's document system (ADAMS). ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA by Leonard D. Wert Acting for /
Victor M. McCree, Director
Division of Reactor Projects

Docket Nos: 50-269, 50-270, 50-287
License Nos: DPR-38, DPR-47, DPR-55

Enclosure: NRC Supplemental Inspection Report 05000269,270,287/2004011
w/Attachment - Supplemental Information

cc w/encl:
B. G. Davenport
Compliance Manager (ONS)
Duke Energy Corporation
Electronic Mail Distribution

Anne Cottingham
Winston and Strawn
Electronic Mail Distribution

Lisa Vaughn
Legal Department (EC11X)
Duke Energy Corporation
422 South Church Street
Charlotte, NC 28242

Beverly Hall, Acting Director
Division of Radiation Protection
N. C. Department of Environmental
Health & Natural Resources
Electronic Mail Distribution

Lyle Graber, LIS
NUS Corporation
Electronic Mail Distribution

cc w/encl: continued see page 3

cc w/encl: continued
Henry J. Porter, Director
Div. of Radioactive Waste Mgmt.
S. C. Department of Health and
Environmental Control
Electronic Mail Distribution

R. Mike Gandy
Division of Radioactive Waste Mgmt.
S. C. Department of Health and
Environmental Control
Electronic Mail Distribution

County Supervisor of
Oconee County
415 S. Pine Street
Walhalla, SC 29691-2145

R.L. Gill, Jr., Manager
Regulatory Issues & Affairs
Duke Energy Corporation
526 S. Church Street
Charlotte, NC 28201-0006

Peggy Force
Assistant Attorney General
N. C. Department of Justice
Electronic Mail Distribution

Distribution w/encl:
L. Olshan, NRR
C. Evans
OE Mail
RidsNrrDipmlipd
PUBLIC

OFFICE	DRP/RII	DRP/RII	DRP/RII	DRS/RII	DRS/RII	EICS/RII
SIGNATURE	RCH	REC1	GAH2	WGR1	MXM3	CFE
NAME	RHaag	RCarroll	GHutto	WRogers	MMaymí	C Evans
DATE	9/9/2004	9/2/2004	9/01/2004	9/2/2004	9/2/2004	9/9/2004
E-MAIL	YES NO	YES NO	YES NO	YES NO	YES NO	YES NO

OFFICIAL RECORD COPY DOCUMENT NAME: C:\ORPCheckout\FileNET\ML042580434.wpd

U. S. NUCLEAR REGULATORY COMMISSION

REGION II

Docket Nos.:	50-269, 50-270, 50-287
License Nos.:	DPR-38, DPR-47, DPR-55
Report No.:	05000269/2004011, 05000270/2004011, 05000287/2004011
Licensee:	Duke Energy Corporation
Facility:	Oconee Nuclear Station, Units 1, 2, and 3
Location:	7800 Rochester Highway Seneca, SC 29672
Dates:	August 9 -13, 2004
Inspectors:	R. Carroll, Senior Project Engineer (Team Leader) W. Rogers, Senior Reactor Analyst G. Hutto, Resident Inspector - Oconee M. Maymí, Reactor Inspector
Approved by:	V. McCree, Director Division of Reactor Projects

Enclosure

SUMMARY OF FINDINGS

IR 05000269/2004011, 05000270/2004011, 05000287/2004011; 08/9-13/2004; Oconee Nuclear Station; Supplemental Inspection for Degraded Mitigating Systems Cornerstone.

The inspection was conducted by a resident inspector, a senior reactor analyst, a senior project engineer, and a reactor inspector. The inspection identified no findings of significance. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 3, dated July 2000.

Cornerstone: Mitigating Systems

This supplemental inspection was performed by the NRC to assess the licensee's problem identification, root cause evaluation, extent of condition determination, and corrective actions associated with two White findings. The two findings, which were in the Mitigating Systems Cornerstone, placed the performance of Oconee Unit 3 in the Degraded Cornerstone Column of the NRC's Action Matrix for the third quarter 2003. The first White finding involved the inadequate installation of electrical connectors on the Unit 3 high pressure injection (HPI) pump emergency power supply cable from the auxiliary service water (ASW) switchgear. This finding was evaluated and closed in Supplemental Inspection Report 05000269,270,287/2003008. The second White finding involved pressurizer ambient heat losses in all three Oconee units exceeding the capacity of the pressurizer heaters powered from the standby shutdown facility (SSF). The performance issues associated with these two findings were previously characterized as having low to moderate risk significance (White) in NRC "Final Significance Determination" letters dated February 7, 2003, and December 30, 2003, respectively.

During the supplemental inspection, which was performed in accordance with Inspection Procedure 95002, the inspectors utilized the results from Supplemental Inspection Report 05000269,270,287/2003008 to address the White HPI pump cable connector finding. The combined assessment of the two White findings that resulted in the Degraded Mitigating Systems Cornerstone is summarized below.

As indicated in Supplemental Inspection Report 05000269,270,287/2003008, the licensee's formal root cause analysis for the White HPI pump cable connector finding was acceptable. However, the extent of condition review performed for the completed root cause evaluation was incomplete. Specifically, the licensee did not identify additional applications of the subject 151LR Elastimold connectors at the other (switchgear) end of Unit 3 HPI pump motor emergency power supply cable. Excluding this omission, the licensee implemented adequate corrective actions to prevent recurrence based upon their root cause analysis. The omitted connector issue was subsequently inspected and found to be acceptable. Based on these inspection results, the White HPI pump cable connector finding (including associated violation 05000287/ 2003007-01) was closed.

The licensee initially performed a Level II assessment of the SSF pressurizer heater issue as permitted via management discretion under Nuclear System Directive (NSD) 208, Problem Investigation Process. This Level II assessment was considered by the inspectors to be reasonably independent, thorough, and consistent with the prescribed charter. However, the inspectors noted that the licensee had not performed a root cause and extent of condition review of the potential broader implications of the Level II assessment finding relative to the inadequate design control measures evidenced through the events surrounding inadequate

pressurizer heater calculation OSC-3144. Additionally, the licensee's commonality review to address the Degraded Mitigating Systems Cornerstone did not possess the attributes of an extent of condition and cause evaluation. These observations resulted in a postponement of the 95002 supplemental inspection at the licensee's request.

Subsequently, the licensee identified more comprehensive extent of condition related actions through the addition of: a design bases document (DBD) test matrix development and review plan; an in-process calculation assessment and review effort; and a completed assessment of long-term and/or unexplained conditions. During the 95002 supplemental inspection, the licensee acknowledged the inspectors' independent extent of condition assessment results and added another extent of condition related corrective action to perform a detailed DBD Test Acceptance Criteria drawing (TAC) review and development effort. These additional extent of condition and cause related corrective actions, along with those previously addressed in Supplemental Inspection Report 05000269,270,287/2003008, were considered to be appropriately focused based on the inspectors' independent extent of condition review.

Although corrective actions appeared to be appropriately prioritized and tracked, the inspectors questioned the scheduled completion end date of December 2006 for the licensee's detailed review of 46 QA-1 risk significant calculations. These calculations, like inadequate pressurizer heater calculation OSC-3144, were apparently screened out and not reviewed under the 1998 Enforcement related (EA 98-268) "Calculation Enhancement Project". Consequently, the scheduled calculation review end date did not seem reasonable. The licensee subsequently developed an additional corrective action to implement and complete an expert panel "input/methodology" screening review of the 46 calculations by November 30, 2004. Overall, corrective actions related to the White SSF pressurizer heater finding adequately addressed compliance restoration and the identified apparent cause and causal factors; this determination of adequacy was made in conjunction with the findings in Special Inspection Report 05000269,270,287/2002008 and those subsequently added "extent of condition" related corrective actions mentioned above. Accordingly, the White SSF pressurizer heater finding (including associated violation 05000269,270,287/2003012-01 and licensee event report 50-269/2002-001) is considered closed.

The following items were assessed as being indicative of a lack of thoroughness in the licensee's corrective action process for the White findings and the Degraded Mitigating Systems Cornerstone: (1) the initial inadequate extent of condition review for the White HPI pump cable connector finding; (2) the lack of an appropriate extent of condition and cause review for the White SSF pressurizer heater finding and the Degraded Mitigating Systems Cornerstone; (3) the initial lack of a combined risk analysis for the two White findings; (4) the failure to properly evaluate and establish timely corrective actions to the 2002/03 Calculation Enhancement Project self-assessment; and (5) the failure to establish a means to determine corrective action effectiveness prior to the 95002 supplemental inspection.

A. Inspector Identified and Self-Revealing Findings

No findings of significance were identified.

B. Licensee Identified Violations

None.

