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

October 12, 2007

EA-06-199
EA-06-294

Duke Power Company LLC
d/b/a Duke Energy Carolinas, LLC
ATTN: Mr. Bruce H. Hamilton
Site Vice President
Oconee Nuclear Station
7800 Rochester Highway
Seneca, SC 29672

SUBJECT: OCONEE NUCLEAR STATION - NRC SUPPLEMENTAL INSPECTION REPORT 05000269/2007009, 05000270/2007009, AND 05000287/2007009

Dear Mr. Hamilton:

On August 31, 2007, the NRC completed a supplemental inspection pursuant to Inspection Procedure 95002, "Inspection for one Degraded Cornerstone or any Three White Inputs in a Strategic Performance Area," at your Oconee Nuclear Station. The enclosed report documents the inspection findings which were discussed on that date with you and other members of your staff.

This supplemental inspection was an examination of your problem identification, root cause evaluation, extent of condition/cause determinations, and corrective actions associated with a third quarter 2006 Mitigating Systems White finding, a fourth quarter 2006 Mitigating Systems White performance indicator (PI), and a fourth quarter 2006 Mitigating Systems White finding. The third quarter 2006 White finding and the fourth quarter 2006 White PI placed the performance of all three Oconee Units in the Degraded Cornerstone Column of the NRC's Action Matrix from the fourth quarter 2006 through the third quarter 2007. The White PI (Emergency AC Power System) was the result of an extended forced outage on Keowee Hydroelectric Unit 2. The third quarter 2006 White finding involved the failure to effectively control maintenance activities, which resulted in a breach of the standby shutdown facility (SSF) external flood protection barrier. The fourth quarter 2006 White finding, which involved the failure to implement adequate foreign material exclusion controls for the Unit 3 reactor building emergency sump (RBES), also contributed to the Degraded Cornerstone performance of Oconee Unit 3. Accordingly, this supplemental inspection also included an independent extent of condition and extent of cause review, as well as an independent safety culture assessment, of the issues related to the White findings, the White PI, and the resultant Degraded Mitigating Systems Cornerstone.

Based on the results of this inspection, no findings of significance were identified. The NRC determined that your corrective actions (both planned and completed) are appropriate to resolve the deficiencies related to the Degraded Mitigating Systems Cornerstone. As such, the

inspection objectives of Inspection Procedure 95002 have been satisfied. Therefore, the SSF flood barrier breach White finding (including associated violation 05000269,270,287/2006017-01) and the Unit 3 RBES foreign material White finding (including associated violation 05000287/2007006-01 and licensee event report 50-269/2006-03) are considered closed. However, it is important to note that NRC's independent extent of condition/cause reviews identified issues and relevant information that were either not originally included or properly assessed in your extent of condition/cause evaluations for each of the White findings, as well as the White PI. In addition, the inspectors considered that one of your planned corrective actions related to the SSF flood barrier breach White finding is crucial to your staff fully understanding the issues related to the finding. Some of the more significant planned corrective actions related to these observations include: (1) an independent assessment by Duke's Safety Review Group of mitigating system flow paths which could be potentially vulnerable to "legacy" foreign material; (2) a review to assess the apparent lack of timeliness to resolve passive civil features (PCF) issues and the delayed implementation of a PCF control program; and (3) a review of the Oconee Nuclear Station Keowee Reliability Analysis to determine if any issues exist that were not identified in the original scope of your extent of condition/cause determination for the White PI. Accordingly, it is requested that you be prepared to discuss these specific corrective actions in the upcoming Regulatory Performance Meeting.

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 Harold Christensen Acting For/

Charles A. Casto, 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 05000269/2007009,05000270/2007009
05000287/2007009 w/Attachment: Supplemental Information

cc w\encl: (See page 3)

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cc w\encl: (See page 3)

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cc w/encl:
B. G. Davenport
Compliance Manager (ONS)
Duke Power Company LLC
d/b/a Duke Energy Carolinas, LLC
Electronic Mail Distribution

Lisa F. Vaughn
Associate General Counsel
and Managing Attorney
Duke Energy Corporation
526 South Church Street-EC 07H
Charlotte, NC 28202

Kathryn B. Nolan
Senior Counsel
Duke Energy Corporation
526 South Church Street -EC07H
Charlotte, NC 28202

David A. Repka
Winston & Strawn LLP
Electronic Mail Distribution

Beverly Hall, Chief Radiation
Protection Section
N. C. Department of Environmental
Health & Natural Resources
Electronic Mail Distribution

Henry J. Porter, Assistant 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

Lyle Graber, LIS
NUS Corporation
Electronic Mail Distribution

R. L. Gill, Jr., Manager
Nuclear Regulatory Issues
and Industry Affairs
Duke Power Company LLC.
d/b/a Duke Energy Carolinas, LLC
526 S. Church Street
Charlotte, NC 28201-0006

Charles Brinkman
Director, Washington Operations
Westinghouse Electric Company
12300 Twinbrook Parkway, Suite 330
Rockville, MD 20852

Letter to Bruce H. Hamilton from Charles A. Casto, dated October 12, 2007

SUBJECT: OCONEE NUCLEAR STATION - NRC SUPPLEMENTAL INSPECTION REPORT 05000269/2007009, 05000270/2007009, AND 05000287/2007009

Distribution w/encl:
L. Olshan, NRR
C. Evans, RII
L. Slack, RII
OE Mail
RIDSNRRDIRS
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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:	05000269/2007009, 05000270/2007009, 05000287/2007009
Licensee:	Duke Power Company LLC
Facility:	Oconee Nuclear Station, Units 1, 2, and 3
Location:	7800 Rochester Highway Seneca, SC 29672
Dates:	August 27 - 31, 2007
Inspectors:	R. Haag, Branch Chief (Team Leader) W. Rogers, Senior Reactor Analyst R. Carroll, Senior Project Engineer A. Hutto, Resident Inspector - Oconee M. Riches, Reactor Inspector (training) J. Helm, Reactor Inspector (training)
Approved by:	C. Casto, Director Division of Reactor Projects

Enclosure

SUMMARY OF FINDINGS

IR 05000269/2007009, 05000270/2007009, 05000287/2007009; 08/27 - 31/2007; Oconee Nuclear Station; Supplemental Inspection for Degraded Mitigating Systems Cornerstone.

This inspection was conducted by a branch chief, a senior reactor analyst, a senior project engineer, a resident inspector and two reactor inspectors (in training). No findings of significance were identified. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 4, dated December 2006.

Cornerstone: Mitigating Systems

This supplemental inspection was performed by the NRC to assess the licensee's problem identification, root cause evaluation, extent of condition and extent of cause determinations, and corrective actions associated with a third quarter 2006 Mitigating Systems White finding, a fourth quarter 2006 Mitigating Systems White performance indicator (PI), and a fourth quarter 2006 Mitigating Systems White finding. The third quarter 2006 White finding and the fourth quarter 2006 White PI placed the performance of all three Oconee Units in the Degraded Cornerstone Column of the NRC's Action Matrix from the fourth quarter 2006 through the third quarter 2007. The White PI (Emergency AC Power System) was the result of an extended forced outage on Keowee Hydroelectric Unit (KHU) 2. The third quarter 2006 White finding involved the failure to effectively control maintenance activities, which resulted in a breach of the standby shutdown facility (SSF) external flood protection barrier. The fourth quarter 2006 White finding, which involved the failure to implement adequate foreign material exclusion (FME) controls for the Unit 3 reactor building emergency sump (RBES) also contributed to the Degraded Cornerstone performance of Oconee Unit 3. The performance issues associated with the SSF flood barrier breach finding and the Unit 3 RBES foreign material finding were previously characterized as having low to moderate risk significance (White). The PI was characterized as White in the licensee's fourth quarter PI data submittal, dated January 17, 2007; the two findings were characterized as such in NRC "Final Significance Determination" letters dated November 22, 2006, and February 13, 2007, respectively.

This supplemental inspection, which was performed in accordance with Inspection Procedure 95002, "Inspection for One Degraded Cornerstone or Any Three White Inputs in a Strategic Performance Area," also included an independent extent of condition and extent of cause review, as well as an independent safety culture assessment, of the issues related to the White findings, the White PI, and the resultant Degraded Mitigating Systems Cornerstone. The combined assessment of these issues is summarized below.

While the licensee's problem identification efforts for both White findings and the event that lead to the White PI are credited for identifying the relevant issues, the inspectors noted that for both White findings, sufficient information was available for earlier identification and correction of the problems. By the end of the inspection, the licensee's root cause evaluations and extent of condition/cause reviews for both White findings and the White PI were considered adequate. This was premised on the satisfactory resolution of issues and relevant information (identified during the NRC's independent extent of condition/cause reviews) that were either not originally included or properly addressed in the licensee's extent of condition/cause evaluations. For example, the inspectors identified additional event mitigating systems that are potentially vulnerable to "legacy" foreign material due to their low and/or no flow conditions, which were not initially included in the system flow paths to undergo FME-related inspections/flushes. With respect to the SSF flood barrier breach White finding, the licensee's extent of condition/cause

review did not assess the Maintenance Rule Expert Panel downgrading of risk for a portion of the barrier for possible broader implications. In addition, the initial extent of condition review for other SSF flooding paths was determined to be insufficient. Furthermore, the inspectors also found that the licensee had not factored equipment failures identified in the Keowee Reliability Analysis into their extent of condition/cause reviews while investigating past failures of Keowee. This was important to determine if other latent uncorrected problems similar to the pole jumper cracking existed.

With the exception of the inadequate interim corrective actions that had been implemented while a new passive civil features (PCF) control program was being developed, the inspectors determined the corrective actions taken and/or planned for both White findings and the White PI were acceptable. Corrective actions addressed the root and contributing causes, and were prioritized commensurate with the risk significance of the corresponding problems. Of special note, is the planned timeliness review of the various programs under which the Hazard Barrier/ PCF program was being tracked. This review is considered to be crucial in fully understanding the issues related to the uncontrolled SSF PCF. The licensee's root cause evaluations properly considered safety culture when reviewing both White findings and the White PI. Safety culture components that significantly contributed to the issues were identified. Corrective actions that have already been implemented or those that are planned, adequately address the safety culture consideration identified in these evaluations.