Report Details

01 Inspection Scope

This 95002 supplemental inspection was performed by the NRC in response to Oconee Unit 3 third quarter 2003 performance being in the Degraded Cornerstone Column of the NRC's Action Matrix as a result of: (1) a fourth quarter 2002 White finding involving the inadequate installation of electrical connectors on the pre-staged Unit 3 high pressure injection (HPI) pump emergency power supply cable from the auxiliary service water (ASW) switchgear; and (2) a third quarter 2003 White finding involving pressurizer ambient heat losses (in all three Units) that exceeded the capacity of pressurizer heaters powered from the standby shutdown facility (SSF). Related to the Mitigating Systems Cornerstone in the Reactor Safety Strategic Performance Area, these two performance issues were previously described in NRC "Final Significance Determination" letters dated February 7, 2003 (NRC Inspection Report 05000269,270, 287/2003007), and December 30, 2003 (NRC Inspection Report 05000269,270,287/ 2003012), respectively. This 95002 supplemental inspection involved a review of the licensee's problem identification, root cause and extent of condition evaluation, corrective actions, and an NRC independent extent of condition review for both White findings. The White HPI pump cable connector finding was previously evaluated and closed in the 95001 Supplemental Inspection Report 05000269,270,287/ 2003008. As such, with the exception of NRC's independent extent of condition review, the assessment results of this earlier 95001 supplemental inspection were utilized in the 95002 supplemental inspection of these two White findings and the associated Degraded Mitigating Systems Cornerstone.

The inspectors assessed the adequacy of the licensee's root cause evaluation by determining if the root causes and contributing causes were understood, and if the resulting corrective actions were sufficient to address those causes in order to prevent recurrence. As noted above, Supplemental Inspection Report 05000269,270,287/ 2003008 was utilized/referenced in the assessment of the White HPI pump cable connector finding. The assessment of the White SSF pressurizer heater finding included: (1) a review of the licensee's Level II assessment documented in Problem Investigation Process report (PIP) O-02-01066, its associated corrective actions, and other related/referenced documents; and (2) interviews with key personnel on the licensee's assessment team, as well as from the licensee's engineering, corrective action and design basis groups. Recognizing that both White findings concerned unique system functions associated with Oconee's mitigation strategies to certain events (i.e., station blackout, fire, flood, etc..), the NRC's independent extent of condition review focused on other unique Oconee system functions that may not be getting verified, maintained, tested, etc.. commensurate with their safety significance. For both White issues and the resultant Degraded Mitigating Systems Cornerstone, a comparison was made of the NRC's independent extent of condition determination with that of the licensee's.

02 Evaluation of Inspection Requirements

02.01 Problem Identification

a. Determination of who (i.e., licensee, self-revealing, or NRC) identified the issues and under what conditions

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - On May 30, 2002, during performance of work order (WO) 98271062 to repair a broken pull ring on the Unit 3 HPI pump motor emergency power supply cable “black” (z phase) connector, the cable socket terminal became separated from the Elastimold elbow. Additional investigation by maintenance personnel revealed that the “red” (x phase) connector was also loose in the elbow. This self-revealing issue was documented in PIP O-02-02972, which was initially screened as an action category 3; but, subsequently re-screened as a category 2.

(2) SSF Pressurizer Heater Issue

On March 7, 2002, during testing development, the licensee identified that the pressurizer ambient heat losses were greater than the capacity of the SSF-powered pressurizer heaters (126 kW) based on calculated heat losses. As determined by calculation, the losses were 143 kW for Unit 1, 149 kW for Unit 2, and 178 kW for Unit 3. These values were significantly greater than the assumed 70 kW ambient heat loss in the original design basis documents, indicating that insufficient SSF pressurizer heater capacity was available to maintain a pressurizer steam bubble during events where the SSF is used to achieve safe shutdown. Without a steam bubble to maintain primary system pressure, reactor coolant system (RCS) subcooling would be jeopardized, and single phase RCS natural circulation would be interrupted due to voiding in the hot leg. Decay heat would then challenge the pressurizer safety valves (PSVs). If a PSV failed to reseat, core damage could result since the SSF standby makeup pump could not make up for the loss in RCS inventory. Consequently, the SSF ASW function (i.e., removal of reactor decay heat via the steam generators) was declared inoperable. The licensee subsequently developed a strategy for operating the pressurizer in a water solid condition. The licensee considered this modified operating strategy a temporary compensatory measure for a degraded or nonconforming condition. This strategy, which was assessed by an NRC Special Inspection Team (Inspection Report 05000269,270,287/2002008), remained in place for the SSF until long-term corrective actions (i.e., modification to provide additional SSF powered pressurizer heaters) were taken to restore the SSF design basis. The licensee captured this issue in their corrective action program under PIP O-02-01066, and reported it in licensee event report (LER) 50-269/2002-001. It was determined that prompt actions had not been taken to resolve the concern of pressurizer heater capacity and RCS pressure control, since the issue was identified first in 1996 and again in 1999. Accordingly, the NRC Final Significance Determination letter dated December 30, 2003, identified this issue as a White finding with an associated violation of 10 CFR 50, Appendix B, Criteria XVI, Corrective Action.

b. Determination of how long the issues existed, and prior opportunities for identification

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - It was concluded that the non-conforming condition for the black phase connector occurred sometime after periodic testing on April 2000, and existed until repairs were performed by WO 98271062 on June 4, 2002.

(2) SSF Pressurizer Heater Issue

This degraded condition existed from the time the SSF was put into service in 1983 until it was discovered in March 2002, despite numerous opportunities to identify the issue. Beginning with pre-operational testing in 1972, the licensee identified that pressurizer ambient heat loss (with spray flow isolated) was greater than anticipated (i.e., between 102 kW and 119 kW versus the Babcox & Wilcox calculated value of 61.9 kW) and that gaps in insulation seams allowed air flow underneath the insulation. Another identified source of probable heat loss was those portions of the pressurizer vent line which remained uninsulated. These insulation deficiencies resulted in the inability to control RCS pressure with one group of heaters (126 kW). Apparently, instead of resolving the insulation deficiencies, an additional 42 kW of heater capacity was energized to compensate for the excess heat loss.

During the design phase of the SSF, which began in 1977, the licensee established that only one group of heaters (126 kW) was required to account for ambient heat loss and maintain RCS pressure. The licensee later justified the single heater group by indicating that the worst case ambient losses from the pressurizer would be 70 kW. In response to NRC questions in 1988, Calculation OSC-3144, Pressurizer Heat Loss, was generated to determine the amount of ambient losses from the pressurizer. This calculation estimated ambient heat losses at 67.9 kW and was used as the Bases for Technical Specification (TS) 3.10.1. This TS Bases required powering 5 of the 9 Bank 2, Group B heaters from the SSF. The licensee's Level II assessment identified several non-conservatisms that affected Calculation OSC-3144, including: (1) failure to address heat losses via condensation in the vent line returning to the pressurizer; (2) underestimating the amount of non-insulated area; (3) treating the heater covers as if they were insulated; and (4) assuming no conductive heat losses from the heater leads.

Other missed identification opportunities disclosed by the licensee's Level II assessment included:

- Crystal River TS Change: In 1992, Crystal River changed their pressurizer TS required "heater capacity from an emergency power supply" from 126 kW to 252 kW, and began doing pressurizer ambient heat loss verifications every refueling outage. Apparently, the issue was never communicated to the Babcock & Wilcox Owner's Group; therefore, Oconee was unaware of this change and an opportunity to identify the issue was missed in 1992.

- Test Matrices: This Engineering initiative began in 1995 to provide a test matrix that linked "shall" requirements in design basis documents (DBDs) to calculations and testing that validated the requirements. This initiative was not completed for several mechanical system DBDs, of which the RCS was one. Consequently, an opportunity to identify the need to test pressurizer ambient heat losses was missed.

- Related PIPs: Numerous PIPs (many “action category 4" from 1996 on) related to pressurizer heater banks being unable to control at setpoint, as well as equipment problems (like pressurizer spray valve leakage) were closed to work orders and modification requests without the underlying problem of insulation deficiencies ever actually being recognized/resolved. Consequently, the overall effect was an increase, over time, in the number of pressurizer heaters (kW) required to maintain equilibrium conditions in the pressurizer.

c. Determination of the plant-specific risk consequences (as applicable) and compliance concerns associated with the issues

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - The licensee and the NRC were in general agreement that the change in core damage frequency (CDF) for the HPI pump cable connector issue was in the White band, with the numerical quantification at approximately 4E-6.

(2) SSF Pressurizer Heater Issue

The licensee documented their risk characterization of the undersized SSF pressurizer heater finding in Severe Accident Analysis Report SAAG #737, Analysis of Inadequate Pressurizer Heaters. This report provided a numerical delta CDF of approximately 7E-7. This differed by a factor of ten from the NRC’s analysis and was consistent with the licensee’s written response dated December 1, 2003, to the NRC’s "Preliminary White Finding Choice Letter" dated August 7, 2003. In their written response, the licensee also indicated that an extensive effort was undertaken to predict operator action and plant response for a scenario where pressurizer ambient heat losses were greater than SSF-powered pressurizer heater capacity. However, because of the complex and varied scenarios involved, the licensee chose not to expend the significant resources necessary to establish, with certainty, the risk significance of this issue. The written response further highlighted two areas believed to be overly conservative in the NRC’s risk analysis. The first area involved PSV modeling uncertainties, and the other was related to the initiating event frequencies associated with a seismic event and with a fire. However, the primary reason for the different numerical results was from PSV failure modeling. When performing the SAAG #737 analysis, the licensee used a lower failure probability for a PSV failing to re-close and an additional uncertainty term that was not used in the NRC analysis. As indicated in NRC’s "Final Significance Determination Letter" dated December 30, 2003, the NRC considered the information provided by the licensee on the preliminary risk analysis and, using the best information available, reached a different conclusion. Therefore, the final risk significance of the inspection finding was characterized as White [>1E-6].

(3) Combined Risk

During the original preparation for this inspection, the inspectors identified to the licensee that no combined risk analysis had been performed. Subsequently, SAAG #737, Revision 1, was issued on July 15, 2004, documenting a collective risk evaluation. The analysis concluded that for the period of time that both findings co-existed, the delta CDF was additive. The inspectors performed an independent assessment as to the probabilistic risk assessment (PRA) collective significance of the two findings using the licensee's full scope PRA model, Revision 2. This review indicated that the risk increases were additive, since no valid accident sequence included the SSF and the HPI pump powered from the ASW switchgear. Therefore, the NRC and the licensee agreed upon the additive nature of the risk increases due to the two findings. With recognized uncertainties, the licensee determined the total delta CDF for the combination of both conditions to be approximately 6.3E-6 and the NRC determined it to be approximately 1.6E-5 (i.e., still within the degraded cornerstone column of the NRC's Action Matrix.)

d. Assessment

As indicated in Supplemental Inspection Report 05000269,270,287/2003008, the licensee initially regarded the HPI pump cable connector deficiency with low safety significance as indicated by the category 3 designation on the associated PIP. Subsequently, the PIP for this issue was appropriately designated as Category 2. It was concluded that the final risk significance of the inspection finding was appropriately characterized as White.

With respect to the SSF pressurizer heater issue, the inspectors determined that the licensee's problem identification efforts effectively addressed: who and under what conditions it was identified; how long it existed; prior identification opportunities; and compliance concerns.

The inspectors viewed the initial lack of a combined risk analysis for the two White findings to be indicative of a lack of thoroughness in the licensee's corrective actions for the Degraded Mitigating Systems Cornerstone. Once completed, however, there was agreement between the NRC and the licensee as to the additive nature of the risk increases due to the two White findings.

02.02 Root Cause and Extent of Condition Evaluation

a. Evaluation of methods used to identify root causes and contributing causes

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - The licensee's root cause analysis (documented in Root Cause Failure Analysis Report, Unit 3 HPI Pump ASW Power Cable Connector Failure, Revision 0) concluded that inadvertent manipulation caused the z-phase (black) Elastimold 151LR connector to became loosened and subsequently disconnected after performance testing in April 2000.

(2) SSF Pressurizer Heater Issue

Due to the historical nature of this event, the licensee did not conduct a root cause/extent of condition evaluation for the SSF pressurizer heater White finding. Instead, a Level II assessment was performed and documented in “action category 1" PIP O-02-01066. [NSD 208 typically requires an “action category 1" PIP to have a root cause analysis and extent of condition evaluation; but, permits the performance of an assessment or common cause in lieu of a root cause for some issues Management deems appropriate.] The Level II assessment reviewed various aspects of the event, including investigating the historical information available on the issue of pressurizer heat loss versus heat capacity, and identifying the factors that contributed to the event. The licensee’s assessment finding indicated that the design control measures associated with the SSF function to maintain single phase natural circulation flow were inadequate, in that:

- Some original assumptions and calculation details in OSC-3144, were inadequate, and the 67.87 kW result was non-conservative.

- Original design deficiencies existed (i.e., inability to control RCS pressure at setpoint with the first group of heaters, excessive heat loss through original insulation never adequately resolved, and unaccounted for heat losses via an uninsulated vent line).

- SSF pressurizer heater Bases for TS 3.10.1 (70 kW) didn’t reflect pre-operational test results (102 kW - 119 kW).

- Various design documents (DBDs), engineering processes (modifications), and corrective action documents (PIPs) failed to identify the importance of pressurizer insulation to SSF operability.

As such, the licensee determined that the apparent cause for the SSF pressurizer heater White finding was a fundamental lack of appreciation for the potential impact of pressurizer insulation deficiencies. The following causal factors were also identified: (1) the SSF design basis for pressurizer heaters to support natural circulation cooling was inadequate (this includes calculation OSC-3144); (2) the potential impact of pressurizer heat loss on natural circulation, and therefore SSF operability, was not well recognized or generally understood by site personnel; and (3) there were several missed opportunities to identify pressurizer insulation deficiencies.

b. Level of detail of the root cause evaluation

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - The licensee’s root cause analysis for the HPI pump cable connector issue was performed to a level of depth which provided reasonable assurance that the root cause and contributing causes would be identified.

(2) SSF Pressurizer Heater Issue

The licensee's Level II assessment of the SSF pressurizer heater issue was conducted per NSD 607, Self Assessments, and included: (1) development of a sequence of events related to the pressurizer ambient heat loss and heater issues leading up to the SSF inoperability; (2) review of the Probabilistic Risk Assessment (PRA) group's evaluation of the significance of the event; (3) independent determination of the adequacy of calculation OSC-3144; (4) assessment of the contributing factors associated with inadequate SSF-powered pressurizer heater capacity; (5) assessment of the contributing factors associated with failure to recognize inadequate SSF-powered pressurizer heater capacity prior to March 2002; and (6) a look for similar industry experience in this area. Performed by a five person team (consisting of the General Office Nuclear Performance Assessment Section manager, the Catawba RCS system engineer, the Oconee SSF system engineer, a senior PRA Group engineer, and an Oconee Safety Review Group root cause specialist) the licensee's Level II assessment was considered by the inspectors to be reasonably independent, thorough, and consistent with the prescribed charter. However, the inspectors noted that the licensee had not performed a root cause and extent of condition review of the potential broader implications of the "action category 1" Level II assessment finding relative to the inadequate design control measures evidenced through the events surrounding inadequate pressurizer heater calculation OSC-3144. This was considered to be indicative of a lack of thoroughness in the licensee's corrective action process. Additional discussion of this observation is provided in Sections 02.02d.(2) and 02.04.

c. Consideration of prior occurrences of the problem and knowledge of prior operating experience

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - The licensee performed an operating experience data base and PIP search for the HPI pump cable connector issue to see if similar problems had previously been identified in connection with Elastimold 151LR connector failures. No earlier failures were identified based on this search.

(2) SSF Pressurizer Heater Issue

The licensee's Level II assessment reviewed numerous PIPs and prior industry experience related to pressurizer heat loss testing and insulation. The review provided industry experience on Three Mile Island, Arkansas Nuclear Entergy Operations, and Crystal River. As indicated previously in Section 02.01b.(2) above, the Level II assessment identified various PIPs (from 1996 on) and the Crystal River pressurizer heater capacity TS change in 1992 as missed opportunities to identify the issue. Although the Level II assessment did consider prior occurrences and operating experience from a material condition degradation standpoint, it failed to consider past calculation inadequacies as discussed in Section 02.02d.(2) below.

d. Consideration of potential common causes and extent of condition of the problem

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - The potential common cause failure mechanism associated with the Elastimold 151LR connectors was adequately addressed. The licensee concluded that the design of this connector makes it susceptible to the failure identified with the z-phase (black) connector (i.e., inadvertent loosening by hand manipulations). Performed by completing an "Operability and Transportability " review, the licensee's extent of condition for the non-conforming cable connector identified that Elastimold 151LR connectors were used on the normal power supply cables for Units 1, 2, and 3 HPI "A" and "B" pump motors and on the portable chillers. However, the NRC identified that the licensee's review failed to identify that the same connectors existed on the other end of Unit 3 HPI pump emergency feeder cable located within the auxiliary service water switchgear enclosure.