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 the performance of all three Oconee Units being in the Degraded Cornerstone Column of the NRC's Action Matrix from the fourth quarter 2006 through the third quarter 2007. Inclusive of the Mitigating Systems Cornerstone within the Reactor Safety Strategic Performance Area, this degraded performance was reflective of: (1) a fourth quarter 2006 White finding involving the failure to implement adequate FME controls for the Unit 3 RBES; (2) a third quarter 2006 White finding involving the failure to effectively control maintenance activities, which resulted in a breach of the SSF external flood protection barrier; and (3) a fourth quarter 2006 emergency AC (EAC) power system White PI resulting from the unavailability of KHU 2 due to an extended forced outage. The White Unit 3 RBES foreign material finding and the White SSF flood barrier breach finding were respectively identified in NRC "Final Significance Determination" letters dated November 22, 2006, and February 13, 2007. The White EAC power system PI was identified in the licensee's fourth quarter PI data submittal, dated January 17, 2007. This 95002 supplemental inspection involved a review of the licensee's problem identification, root cause, extent of condition/cause determinations, and corrective actions, as well as an NRC independent extent of condition/cause review and safety culture assessment, with respect to the White findings, the White PI, and the resultant Degraded Mitigating Systems Cornerstone.

The inspectors assessed the adequacy of the licensee's root cause evaluation for each of the three White performance issues by determining if the root cause(s) and contributing cause(s) were understood (for each individual issue and collectively), and if the resulting corrective actions were sufficient to address those causes in order to prevent recurrence. Each White performance issue assessment included: a review of the licensee's Root Cause Evaluation Report, related Problem Investigation Process reports (PIPs), associated corrective actions, and other related/referenced documents; interviews with key personnel that participated in the licensee's root cause evaluation, as well as from the licensee's Engineering, Operations, Maintenance, and Risk Assessment groups; and a comparison of the NRC's independent extent of condition/cause review and safety culture assessment with that of the licensee's. The scope of each NRC independent extent of condition/cause review and safety culture assessment are further detailed in Sections 02.04 and 02.05, respectively. All documents reviewed during this supplemental inspection are listed in the Attachment to this report.

02 Evaluation of Inspection Requirements

02.01 Problem Identification

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

(1) Unit 3 RBES Foreign Material

On April 30 and May 1, 2006, with Oconee Unit 3 in Mode 5 as part of its end-of-cycle (EOC) 22 refueling outage (RFO), the licensee conducted an as-found, foreign object search and retrieval (FOSAR) inspection of the A and B suction lines from the RBES to

the containment sump isolation valves (3LP-19 and 3LP-20) prior to installing a new, larger RBES. The FOSAR revealed a large flat washer (2.75 inches outside diameter and 1.125 inches inside diameter), a large cotter pin, a piece of wood (approximately 3 inches long), a piece of wire, small pieces of gasket material, and a metal disc (thought to be a penny) inside of the suction piping leading from the RBES to the 3A low pressure injection (LPI) and reactor building spray (RBS) pumps. Also revealed was a small nail, a large piece of thick wire (approximately 12 inches long and 0.1 inches thick), what appeared to be a 1/4-inch allen wrench (not found during debris removal), a couple of pieces of small, thin wire, and the head of an adjustable wrench (approximately 3 inches long, 3 inches wide and 0.75 inches thick) inside of the suction piping leading from the RBES to the 3B LPI and RBS pumps. This licensee-identified issue was captured and evaluated in their corrective action program under PIP O-06-02468. This information, along with the potential effects of the debris found during the FOSAR inspection of the RBES in Unit 2 (October 2005) and in Unit 1 (June 2006), was reported in licensee event report (LER) 50-269/2006-03, dated July 31, 2006.

(2) SSF Flood Barrier Breach

On August 13, 2003, an access plate on an exterior SSF wall was removed to allow routing of temporary power cables in support of SSF outage activities. The approximate 4"X7" opening that is normally covered by the access plate is located at about the 4.71 foot flood elevation. This opening is within the 5-foot SSF flood barrier that is credited in the Probabilistic Risk Assessment (PRA). The SSF flood barrier remained degraded until the access plate was reinstalled on August 3, 2005. A member of the Operations organization questioned whether the condition was acceptable and relayed the concern to the cognizant system engineer who contacted a member of the corporate PRA staff. After consulting the PRA model, the PRA staff member immediately recognized the ramifications and informed the system engineer. This issue was documented in the licensee's corrective action program as PIP O-05-4978. To fully understand the sequence of events for the breached flood barrier, the inspectors reviewed the licensee's root cause evaluation report for this issue, which is documented in PIP O-07-1662, the other PIPs referenced in the root cause evaluation report and held discussions with licensee personnel. The inspectors confirmed that the breach of this risk significant structure/flood barrier was identified by the licensee.