(2) SSF Pressurizer Heater Issue/Degraded Mitigating Systems Cornerstone

Sections 02.02a.(2) and 02.02b.(2) above discuss in detail licensee management's initial decision not to perform a root cause/extent of condition review for the original "action category 1" SSF pressurizer heater issue or the associated "action category 1" assessment finding. However, with respect to the degraded mitigating systems cornerstone, the licensee did perform a commonality review of the White SSF pressurizer heater finding and the White HPI pump cable connector finding. Documented under corrective action #67 in PIP O-02-01066, the commonality review consisted of a search of the licensee's corrective action data base for deficiencies resulting from equipment failures and unplanned TS entries during the preceding 2 year period. The review focused on systems/components unique to Oconee, and looked for any common causes or contributing factors that were apparent between the search items and the two White findings. It concluded that there were very few human performance issues noted as a result of the problem search and that many of the problems noted were identified as a result of questions that go beyond the normal day to day operation of the station. The inspectors found that while a few issues/events assessed by the commonality review were described by these conclusions, the vast majority of the identified issues/events had some component of human error and would be best characterized as self-revealing. The licensee did note in their conclusions that: some problems were more basic to the programs required to maintain high confidence in equipment reliability; that the noted problems crossed boundaries such as configuration control, design basis understanding, and maintenance practices; and that some actions have been taken and/or are being considered to improve system reliability, reduce operator burden, and remove non-conforming items. Identified examples included the performance of: an SSF reliability/availability assessment (PIP O-03-03281); an Oconee design vulnerability assessment (PIP O-04-04733); and an SSF risk reduction study planned later this year.

The inspectors determined that the licensee's commonality review was a compilation of previously identified Oconee "unique system" issues that did not possess the attributes of an extent of condition and cause review. Specifically, the licensee did not consider

the identified cross boundary problem areas of the previous "unique system" issues and the White findings (e.g., design basis measures, equipment maintenance practices, etc.) and determine whether there are similar problems in other areas/unique systems of the plant that have not yet been identified. As a result of not performing an appropriate extent of condition and cause review, the original 95002 supplemental inspection was postponed and rescheduled to allow the licensee to develop a more comprehensive extent of condition and cause assessment.

Subsequent to the 95002 supplemental inspection postponement, the following extent of condition related corrective actions were added to associated PIP O-02-01066:

- Development/Review of DBD Test Matrices - Recognizing that the RCS DBD described the design basis requirements for the SSF pressurizer heaters, the licensee's Level II assessment team concluded that the lack of testing to validate the required number of pressurizer heaters would have been apparent had a Test Matrix been added to the DBD. The licensee initially elected not to act on the Level II assessment team's recommendation for improvement in this area. However, corrective actions were subsequently identified after the 95002 supplemental inspection postponement to develop a corresponding Test Matrix for those seven mechanical system QA-1 DBDs that didn't have one (i.e., RCS, component cooling system, feedwater system, gaseous waste disposal system, instrument air system, liquid waste disposal system, and low pressure injection & core flood systems). Additional corrective actions were also identified to conduct reviews of exiting test matrices with respect to Maintenance Rule High Safety Significant functions. By the time the onsite 95002 supplemental inspection began, the licensee had completed its review of existing mechanical and electrical test matrices for the SSF. The inspectors independent extent of condition review (Section 02.04) identified that the completed SSF review effort had failed to identify that the accredited cooling fans in the SSF control room electrical cabinets had not been addressed in the SSF electrical test matrices; and, like the pressurizer heaters, had no DBD Test Acceptance Criteria drawings (TACs). Consequently, a corrective action was established for a detailed TAC review and development effort.

- Calculation Assessment/Review - During the 4th quarter 2002 through the 1st quarter 2003, the licensee conducted a self-assessment of the Calculation Enhancement Project. The self-assessment identified 46 additional QA-1 risk significant calculations that were not reviewed under the Calculation Enhancement Project or other review efforts. Prior to August 2004, the corrective actions to this self-assessment were to revise the screening criteria for what calculations would be periodically reviewed under Engineering Directive Manual (EDM) 201, Engineering Support Program, by the end of the 3rd quarter 2004. Such a periodic review generally involves four to six calculations/system by the applicable system engineer annually.

  Following a review of this self-assessment (captured in PIP O-03-02784) and interviewing personnel involved in the Calculation Enhancement Project, the inspectors determined that:

- The self-assessment of the Calculation Enhancement Project was performed to verify that the 1998 Enforcement Action [EA 98-268] commitment to identify, control, and maintain Oconee specific calculation inputs had been satisfied. Implemented under corrective action #9 of PIP O-98-00707, the Calculation Enhancement Project was one of numerous corrective actions stemming from the 1998 identification of inadequate calculations related to borated water storage tank (BWST) level swapover to the containment sump. In 2000, another inadequate calculation was identified dealing with the spent fuel pool as the suction source for the HPI pump(s). This finding, coupled with another finding in 2001, caused the licensee to initiate PIP O-01-02791 for a Degraded Mitigating Systems Cornerstone under the Reactor Oversight Process. It was corrective action #19 of this PIP that partially resulted in the performance of the licensee's self-assessment of the Calculation Enhancement Project.

- This 2002/03 self-assessment identified that the existence of a small number of remaining calculations was the exception to meeting the original scope of the Calculation Enhancement Project. Therefore, the actions indicated during the June 22, 1998, BWST Enforcement Conference to establish the scope (population) of those risk significant QA-1 calculations to be enhanced by December 31, 1998, had not been fully accomplished. The self-assessment report did not identify this shortfall as a finding (i.e., meeting NSD 208 action category criteria 1 or 2) or deviation (i.e., meeting NSD 208 action category criteria 3 of 4) as defined in section 607.5, Terms and Conditions, of NSD 607. Based upon the category definition examples of Appendix C in NSD 208, at least a category 3 categorization and an apparent cause analysis of this shortfall would have been appropriate. As of the onsite 95002 supplemental inspection, there was no discrete date to complete the review/revision of the 46 QA-1 risk significant calculations, although the intent of corrective action #11 to PIP O-98-00707 was for the revision of all outstanding calculations and completing the Calculation Enhancement Project by December 31, 2004.

- While the 46 calculations would be reviewed under EDM 201, the review would have allowed engineers to review calculations which they previously prepared or revised. This is different than the method used to review calculations under the Calculation Enhancement Project.

- The analysis section of associated PIP O-03-02784 dealing with when and how to review these calculations, did not consider the complete history of inadequate calculations at Oconee. For example, calculation OSC-3144 had been previously identified as being inadequate and communicated as such to the engineering staff prior to the self-assessment. Consequently, it was screened out in the self-assessment and its implications of inadequacy were not factored into the decision as to when to perform an adequacy review of the remaining calculations.

– Since an extent of condition review explicit to inadequate pressurizer heater calculation OSC-3144 was not originally performed under PIP O-02-01066 or its associated "category 1" Level II assessment finding, the licensee could not explain why calculation OSC-3144 had not been reviewed and identified as deficient under any of the calculation upgrade programs, particularly under the Calculation Enhancement Project. After the postponement of the 95002 supplemental inspection, the licensee initiated corrective action #83 to PIP O-02-1066 to determine why OSC-3144 was not identified as inadequate by the Calculation Enhancement Project. The licensee initially indicated (as documented in corrective action #83) that the computerized listing of calculations did not indicate calculation OSC-3144 as QA-1. However, the inspectors determined that the calculation was annotated as QA-1 and was part of the original population of QA-1 calculations to be considered for the next screening filter of risk-significant. Consequently, after additional review, the licensee determined that the calculation had been excluded due to low risk significance.

– Since an extent of condition review explicit to inadequate calculation OSC-3144 was not performed (prior to the preparation for the 95002 supplemental inspection or in the ensuing 13 weeks the inspection was postponed), the licensee did not:

(i) couple the 46 unreviewed calculations of the 2002/2003 self-assessment as being part of the scope of an extent of condition review for the undersized Pressurizer heater finding;

(ii) recognize that the 46 unreviewed calculations of the 2002/2003 self-assessment had not been annotated as a finding/deviation in the self-assessment report; and

(iii) challenge the decision to allow the calculations to remain unreviewed for an extended period of time.

In response to the inspectors observations while onsite, the licensee revised PIP O-03-02784 to include the establishment of an expert panel to review the calculations for obvious latent safety significant issues and operability concerns, as well as inappropriate design inputs, assumptions, and methodology. The expert panel efforts were targeted to be completed by November 30, 2004. If not flagged by the expert panel, the calculations are to be reviewed in detail by December 2006.

• Long-term/Unexplained Conditions Assessment - A 2003 cross functional Oconee team assessment (PIP O-03-7080, SOER 02-04 Recommendation 3) was subsequently identified after the 95002 supplemental inspection postponement to address whether similar situations exist where actions to correct safety-significant issues have been inappropriately delayed. The in-depth assessment focused on abnormal plant conditions that were not well-understood, as well as long-standing plant issues that remained unresolved or

whose ultimate resolution appeared to be untimely. Corrective actions were created for the Plant Health Committee (PHC) to evaluate and resolve the identified areas for improvement (i.e., inadequate feedwater suction piping restraint, Unit 1 reactor coolant pump seal performance concerns, possible containment liner degradation between the gaps of installed equipment and the liner plates, and timeliness concerns in reviewing safety system piping stress analysis calculations). A corrective action was also created for the PHC to consider a process for future identification and oversight of similar abnormal plant conditions/indications that cannot be readily explained.

e. Assessment

[From Supplemental Inspection Report 05000269,270,287/2003008] - The licensee's root cause evaluation review for the White HPI pump cable connector finding was adequate; however, the extent of condition review failed to identify all applicable applications of connectors that may be vulnerable to the same failure mechanism. (This was subsequently addressed satisfactorily; but, was considered by the inspectors of the 95002 supplemental inspection to be indicative of a lack of thoroughness in the licensee's corrective action process for the White HPI pump cable connector finding.)

Performed in lieu of a root cause and extent of condition evaluation under the management discretionary allowance of NSD 208, the licensee's Level II assessment of the SSF pressurizer heater issue was considered by the inspectors to be relatively independent, thorough, and consistent with the prescribed charter. However, the inspectors noted that the licensee had not performed a root cause and extent of condition review of the potential broader implications of the "action category 1" Level II assessment finding relative to the inadequate design control measures evidenced by the events surrounding inadequate pressurizer heater calculation OSC-3144. In addition, the inspectors determined that the licensee's commonality review to address the Degraded Mitigating Systems Cornerstone, was a compilation of previously identified Oconee "unique system" issues that did not posses the attributes of an extent of condition and cause review. Specifically, the licensee did not consider the identified cross boundary problem areas of the previous "unique system" issues and the White findings (e.g., design basis measures, equipment maintenance practices, etc.) and determine whether there are similar problems in other areas/unique systems of the plant that have not yet been identified. As a result of not performing an appropriate extent of condition and cause review, the 95002 supplemental inspection was postponed and rescheduled to allow the licensee to develop a more comprehensive extent of condition and cause assessment. This lack of thoroughness in the licensee's corrective action process limited their response to the White SSF pressurizer heater finding and the Degraded Mitigating Systems Cornerstone.

The licensee's 2002/03 self-assessment of the Enforcement related (EA 98-268) Calculation Enhancement Project was effective in identifying 46 additional QA-1 risk significant calculations that had not been reviewed; thereby, revealing the failure to establish the scope (population) of those risk significant QA-1 calculations to be enhanced by December 31, 1998. Based upon NSD 208, identification of this shortfall as a "category 1 or 2" finding (with a root cause/extent of condition review) or at least a "category 3" deviation (with an apparent cause analysis) would have been appropriate;

however, the licensee's self-assessment did neither. Consequently the licensee did not factor the implications of inadequate pressurizer heater calculation OSC-3144 into the decision as to when to perform an adequacy review of the 46 remaining calculations. This was indicative of a lack of establishing appropriate corrective actions. The subsequent creation of an additional corrective action to implement and complete an expert panel "input/ methodology" screening review of the 46 calculations by November 30, 2004, was considered appropriate to support not completing the detailed calculation reviews until December 2006.

The inspectors' independent extent of condition review (Section 02.04) identified that the completed review of SSF mechanical and electrical DBD test matrices did not identify that the accredited cooling fans in the SSF control room electrical cabinets had not been addressed; and, like the pressurizer heaters, had no TAC. This was indicative of a lack of thoroughness in the licensee's extent of condition review effort. The subsequent establishment of a corrective action for the performance of a detailed TAC review and development effort was considered by the inspectors to be appropriate.

The licensee's extent of condition/cause related efforts, specifically those that were completed/addressed in Supplemental Inspection Report 05000269,270,287/2003008 and those subsequently established as corrective actions after postponement of the 95002 supplemental inspection (i.e., DBD test matrix development and review, detailed TAC review and development, calculation reviews [expert panel and final], and long-term/unexplained conditions assessment), were considered to be appropriately focused with respect to the Degraded Mitigating Systems Cornerstone. This was confirmed by the inspectors' independent extent of condition review discussed in Section 02.04.

02.03 Corrective Actions

a. Appropriateness of corrective actions

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - The inspector reviewed all completed and pending corrective actions related to this finding and considered them to be appropriate. Several Category 3 PIPs were reviewed that concerned recurring performance problems encountered during removal and reinstallation of HPI pump motors. The problems were not related to the Elastimold connectors, but dealt with the motor lead terminal connections and stripping of the threads on the high voltage bushing stud when disconnecting the motor leads.

(2) SSF Pressurizer Heater Issue

The licensee's corrective actions for the SSF pressurizer heater issue were captured in PIP O-02-01066. The immediate corrective actions included declaration of the SSF ASW system inoperable (since the heaters are a recognized support system) and entry into TS 3.10.1.

To restore the SSF to an "operable but degraded condition" and exit associated TS 3.10.1, the licensee developed a strategy for operating the SSF with the pressurizer in a

water solid condition. This temporary compensatory measure included the incorporation of procedural guidance into abnormal procedure AP/0/A/1700/025, Standby Shutdown Facility Emergency Operating Procedure, for maintaining stable Mode 3 conditions with the RCS water solid following an SSF event. NRC Special Inspection Report 05000269,270,287/2002008 documented the NRC's assessment of the "operable but degraded condition" of the SSF with the temporary compensatory measure in place. This Special Inspection reviewed the applicable changes made in Revision 21 to AP/0/A/1700/025, associated operator training (including simulator performance), and the RETRAN computer analysis used to support the new guidance. In addition, Selected Licensee Commitment (SLC) 16.5.8a was created as an interim administrative action to provide more restrictive requirements related to pressurizer heater capacity (powered from an emergency power supply) pending revision of TS 3.4.9, Reactor Coolant System. This SLC included surveillances to verify the required heater capacity is maintained (378 kW [versus 125 kW] every 18 months]. Procedures IP/0/B/0200/037, Pressurizer Heater Test and Surveillance, and IP/0/B/0200/037B, Pressurizer Heater Control Circiut Test, were also revised to reflect the new surveillance requirement. Additionally, operating procedures OP/0/A/1102/025, Cooldown Following Major Site Damage, and OP/0/A/1102/024, Plant Assessment and Alignment Following Major Site Damage, were revised to recognize solid plant cooldown.

As previously discussed in Section 02.02a.(2), the licensee determined that the apparent cause for the SSF pressurizer heater White finding was a fundamental lack of appreciation for the potential impact of pressurizer insulation deficiencies. Corrective actions to address this apparent cause, including the two Corrective Actions to Prevent Recurrence *[CAPR]*, are grouped below by the three licensee identified causal factors:

(i) The SSF design basis for pressurizer heaters to support natural circulation cooling was inadequate.

Corrective actions taken/planned to address this included: revising/improving calculation OSC-3144, Pressurizer Heat Loss; assessing/reviewing risk significant calculations that, like calculation OSC-3144, had not been reviewed under the "Calculation Enhancement Project" or other review efforts...(this includes the establishment and performance of a expert panel pre-review screening); implementing modification NSM ON-53110 to provide additional SSF powered pressurizer heaters; revising calculation OSC-5093, SSF Electrical Distribution System Load Flow, Voltage Adequacy and Fault Study, to determine kW per heater delivered for NSM 53110; completing a previous Oconee initiative to develop DBD test matrices for seven remaining mechanical systems, and review those test matrices already completed to ensure all Maintenance Rule High Safety Significant functions have been captured; clarifying system engineer ownership of the SSF functional requirements to maintain RCS natural circulation, and relocating the SSF system engineer to the Primary Systems section to allow better communication and coordination of issues that have the potential to affect SSF natural circulation; revising the RCS DBD to reflect a minimum of 400 kW of operable pressurizer heaters capable of being powered from an emergency supply; revising the Design Events DBD to reflect operator time critical actions; revising the SSF ASW DBD and calculation OSC-4171, SSF ASW Design Inputs Calculation, to reflect decrease in RCS pressure to support

solid plant operations from the SSF; revising the SSF Reactor Coolant Makeup Pump DBD and calculation OSC-5372, Maximum Allowed Reactor Coolant Pump Seal Leakage Rate & Maximum Allowed Total Combined RCS Leakage Rate for SSF Reactor Coolant Makeup System Operability, to reflect the maximum leak rate for solid plant cool down of the RCS; and reviewing existing/developing new TACs.

(ii) The potential impact of pressurizer heat loss on natural circulation, and therefore system operability, was not well recognized or generally understood by site personnel.

Corrective actions taken/planned to address this included: developing enhanced periodic test procedure IP/0/B/0200/037C, Pressurizer Ambient Heat Loss Test, which is to be performed following each unit startup *[CAPR]*; revising TS 3.4.9, Reactor Coolant System, and Updated Final Safety Analysis Report Section 5.4.6.2 to change the minimum pressurizer heater capacity when powered from an emergency power supply from 126 kW to 400 kW; revising TS 3.10.1 Bases, Standby Shutdown Facility, to reflect (by Unit and pressurizer out-leakage) the newly calculated numbers of operable pressurizer heaters required for SSF operability; replacing the pressurizer spray line bypass valve in all three units to support leak rate testing of the pressurizer spray valve and better ambient heat loss determination.

(iii) There were several missed opportunities to identify pressurizer insulation deficiencies.