(3) EAC Power System Unavailability

The Mitigation System Performance Index (MSPI) for the EAC power system PI crossed the White threshold primarily due to unavailability incurred as a result of the KHU 2 emergency lockout that occurred due to a failed rotor pole jumper. This event occurred on September 23, 2006 and was self-revealing. The licensee appropriately accounted for and included the unplanned unavailability from this event in their MSPI data submittal and the index turned White for the fourth quarter 2006. Identification of the White PI was, therefore, identified by the licensee.

b. Determination of how long the issue(s) existed, and prior opportunities for identification

(1) Unit 3 RBES Foreign Material

Although it is not exactly known when the aforementioned foreign material entered into the RBES piping, it is certain that it was in the Unit 3 RBES piping for at least the duration of cycle 22 [December 24, 2004 (Mode 4 towards startup) through April 29, 2006 (Mode 5 for the EOC RFO)]. Based on observed degradation of the foreign material and inadequate foreign material work standards prior to 2004, the licensee concluded that the foreign material entered the Unit 3 RBES piping sometime between construction and September 2004; where it remained until being discovered on April 30 - May 1, 2006.

A missed identification opportunity disclosed by the licensee's root cause evaluation was the April 2002 operating experience (OE) report involving foreign material found in the Shearon Harris containment sump suction line to a residual heat removal pump. The licensee indicated that a review of this OE should have expedited an inspection of Oconee's RBES piping to ensure system reliability. In addition, it was also indicated that Duke failed to realize that the RBES modification provided access to previously un-inspected areas of the emergency core cooling system (ECCS) sump lines and that its experience at other Oconee units or other units of the Duke fleet may have been less relevant than industry experience involving construction debris found when opening ECCS suction lines. As such, the licensee concluded that a more thorough evaluation of Unit 2 sump debris (considered at the time to be an isolated case) and the industry OE could have led to more timely inspections of Units 1 and 3 RBESs and the identification of debris.

Based on a review of available foreign material exclusion (FME) related PIP trending data, the inspectors concluded that the number of identified FME "legacy" issues should have also prompted a more timely response in assessing the possibility and potential effects of debris in the RBESs, as well as in other similarly vulnerable (i.e., low, or no flow condition) risk significant systems. In support of this conclusion, the inspectors discovered that approximately one month prior to the discovery of the Unit 2 RBES debris in October 2005, an independent FME program assessment by Duke's Nuclear Assessments and Issues Division (NAID) recommended (in view of the continuing PIPs associated with legacy foreign material) an initiative to systematically search for and retrieve legacy foreign material. This NAID assessment (PIP O-05-06024) did not appear to be captured in the licensee's root cause evaluation.

(2) SSF Flood Barrier Breach

Based upon a review of the various PIPs associated with breached SSF flood barrier and interviews with licensee personnel, the inspectors confirmed that this condition existed for approximately two years (August 2003 - August 2005). During this period, there were three separate instances where the condition was noted and documented in PIPs O-05-1255, O-05-1082, and O-05-3820. However, in all three cases the condition was viewed as a housekeeping matter and not recognized as a breach of the SSF flood barrier. One of the PIPs was initiated by the SSF Risk Reduction Team, based on their observation of the access plate being removed and cables routed through the opening. It was a member of the operations staff that wrote one of the previous PIPs, and was

following up on the issue that was the impetus for recognizing the significance of the condition.

The inspectors concluded that the licensee had numerous opportunities to recognize the actual significance of the removed access plate and prevent this condition from existing for approximately two years. The SSF Risk Reduction Team was very knowledgeable of the SSF design features and the importance of flood protection, yet they failed to recognize the risk significance of this particular barrier breach. The lack of some key, valid information by many Oconee onsite personnel about the risk significance of SSF PCFs contributed to this lack of recognition.

(3) EAC Power System Unavailability

The unavailability accrued to KHU 2 and the overhead power path occurred from September 23, 2006, to October 19, 2006. This caused the EAC power system PI to turn White during the fourth quarter of 2006. There were no prior opportunities to identify this degraded condition.

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

(1) Unit 3 RBES Foreign Material

As noted in associated LER 50-269/2006-03, Duke's initial evaluation of the aforementioned Unit 3 RBES foreign material concluded that the crescent wrench jaw could have affected either the 3B LPI or RBS pump, and the washer could have only affected the 3A RBS pump (having inappropriately assumed the washer would pass through the 3A LPI pump). The NRC staff's initial analysis (included in NRC's "Preliminary Determination Letter" dated November 30, 2006) indicated that the foreign material/debris found in both RBES suction trains could move downstream during RBES recirculation modes for medium break and large break loss of coolant accident (LOCA) scenarios; thereby, potentially damaging the 3A and 3B LPI pumps and rendering them unable to perform their ECCS recirculation function. The NRC's initial calculated risk increase over the base case core damage frequency (CDF) was > 1E-5 but < 1E-4, without considering recovery with 3C LPI pump due to the uncertainty surrounding its viability in the deteriorative atmospheric conditions that would result from a possible seal failure on the LPI B pump in the same compartment.

The licensee (based on subsequent analysis and debris transport test simulation results) determined the CDF contribution to be 8.7 E-07/year and the large early release frequency impact to be < 8.7 E-09/year. As indicated in NRC's "Final Significance Determination Letter" dated February 13, 2007, after carefully considering the information developed during the inspection and the information presented by Duke at the regulatory conference, the NRC concluded that the change in CDF was < 1E-5/year but > 1E-6/year. Consequently, this issue was identified as a White Mitigating Systems finding/violation involving inadequate FME controls for the Unit 3 A and B RBES suction.

The inspectors reviewed the Unit 1 operational decision making assessment (documented in Unit 3 PIP O-06-02468) that was performed in light of the debris found during the pre-sump modification FOSAR inspections conducted in Unit 2 (October

2005) and Unit 3 (June 2006). Like Units 2 and 3, the Unit 1 pre-sump modification FOSAR was to be conducted during the upcoming RFO (EOC 23) that was scheduled for October 2006. It was determined that the licensee's decision to not wait for the Unit 1 EOC 23 RFO, but to shutdown Unit 1 on June 13, 2006, following the return of Unit 3, was appropriate. Similar to Unit 2, the debris found in Unit 1 was determined to only affect one ECCS train; resulting in it being identified as a Green (change in CDF < 1E-6) licensee identified violation.

(2) SSF Flood Barrier Breach

The inspectors considered the applicable accident sequences associated with the degraded SSF flood barrier and noted that the two other 95002 issues (i.e., Unit 3 RBES foreign material and EAC power unavailability) did not amplify the risk importance for the degraded SSF flood barrier. However, the licensee's extent of cause review included other previously identified vulnerabilities for the SSF 5-foot flood barrier. These vulnerabilities are discussed in Section 02.02d.(2). Considering this information and using the licensee's initiating event frequency and the estimated percentage of time the SSF 5-foot flood barrier would be impacted, the inspectors determined that the increase in CDF did not warrant a different regulatory response beyond the 95002 Supplemental Inspection. A more recent example of the licensee not controlling a PCF is discussed in Section 02.02b.(2) and referenced in PIP O-07-04694 (i.e., removal of auxiliary building flood protection curb.) This additional example of improper PCF controls did not increase the risk significance enough to warrant a different regulatory response.

With respect to compliance, the facility unknownly operated for an extended period of time without appropriately accounting for the risk increase while accomplishing other maintenance activities. The compliance concerns dealing with this issue stem around compliance with 10CFR50.65 requirements. This included establishing the appropriate risk significance for structures, systems, and components (SSCs); being able to sufficiently understand the risk significance of breaching/removing PCFs from service; and taking the required actions to evaluate maintenance configurations that exist for >90 days.

(3) EAC Power System Unavailability

The licensee concluded from calculation OSC-9174, Risk Assessment Input to the 2007 95002 Inspection at Oconee, that the unplanned KHU 2 unavailability increased the non-seismic CDF by 1E-8 /year above the base case for Unit 1, and 3E-8 /year for Units 2 and 3. The Unit 1 value is lower because the Unit was in a refueling outage during a significant portion of the Keowee unavailability. Since the pole jumper was repaired in October 2006, there have been no significant additional unplanned unavailability and there are no compliance concerns associated with the White PI.

(4) Combined Risk

The inspectors reviewed licensee calculation OSC-9174, which evaluated the collective effects of the three White issues reviewed by this 95002 inspection. The calculation concluded that there was no overlap between any of the three issues to mitigate a specific accident initiator, therefore, the combined risk/CDF was additive. After reviewing the potential accident sequences, the inspectors agreed with this conclusion;

but only as it related to the specific examples identified prior to this inspection. The inspectors requested the calculation be revised to include additional as built design features that adversely impacted the 5-foot flood barrier for the SSF, which were identified during the extent of cause review and any other extent of condition aspects from the other two 95002 issues. PIP O-07-1662, corrective action (CA) 28 was initiated to update the calculation. This revised calculation was reviewed by the inspectors. For those piping segments yet to be inspected or tested for debris, a reasonable probability that debris could fail the affected functions was applied. The resulting collective CDF was in the Yellow band. The inspectors considered the revised calculation satisfactory and the NRC's regulatory response was appropriate for the plant specific risk consequences.

d. Assessment

With respect to the Unit 3 RBES foreign material White finding, the inspectors determined that the licensee properly addressed the identification and duration of the finding. Although the licensee addressed a prior identification opportunity involving missed industry OE, the inspectors concluded that PIP trending of FME "legacy" issues should have also prompted a more timely response in assessing the possibility and potential effects of debris in all three Units' RBESs, as well as in other similarly vulnerable risk significant systems. It was determined that the licensee's decision to shutdown Unit 1 early to conduct the pre-sump modification FOSAR inspection was appropriate.

While the breach of the SSF flood barrier was eventually recognized by the licensee and corrected, the condition existed for approximately two years with numerous entries in the corrective action program that failed to recognize the risk significance of this particular barrier breach and implement timely corrective actions. The lack of knowledge by many Oconee onsite personnel on how this specific breach impacted the flood barrier function contributed to the inadequate control of this SSF PCF. The licensee appropriately understood the compliance concerns associated with this finding

For the White EAC power system PI, the licensee's problem identification efforts effectively addressed who identified the issue, how it was identified, how long it existed, prior identification opportunities, and compliance concerns.

Regarding the combined risk of the three White issues and related extent of condition aspects, the NRC's regulatory response was appropriate for the collective plant specific risk consequences.