Corrective actions taken/planned to address this included: performing visual and thermal imaging examinations of the insulation; completing work orders for insulation repairs and replacements; initiating additional work orders for insulation walkdowns every refueling outage to document all missing and/or damaged insulation and for infrared inspections every third outage *[CAPR]*; initiating minor modifications to improve pressurizer mirror insulation in all three Units [OE-18343 (Unit 1), OE-18283 (Unit 2), OE 18342 (Unit 3)]; providing training to Engineering personnel to raise awareness of the importance of challenging original design assumptions and calculations when assessing and evaluating structure, system, and component operability; communicating lessons learned with respect to pressurizer ambient losses via INPO OE Notice 13613; addressing the existence of long-term/similar situations where actions to correct safety-significant issues were inappropriately delayed; and establishing a PHC process for future identification and oversight of similar abnormal plant conditions/indications that cannot be readily explained.

As depicted above, the inspectors reviewed all 104 corrective actions in associated PIP O-02-01066, as well as those generated as a direct result of the 95002 supplemental inspection. Completed actions were verified to have been performed as indicated. Overall, corrective actions were considered to have adequately addressed compliance restoration as well as the identified apparent cause and causal factors. This determination of adequacy was made in conjunction with the findings in Special Inspection Report 05000269,270,287/2002008, and was greatly dependant on the

subsequent addition of a detailed TAC review and development effort, as well as other appropriate "extent of condition" related corrective actions such as the calculation reviews and the test matrix development and review effort.

b. Prioritization of corrective actions

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - It was concluded that the licensee's corrective actions were properly prioritized to address the risk for the White finding after associated PIP O-02-02972 was re-screened from action Category 3 to action Category 2.

(2) SSF Pressurizer Heater Issue

The inspectors determined that corrective actions were appropriately prioritized with consideration of risk significance of the issue and/or regulatory compliance. Corrective action assignment of responsible work group/organization and priority code appeared appropriate to facilitate timely performance that is commensurate with importance.

c. Establishment of schedule for implementing and completing the corrective actions

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - The inspector verified that the licensee's corrective action program identified assigned individuals, completion dates, and reference numbers to facilitate adequate tracking of corrective actions to ensure the corrective actions would be completed commensurate with the assigned priority code.

(2) SSF Pressurizer Heater Issue

Upon reviewing both completed and planned corrective actions, which were formally tracked in associated PIPs, the inspectors expressed concern over the scheduled completion end date for the licensee's detailed review of 46 QA-1 risk significant calculations. The licensee subsequently developed an additional corrective action to implement and complete an expert panel "input/methodology" screening review of the 46 calculations by November 30, 2004. (See Section 02.02d.(2) under "Calculation Assessment/Review" for more details.)

d. Establishment of quantitative or qualitative measures of success for determining the effectiveness of the corrective actions to prevent recurrence

(1) HPI Pump Cable Connector Issue

[From Supplemental Inspection Report 05000269,270,287/2003008] - The effectiveness of the corrective action to prevent recurrence for the inadequately installed HPI pump emergency power supply cable connectors will be trended/evaluated under the provisions of the licensee's corrective action program.

(2) SSF Pressurizer Heater Issue

Due to the large number of corrective actions in PIP O-02-01066, the licensee indicated that an individual would be assigned to oversee the implementation and closure of its corrective actions. However, it was not apparent to the inspectors that measures were taken to assure that the associated corrective actions would be effective in preventing recurrence. The licensee acknowledged this observation and generated corrective action #103 in PIP O-02-01066 to perform a Level II assessment to validate the effectiveness of the overall corrective action plan.

e. Assessment

[From Supplemental Inspection Report 05000269,270,287/2003008] - Corrective actions implemented by the licensee were adequate to resolve the deficiencies associated with the White HPI pump cable connector finding. The priority given to the corrective actions was appropriate, based on the final significance (Category 2 PIP) that the licensee assigned to this problem. Continuing problems with HPI pump motor lead terminations (not related to Elastimold connectors) highlighted a weakness in the corrective action program to effectively resolve recurring problems. The White mitigating systems finding [including associated violation (VIO) 05000287/2003007-01] is closed based on objective evidence reviewed by the inspector.

Overall, corrective actions related to the White SSF pressurizer heater finding were considered to have adequately addressed compliance restoration and the identified apparent cause/causal factors. This determination of adequacy was made in conjunction with the findings in Special Inspection Report 05000269,270,287/2002008, and was greatly dependant on the subsequent addition of a detailed TAC review and development effort and other appropriate “extent of condition” related corrective actions such as the calculation reviews and the test matrix development and review effort. Although corrective actions appeared to be appropriately prioritized, assigned and formally tracked, the inspectors expressed concern over the scheduled completion end date (December 2006) for the licensee’s detailed review of 46 QA-1 risk significant calculations. The licensee subsequently developed an additional corrective action to implement and complete an expert panel “input/methodology” screening review of the 46 calculations by November 30, 2004. Accordingly, the White SSF pressurizer heater finding (including associated VIO 05000269,270,287/2003012-01 and LER 50-269/2002-001) is considered closed.

Due to the large number of corrective actions associated with the White SSF pressurizer heater finding, the licensee indicated that they would be overseen by an individual and a Level II assessment would be performed to validate overall corrective action effectiveness. Both of these planned actions were considered appropriate; but, the failure to establish a means to determine corrective action effectiveness prior to the 95002 supplemental inspection was viewed to be indicative of a lack of thoroughness in the licensee’s corrective action process, which had limited their response to the White SSF pressurizer heater finding.

02.04 Independent Assessment of Extent of Condition and Generic Implications

The inspectors performed an independent assessment of the licensee's conclusions with respect to the extent of condition and cause for the White HPI cable connector finding and the White SSF pressurizer heater finding. In their commonality review, the licensee indicated that some problems were more basic to the programs required to maintain high confidence in equipment reliability and cut across boundaries such as configuration control, design basis understanding, and maintenance practices. The inspectors also recognized that these problems concerned the unique system functions/components associated with Oconee's mitigation strategies to certain events (i.e. station blackout, fire, flood, etc.). As a result, this independent assessment sampled other unique system functions/components through a review of: design bases, calculations, maintenance history, operating history, test results, and PIPs. The unique system functions/components assessed, included: the SSF heating ventilation and air conditioning (HVAC) system; SSF reactor coolant makeup (RCMU) pump suction stabilizer and pulsation dampener; the RCMU pump discharge relief valve; the spent fuel pool (as a suction source for the SSF RCMU pump); valve 0CCW-384 (which diverts the SSF diesel generator cooling water return from the condenser circulating water header to the storm drain to prevent excessive heatup of the SSF ASW supply); Cutler Hammer control switches used for SSF functions; and the SSF ASW pump suction air ejector. In addition, the RCS DBD was reviewed for Test Acceptance Criteria drawings (TACs) and a random sample of category 4 PIPs were reviewed for proper prioritization.

Independent Assessment Results

- Multiple omissions or errors existed in the TACs. As indicated in EDM 170, Design Specifications, A TAC specifies the design criteria, test objectives, operability requirements, testing frequencies, and the test acceptance criteria for any tested safety-related structure, system, or component. The identified TAC related deficiencies are as follows:

  – With respect to the SSF ASW pump suction air ejector, the test procedure acceptance criteria for volumetric flow rate was more conservative than that specified in the TAC. This was due to the fact that the flow rotometer used for the measurements is not optimized for the range of flow that is expected (0-24 scfm range for an acceptable flow of 1.69 scfm). The conservatism in the acceptance criteria gives additional margin for measurement uncertainty. The inspectors also noted that the test procedure used a barometric pressure reading from the plant operator aid computer to correct an absolute pressure acceptance criteria to an equivalent gauge reading. The TAC did not include the uncertainty error for this measured parameter into the acceptance criteria.

    The licensee generated PIP O-04-05306 to document this discrepancy and performed an operability assessment to address any current operabilty implications. The licensee determined that the additional uncertainty added by the barometric pressure reading was bounded by

the actual vacuum pressure established by the testing personnel; therefore, operability was maintained.

– Even though the SSF HVAC system consisted of three loops (i.e., air flow, Freon, and service water), only one equipment TAC, associated with SSF service water, existed for the SSF HVAC system. Furthermore, a system TAC had not been generated for the design basis function to maintain general area temperatures within acceptable limits in the SSF to prevent equipment failures. In response to these two TAC omissions, the licensee generated PIP O-04-05236 and corrective action #104 to PIP O-02-01066, respectively.

– A TAC had not been generated specific to SSF Cabinet Cooling Fans IC1A, IC1B, IC2A, IC2B, and MECA in the SSF control room. To address this specific issue, the licensee generated PIP O-04-05211.

– No TAC (system or equipment) existed in the DBD for the RCS. Also, no equipment TAC existed for the pressurizer heaters in any of the SSF DBDs. Therefore, the pressurizer heaters are not captured under any DBD TAC.