02.02 Root Cause and Extent of Condition Evaluation

a. Evaluation of method(s) used to identify root cause(s) and contributing cause(s)

(1) Unit 3 RBES Foreign Material

Unit 3 foreign material PIP O-06-02468 was originally classified as action Category 3, similar to those for Unit 2 (PIP O-05-6829) and Unit 1 (PIP O-06-3928). When determined to be reportable to the NRC for all three units, Unit 3 PIP O-06-02468 was upgraded to Category 2; however, as permitted by Nuclear System Directive (NSD) 208,

Problem Investigation Process, licensee management decided that an apparent cause (versus the NSD 208 specified root cause) would be done for all three Units, because it was felt that a root cause would not add any value to this perceived FME Legacy issue. The identified causal factors in PIP O-06-02468, LER 50-269/2006-03, and the licensee's March 15, 2007, letter (Reply to the NRC's "Final Significance Determination" Notice of Violation), indicated that the Legacy foreign material found in Unit 3 was introduced during flange installation and removal activities. The identified apparent cause was substandard FME practices. Indicated contributing factors included a lack of worker understanding of importance of rigorous FME control in this work location coupled with inadequate procedural guidance for performing the flange installation and removal tasks.

As a result of legacy foreign material and the White Mitigating Systems finding/violation involving inadequate FME controls for the Unit 3 A and B RBES, the licensee initiated a root cause investigation on March 6, 2007. As documented in PIP O-07-0937, the investigation focused on Duke's FME policy from construction to present, with the objective to determine the time frame when Oconee's FME program may have allowed the foreign material to enter into the system. Completed on April 19, 2007, the root cause investigation utilized Barrier Analysis as the formal method of evaluation. The investigation determined that legacy foreign material existed, due to inadequate procedural guidance during the time period from construction until September 2004. The factors used to determine if the material discovered could be considered "legacy foreign material," were material degradation (e.g., corrosion, color, deformation, type of material discovered, etc.) and foreign material work standards prior to 2004.

(2) SSF Flood Barrier Breach

Based on the review of the licensee's root cause evaluation as documented in PIP O-07-1662, the inspectors determined that the licensee used standard methods for determination of the causal factors leading to the breach of the SSF flood barrier. These methods included barrier analysis, establishing a time line, causal factor charting, and 'Why' charting. There were differences in the licensee's and the inspectors' assessment of root cause, which the licensee attributed to the use of different beginning points for the root cause investigation time period. The licensee used the breach of the SSF 5-foot flood barrier in August 2003 as the beginning point; whereas, the team viewed the issuance of Regulatory Issue Summary (RIS) 2001-09, Control of Hazard Barriers, in April 2001 and recognition in March 2001 that the high energy line break blow out panels located in the east penetration rooms had not been properly controlled, as the beginning point.

(3) EAC Power System Unavailability

The licensee performed a formal root cause evaluation of the pole jumper failure, since this event was the substantial contributor to the White PI. The licensee used a number of systematic methods in their analysis, including a failure mode analysis, a fault tree analysis, an event and causal factor chart, and 'Why' charting. The licensee concluded that the root causes for this event were: (1) inadequate rotor pole jumper inspection techniques; and (2) pole jumpers on poles 11/12 and 41/42 experienced relative motion between the joints because of pole/coil movement, which resulted in cracks and eventually breakage in the pole jumper leafs. Contributing causes identified included:

(1) the licensee's failure to properly investigate the same type of pole jumper failure in 1985 and implement corrective actions to prevent recurrence; and (2) the KHUs not being instrumented to monitor trends in balancing, vibrations, or pole looseness. The inspectors concluded that the cause codes assigned to the root and contributing causes were appropriate.

b. Level of detail of the root cause evaluation

(1) Unit 3 RBES Foreign Material

The licensee's root cause evaluation included: (1) an extensive time line of the FME program and related improvements; (2) an extent of condition review; (3) an operating experience review; and (4) a safety culture component assessment. Performed by Oconee's FME Coordinator, the root cause analysis was considered by the inspectors to be reasonably independent, thorough, and consistent with NSD 212, Cause Analysis.

(2) SSF Flood Barrier Breach

The inspectors determined that the level of detail of the licensee's root cause evaluation identified a substantial number of the causal factors. The licensee identified the following two root causes for this White finding: (1) the access cover for the SSF flood barrier was not recognized as a risk significant PCF; and (2) site processes were ineffective in controlling the duration of work activities associated with this PCF breach. The inspectors agreed that there was a failure to recognize the risk significance of defeating the PCF. The inspectors viewed the underlying reason for the SSF flood barrier breach as primarily a combination of the following major causal factors:

- First, the licensee had a long-standing awareness that the program for control of PCFs was deficient, with insufficient interim measures to prevent recurrence until completion of a long-term program upgrade.

- Second, and to a lesser extent, the Maintenance Rule Expert Panel downgraded the risk significance of this portion of the SSF PCF.

This combination led to the lack of sufficient information for the decision maker (i.e., Work Control Coordinator) to establish the appropriate risk significance for the maintenance activity that caused this PCF breach and "a failure to recognize the risk significance of defeating the PCF."

With regard to the first causal factor, previous performance deficiencies (i.e., securing portions of the high energy line break blowout panels in the auxiliary building penetration rooms such that their operation as a pressure reduction device was hampered, and realizing that a main control room door was modified such that its ability to function as a differential pressure reduction device was defeated) highlighted to management the need for better controls over PCFs. During the same time frame, a 2002 engineering assessment of RIS 2001-09, Control of Hazard Barriers, highlighted PCF control weaknesses. In response to these concerns over the controls for PCFs, an Action Plan was developed for long-term resolution, PCFs as a group were classified as a(1) under the Maintenance Rule, and the System Health Report for PCFs was designated Yellow.