- The Test Matrix (i.e., Appendix B to a DBD) was not required in any administrative control document. Therefore, there was no programmatic requirement to produce the Test Matrix.

- The Test Matrix and the actual test/surveillance procedures associated with SSF HVAC functions contained omissions. Neither document type included testing the SSF Cabinet Cooling Fans, confirmation that the actual ambient temperatures within numerous compartments of the SSF were within design limits, or confirmation that the temperature within the SSF cabinets were within design limits.

- Based upon interviews, the licensee had identified the need to improve SSF ventilation performance monitoring and was targeting Fall 2004 to complete a computer calculation for postulated heat up rates.

- The material condition of the SSF HVAC indicated that the system was meeting its intended function.

- No mis-classifications of Category 4 PIPs were identified from the random sampling.

- With respect of the valve 0CCW-384, it was a time critical manually operated valve with a bonnet relief path to mitigate pressure locking. The operability evaluation showed that this valve ultimately would have been able to perform its design function. This condition was identified by the licensee's effort to review all safety significant manual active valves to ensure they were sized and tested to meet their design basis functions.

Comparison with Licensee's Efforts

The licensee's initial Level II assessment of the White pressurizer heater finding under PIP O-02-01066 failed to identify the aforementioned omissions in the TACs. Also, the extent of condition related review of the SSF DBDs (added to PIP O-02-01066 after the 95002 special inspection postponement and completed prior to the inspection team's arrival in August 2004) did not identify the TAC omissions or the Test Matrix/test procedure omissions associated with the accredited SSF cabinet cooling fans. Because of the inconsistent use of TACs identified by the inspectors, the licensee generated an extent of condition and cause related action under PIP O-04-05206 for a detailed TAC review and development effort. With the inclusion of this detailed TAC review, the licensee's subsequently added extent of condition and cause related efforts (discussed in Section 02.02d.(2)) appear to be appropriately focused with respect to the Mitigating Systems Cornerstone.

03 Exit Meeting

The inspectors presented the inspection results to Mr. Ron Jones, Oconee Site Vice President, and other members of licensee management at the conclusion of the inspection on August 12, 2004. The licensee acknowledged the findings presented. The inspectors asked the licensee whether any of the material examined during the inspection should be considered proprietary. No proprietary information was identified.

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee

K. Anderson, Emergency Feedwater System Engineer
G. Armentrout, Civil Engineering
L. Azzarello, Modifications Engineering Manager
S. Batson, Mechanical/Civil Engineering Manager
E. Burchfield, Previous Design Bases Engineering Manager
R. Burley, HVAC System Engineer
N. Clarkson, Regulatory Compliance
G. Davenport, Regulatory Compliance Manager
K. Grayson, Standby Shutdown Facility System Engineer
T. Harbinson, Component Engineering
R. Harris, Maintenance Rule Coordinator
T. Hathcock, Project Management Group
L. Keller, Regulatory Compliance Manager - Catawba
P. Mabry, Mechanical/Civil Engineering
R. Matheson, Safety Review Group
R. McCoy, Design Bases Engineering
S. Nader, PRA Group Corporate Engineering
L. Nicholson, Safety Assurance Manager
J. Robertson, Design Bases Engineering
J. Smith, Regulatory Compliance
P. Stovall, Safety Review Group Manager
J. Weast, Regulatory Compliance

NRC

L. Wert, Deputy Director, Division of Reactor Projects

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None

Previous Items Closed

05000269,270,287/2003012-01	VIO	Failure to Promptly Identify and Correct Insufficient SSF Pressurizer Heater Capacity (Section 02.03e.)

50-269/2002-001	LER	Pressurizer Heat Loss Exceeds SSF Powered Heater Capacity (Section 02.03e.)

Discussed

None

DOCUMENTS REVIEWED

Drawings

OFD-133A-2.5, Condenser Circulating Water System (SSF Auxiliary Service), Rev. 40

ONTC-0-101A-0001, Test Acceptance Criteria for SSF RC Makeup Suction Stabilizer Bladder Precharge Pressure Test, Rev. 0

ONTC-0-101A-0002, Test Acceptance Criteria for SSF RC Makeup Pulsation Dampener Bladder Precharge Pressure Test, Rev. 1

ONTC-0-133A-0002, Test Acceptance Criteria for SSF HVAC Service Water System Performance Test, Rev. 0

ONTC-2-133A-0004, Test Acceptance Criteria for SSF ASW Suction Pipe Air Ejector Test, Rev. 1

Technical Specifications

TS 3.4.9 and Bases, Pressurizer

TS 3.10.1 and Bases, Standby Shutdown Facility

Updated Final Safety Analysis Report

Section 5.4.6, Pressurizer

SLC 16.5.8a, Pressurizer Heaters

Minor Modifications

ONOE-16899, Install and Terminate Cable 2XSF101A in Unit 2 Reactor Building for Unit 2 Pressurizer Heater Upgrade

ONOE-16929, Install and Terminate Cable 2XSF101A in Unit 2 Reactor Building for Unit 2 Pressurizer Heater Upgrade, Rev. 0

ONOE-16930, Install and Terminate Cable 3XSF101A in Unit 3 Reactor Building for Unit 3 Pressurizer Heater Upgrade, 10/10/02

ONOE-18123, SSF ASW DBD, OSS-0254.00-00-1005, Revision to Reflect New Guidance to Support Solid Plant Operations from the SSF, 12/01/03

ONOE-18283, Replace Damaged and Missing Metal Reflective Insulation with New Pieces of Insulation, 05/06/04

ONOE-18267, RC Makeup System DBD Revision to Reflect Maximum Allowed Total Combined RCS Leakage Rate Required for a Water Solid Cooldown of the RCS, 02/24/04

ONOE-18308, Revise Appendix C of the Design Basis Events DBD to Include Time Critical Action for the SSF Pressurizer Heaters, 03/11/04

ONOE-18420, RCS DBD Revision to Include Changes to Pressurizer Heaters, 05/24/04

Modifications

NSM ON-53110, Additional Pressurizer Heaters Powered/Controlled from SSF, Rev. 5

Work Orders

94065722, 93065869, 94059581 - PM Replace RCMU Pump Accumulator Bladders

94065735, 94065750, 93065874, 94059608, 94059853, 95054314 - Check Precharge Pressures on RCMU Pump Bladders

97055054, Install Filter Assemblies for SFP Emergency Makeup Filter Unit

98006594, 98489521, 98493470 - Inspect and Repair Pressurizer Insulation, 12/29/01, 04/18/03, 06/02/03

98392876, Replace New Mirror Insulation on Pressurizer, 11/18/03

98484020, 98485529, 98485530 - Infrared Inspection of Pressurizer, 03/25/03, 10/14/03, 04/27/04

98492947, Pressurizer Heat Loss Test per TT/1/A/0/251/099, 04/29/02

98493580, 98493583 - Post Outage Infrared Inspection of Pressurizer, 11/2/03, 06/09/03

98529514, 98529515 - 3RC-2 Determine As Found Position, 05/09/04, 02/18/04

98540458, 98540462, 98540460, 98567156, 98606628, 98633458 - Pressurizer Heater Ambient Loss Test

98574154, 98574165, 98574167, 98574171, 98574177, 98574179 - Infrared Inspection of U1, U2, U3 Pressurizer

98669756, Spent Fuel Filter Removal and Replacement

Procedures

AM/0/A/3009/012 A, Emergency Plan for Refilling Spent Fuel Pools, Rev. 2

AP/0/A/1700/025, Standby Shutdown Facility Emergency Operating Procedure, Rev. 26

IP/0/B/0200/037, Pressurizer Heater Test and Surveillance, Rev. 54

IP/0/B/0200/037B, Pressurizer Heater Control Circuit Test, Rev. 1

IP/0/B/0200/037C, Pressurizer Ambient Heat Loss Test, Rev. 1

MP/0/A/1200/010A, Relief Valve Set Pressure Testing and Adjustment, Enclosure 13.7, 1,2,3 HP-404 Relief Valve Test Data Sheet, Rev. 12

MP/0/A/1800/097, Accumulator Data Sheet, Rev. 9

OP/0/A/1102/024, Plant Assessment and Alignment Following Major Site Damage, Rev. 25

OP/0/A/1102/025, Cooldown Following Major Site Damage, Rev. 16

OP/0/A/1108/001, Curves and General Information, Rev. 56

OP/1/A/1103/002, Filling and Venting RCS, Rev. 80

OP/1/A/1502/007, Operations Defueling/Refueling Responsibilities, Rev. 72

OP/2/A/1102/020D, SSF and Outside Rounds, Rev. 13

OP/3/A/1103/002, Filling and Venting RCS, Rev. 62

PT/0/A/0400/005, Standby Shutdown Facility Auxiliary Service Water Test, Rev. 43

PT/0/A/0400/006, SSF HVAC Serice Water Pump Test, Rev. 26

PT/O/A/0400/016, SSF HVAC System Flow Test, Rev. 7

PT/1/A/0400/007, Standby Shutdown Facility Reactor Coolant Makeup Pump Test, Rev. 37