These observations were the basis for the inspectors determining that the licensee had a long-standing awareness that PCF controls were deficient.

Following the recognition that the program for controlling PCFs needed improvements, additional examples of PCF control problems continued to occur. Examples included: an unapproved flood curb removal in 2005; the installation of a tent that could have impaired the natural air circulation pathways for emergency core cooling system components; the long-standing removal of the SSF flood barrier access plate; and the second occurrence of an unapproved flood curb removal. These and other examples led to the inspectors' conclusion that insufficient interim measures were implemented to properly control PCFs until program improvements were completed.

The licensee's root cause evaluation discussed the second causal factor noted above, but did not view it as an important contributor to the White finding. The inspectors noted a tie between the licensee's root cause of ineffective site processes for controlling the duration of work activities and the Maintenance Rule Expert Panel risk significance downgrade. Had the maintenance activities that removed the access plate been properly identified as risk significant, the existing Maintenance Rule program for controlling work would have sufficiently controlled the duration of the configuration. The inspectors concluded that the licensee's root cause evaluation did not appropriately consider a causal factor that was directly linked to one of their root causes.

The licensee's root cause evaluation identified the lack of performing a 10 CFR 50.59 safety evaluation after the condition existed for 90 days as a contributing cause. The inspectors only agreed with this contributing cause from a very narrow perspective. Given the non-design basis aspect of the SSF flood barrier access plate, a safety evaluation could have easily accepted the condition as acceptable without further consideration. Therefore, performing the safety evaluation would not have assured restoration of the PCF. For other cases involving design bases attributes, the 10 CFR 50.59 review would be a more robust barrier in limiting the duration.

The inspectors observed that one aspect of the licensee's root cause evaluation for determining oversight organization's involvement with the issue was handled through PIP reviews based upon key word searches. There was not a specific focus that considered whether oversight organizations could have or should have identified this issue. The inspectors viewed this as a limitation in the licensee's root cause evaluation process.

(3) EAC Power System Unavailability

The inspectors found that the level of detail in the root cause evaluation was appropriate. It included a review of the previous 1985 pole jumper failure and associated repair documentation, the results of detailed inspections of the rotor poles for both Keowee units, a detailed metallurgical analysis of the identified pole jumper cracking, and correspondence with a number of hydro generator specialists within the industry.

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

(1) Unit 3 RBES Foreign Material

As previously indicated in Section 02.01b.(1), the licensee's evaluation identified a missed opportunity in this case to apply industry OE in a timely manner (i.e., Shearon Harris containment sump suction line debris - April 2002). Similarly, the Inspectors concluded that the number of identified FME "legacy" issues should have also prompted an earlier, more timely licensee response. The licensee's OE data base review for recurring and similar events, resulted in identifying PIP O-02-5815 (Foreign material found in the Unit 2 upper surge tanks) as a similar event. However, it did not identify previously mentioned PIPs O-05-6829 (Unit 2 RBES foreign material) and O-06-3928 (Unit 1 RBES foreign material). The inspectors determined this was due to NSD 212 limiting the OE data base review to Category 1 and 2 PIPs (for the 60 month period prior to the event), and the subject PIPs were classified as Category 3. As such, the inspectors questioned if the limited PIP Category scope could have potentially impacted the intended purpose of the prescribed OE data base review, which is to determine if more broadly applied corrective actions may be needed. The licensee captured this observation for further review in their corrective action program under PIP O-07-4770.

(2) SSF Flood Barrier Breach

Based upon a review of the root cause evaluation documented in PIP O-07-1662 and interviews with the individuals that performed the root cause evaluation, the inspectors verified that the licensee's root cause team considered operating experience and prior station specific occurrences while performing the root cause evaluation.

(3) EAC Power System Unavailability

The root cause evaluation considered the prior pole jumper failure that occurred on Keowee Unit 2 in 1985, as well as operating experience from the hydro industry. The licensee concluded that operating experience from the hydro industry is of limited value, since failures that occur in the industry typically do not receive formal evaluations and are not documented to the extent seen within the nuclear industry. There are no other nuclear plants that use hydro generation units as an emergency AC power source. Based on all of the OE reviewed in the analysis, the licensee concluded that the failure of the rotor pole jumper was not OE preventable. The licensee has created a corrective action to determine a method to regularly obtain and review OE for hydro generation both within and outside Duke Energy.

d. Consideration of potential common cause(s) and extent of condition of the problem

(1) Unit 3 RBES Foreign Material

In view of the root cause being legacy foreign material due to inadequate FME controls from construction to 2004, the licensee's extent of condition review (stemming from corrective actions delineated in Unit 1 RBES foreign material PIP O-06-03928) focused on other potentially vulnerable systems required for event mitigation. The vulnerability to legacy foreign material was based on the system not typically receiving flow during

normal operation or testing. As a result of this review, the following flow paths were identified as having not been tested periodically or having only received a one time test: (1) RBES to LPI suction header; (2) SSF letdown lines; (3) drains from the fuel transfer canal and reactor vessel cavity to the reactor building normal sump; (4) alternate/boron dilution paths to RBES; (5) LPI crossover lines; (6) high pressure injection (HPI) pump suction from the spent fuel pool; (7) piping downstream of recirculation line to RBS nozzles; (8) SSF auxiliary service water (ASW) path; and (9) portions of the station ASW system piping.