PT/1/A/0400/010, Standby Shutdown Facility RC Makeup System Check Valve Stroke Test, Rev. 22

PT/1/A/0600/001, Periodic Instrument Surveillance, Rev. 258

RP/0/B/1000/019, Technical Support Center Emergency Coordination Procedure, Rev. 16

TN/5/A/3110/AL1, Unit 1, 2, and 3 Pressurizer Heater Group C Removal from Plant Power to SSF Power, Rev. 0

TT/1/A/0251/099, Unit 1 Pressurizer Ambient Loss Test, Rev. 0

PIPs

G-01-00077, PIP numbers are Not Being Recorded on Work Requests for Cross Reference Purposes

O-98-00707, Error in Assumed Elevation of Borated Water Storage Tank Level Indicators

O-99-00902, Evaluation of Manual Active Valves

O-00-04054, SSF HVAC Chiller Capacity is Based on an Unchecked/Unverified Fax from the Chiller Manufacturer

O-01-00433, Failed Switch for 3HP-426

O-01-02791, Oconee Nuclear Station Degraded Mitigating Systems Cornerstone Stemming from HPI/SFP Calculation Inaccuracies & the Inability to Place the Auxiliary Service Water Pump into Service within 40 Minutes as Required by the Safety Analysis

O-01-03115, SSF A/C unit Compressor #1 Condenser Pressure Found to Exceed Surveillance Upper Limit

O-01-03689, AP/O/A/1700/25 Requires Operators to Have a Portable Spot Cooler Installed if SSF Control Room exceeds 85°F...No Accurate Temperature Measurement Exists

O-02-01066, Pressurizer Ambient Heat Losses are Greater than Calculated in OSC-3144, Impacting SSF ASW System Operability (T.S. 3.10.1) and T.S. 3.4.9 (Pressurizer)

O-02-03414, Refrigerant Charge Lost on Air Handling Unit 0-42

O-02-03416, BTO 97 did not Provide Electrical Isolation for Air Handling Unit 0-42

O-02-04678, Level II Assessment to Identify Additional Initiatives to Meet the Objective to Improve Design Basis of the Plant

O-02-04679, Risk Significant Issues Exist That Are Not Captured by Existing Processes for Minimizing Unavailability of Risk Significant Items

O-03-00835, Calculation Impact Assessment Evaluation Performed During the Revision of Calculation OSC-5501

O-03-02120, EFW Steam Traps Out of Service

O-03-02784, DBG Level II Self Assessment of the Calculation Enhancement Project

O-03-03134, Air Handling being Removed from Service During Electrical Testing

O-03-03281, Document SSF Unavailability Reduction Efforts Assessment

O-03-04092, Seismic Fragility of Main Feeder Bus Relays

O-03-04275, GO-03-44 (NPA) (SOER 02-04) - Safety Culture Assessment

O-03-05188, 1CCW-268 Failed to Remain Closed While Stroke Testing

O-03-06871, #1 HVAC Compressor Discharge Pressure is Low

O-03-07080, SOER 02-04 Recommendation 3 Assessment Report

O-04-01846, Valve 0CCW-384 Pressure Locking Concerns

O-04-02523, SSF Cutler Hammer Switches Maintenance Rule A1

O-04-02623, Valve 0CCW-101 May Require Excessive Rim Pull to Open the Valve

O-04-03487, Decision by SA Management Not Perform Formal Root Cause Analysis Not Properly Documented in PIP 02-1066

O-04-04733, Level 2 Assessment from Regulatory Brainstorming Workshop

O-04-04780, Level 1 Assessment of the Effectiveness of Corrective Actions in PIP O-02-01066 and PIP O-02-02972

Calculations

OSC-0619, Analysis for Use of Spent Fuel Pool Inventory for Standby Shutdown Facility, Rev. 19

OSC-2030, Standby Shutdown Facility HVAC Load Calculations, Rev. 11

OSC-2304, SSF Service Water Suction Air Ejector Calculations, Rev. 1

OSC-3144, Pressurizer Heat Loss, Rev. 4

OSC-3477, SSF HVAC Service Water System Calculation, Rev. 5

OSC-4171, SSF ASW Design Inputs Calculation, Sections 5.1, 5.13, 9.2, Rev. 25

OSC-4998, Units 1 and 2 Spent Fuel Pool Heatup Rate Calculations, Rev. 9

OSC-5093, Appendix 8, Study to Evaluate NSM-53110/00/00/00 Pressurizer Heater Load Additions to the SSF, Rev. 9

OSC-5372, Maximum Allowed RC Pump Seal Leakage Rate & Maximum Allowed Total Combined RCS Leakage Rate for SSF RC Makeup System Operability, Rev. 18

OSC-6007, SSF RC Makeup Suction and Pulsation Dampener Bladder Precharge Pressure and SSF RC Makeup Pump NPSHA, Rev. 4

OSC-6051, Verification of Alternate Method Used to Fill Spent Fuel Pools Following Operation of SSF RC Makeup System, Rev. 5

OSC-8585, Past Operability Evaluation for 0CCW-384 due to Pressure Locking Concerns, Rev. 0

Nuclear System Directives

NSD 208, Problem Investigation Process, Rev. 26

NSD 210, Corrective Action Program, Rev. 4

NSD 212, Cause Analysis, Rev. 14

NSD 607, Self Assessments, Rev. 8

Engineering Directive Manuals

EDM 170, Design Specifications, Revision 11, dated 6/24/04

EDM 201, Engineering Support Program

EDM 601, Appendix K, Engineering Review Screen for Design Changes

Work Process Manuals

WPM 401, Problem Communication Guidelines, Rev. 7

WPM 500, Planning, Rev. 16

Miscellaneous

Calculation Enhancement Report, Assessment Number 2DBG03001 dated 3/11/03

Continuing Engineering Training Handout, Pressurizer Heat Loss Case Study, 10/2/02

Design Basis Specification for the Standby Shutdown Facility HVAC System, OSS-0254.00-00-1009, Revision 7

Lesson Plan, NSD 203 - Operability, Rev. 0

MARF 378, Replacement of SSF Control Room Analog Gauges With Digital Gauges, 07/14/03

Severe Accident Analysis Report, SAAG File 737, Analysis of Inadequate Pressurizer Heaters Powered by ONS SSF, Revision 1

PIPs Generated During Inspection

G-04-00294, Inappropriate Closure of CA #9 in PIP G-01-00077 (Corrective Action Closure to Lower Tier Programs)

O-02-01066, Pressurizer Ambient Heat Losses Greater than Calculated, CAs #103 (Assessment of CA Effectiveness) and #104 (SSF Operator Rounds)

O-03-02784, DBG Level II Self Assessment of the Calculation Enhancement Project, CA #s 3, 4, 5, 6, 7, 8, 9, and 10 (Calculation Expert Panel Review)

O-04-02995, Oconee Not Fully Prepared for 95002 NRC Inspection on SSF Pressurizer Ambient Heat Loss and HPI Emergency Power Cable

O-04-05192, Paper Copy of Calculation OSC-4171 Rev. 25 Did Not Contain Changes Made by Rev. 24

O-04-05206, Inconsistent Use/Creation of Test Acceptance Criteria Drawings Required to Support Testing Activities

O-04-05211, SSF Cabinet Cooling Fans Credited for Turbine Building Flooding Event but Not Tested or Observed on Operations Rounds

O-04-05236, SSF HVAC System DBD May Need Additional TACs

O-04-05306, Instrument Uncertainty Associated with the Barometric Pressure Measurement (A1008) Input is Not Included in the Performance Test Acceptance Criteria for the SSF Service Water System Air Ejector

LIST OF ACRONYMS

ASW	-	Auxiliary Service Water
BWST	-	Borated Water Storage Tank
CA	-	Corrective Action
CDF	-	Core Damage Frequency
DBD	-	Design Bases Document
EA	-	Enforcement Action
EDM	-	Engineering Directive Manual
HPI	-	High Pressure Injection
HVAC	-	Heating Ventilation and Air Conditioning
kW	-	kilo-Watts
LER	-	Licensee Event Report
NSD	-	Nuclear System Directive
PHC	-	Plant Health Committee
PIP	-	Problem Investigation Process (report)
PRA	-	Probabilistic Risk Assessment
PSV	-	Pressurizer Safety Valve

RCS	-	Reactor Coolant System
SCFM	-	Standard Cubic Feet per Minute
SLC	-	Selected Licensee Commitment
SSF	-	Standby Shutdown Facility
TAC	-	Test Acceptance Criteria (drawing)
TS	-	Technical Specification
VIO	-	Violation
WO	-	Work Order