Based on a PIP O-07-0937 corrective action review board (CARB) action item, engineering performed a risk/consequence review of the above flow paths and recommended that FME-related inspections/flow testing be performed for the first three flow paths. As for the remaining six flow paths, engineering provided justifications that no further action was required. These justifications and a selected listing of associated pre-2005 work orders were reviewed by the inspectors. As a result of the inspectors' review and questions posed to the licensee, new corrective actions (CA) were written to perform FME-related inspections and/or flow tests for: (1) the credited station ASW system flow path (other than the normally tested pump recirculation test flow path) [PIP O-07-0937, CA 7]; and (2) the SSF ASW discharge header between valve CCW-458 and the emergency feedwater (EFW) header on all three Units [PIP O-05-03770, CA 231].

Further review of PIP O-06-03928 (Unit 1 RBES foreign material) indicated that the following systems were confirmed under the licensee's extent of condition review to achieve post-accident flow rates through regularly scheduled tests: EFW, reactor building cooling units (RBCU), low pressure service water (LPSW), condenser circulating water (CCW), emergency condenser circulating water (ECCW), Keowee, and high pressure service water (HPSW). Though not addressed in the licensee's cause evaluation, the corrective actions stemming from the NAID assessment discussed in Section 02.01b.(1) focused on an initiative to systematically search for piping/systems that have throttle points (orifices) and/or are not inspected/tested, such that foreign material could adversely affect a safety function/indication or unit reliability. This effort looked at, and similarly dispositioned a number of the above mentioned systems (including EFW), as well as many others.

Overall, the above efforts were considered to be appropriately focused. However, similar to the inspectors' justification review discussed above, the inspectors' independent extent of condition/cause review (Section 02.04(1)) also resulted in the licensee writing an additional corrective action item to perform FME-related inspections and/or flow tests for each Unit's EFW cross-connection line [PIP O-07-0937, CA 6]. As such, the inspectors considered it appropriate that the licensee had planned for the Safety Review Group (SRG) to perform an independent assessment of potentially vulnerable flow paths. This independent assessment, which was previously incorporated into PIP O-07-0937 as another CARB action item, had a due date of October 31, 2007.

(2) SSF Flood Barrier Breach

To obtain a better understanding of how, when, and exactly what aspects of extent of condition were considered by the licensee, the inspectors reviewed four PIPs and interviewed applicable personnel associated with those reports. These PIPs were O-05-4978, Ramifications of SSF opening; O-05-3770, SSF Risk Reduction Review; O-06-0740, SSF sewage lift station vent line elevation too low to prevent backflow; and O-07-1662, Root Cause evaluation of SSF wall breach.

The SSF flood barrier breach was secured in August 2005 and the licensee performed a walk-down to determine if other breaches existed. No other SSF flood barrier breaches were identified. A broader extent of condition review to ascertain whether there were other aspects (i.e., design or operations) that compromised the SSF 5-foot flood barrier was not performed. The NRC resident inspectors performed an in-depth review of the SSF flood barrier in 2006. Based on questions from the resident inspectors, the licensee recognized that the SSF's sewage lift piping configuration would allow external flooding at elevation 797 to pass into the SSF; thereby, circumventing the SSF's 5-foot flood barrier. Additionally, it was recognized that the SSF's drinking water system was not seismically restrained. Flooding from this water source would also cause a loss of SSF function. In response to these new discoveries, the licensee initiated PIPs, isolated the sewage and drinking water systems from the SSF, and performed a detailed walk-down with specific emphasis on other potential flooding paths.

In 2007, the licensee established the root cause evaluation team that performed extent of condition/cause reviews. The review included: (1) confirming if PCFs were properly identified as risk significant, the associated maintenance activities would be properly controlled; (2) determining whether PIPs written to assess other RISs were open; and (3) assess whether security or fire PCFs could be compromised. As part of these reviews, the licensee's root cause team identified that implementation procedures were not in place for ensuring that a safety evaluation would be performed for any maintenance configuration lasting for greater than 90 days. Based upon this discovery, all in-progress maintenance activities greater than 90 days old were reviewed as an extent of condition evaluation. Due to previous extensive efforts that evaluated the potential for other SSF flood paths, the licensee's root cause team took credit for these efforts in their extent of condition evaluation.

In addition to the insufficient initial extent of condition review for other potential SSF flooding paths, the NRC also identified areas that were omitted from the licensee's extent of condition/cause review. These are discussed in the Section 02.04(2).

(3) EAC Power System Unavailability

As part of the extent of condition review, the licensee performed detailed inspections of the remaining KHU 2 pole jumpers and all pole jumpers on KHU 1. Additional cracks on poles 11/12 were found on KHU 2 and repaired. These cracks were also analyzed as part of the root cause determination. There was no cracking found on KHU 1 pole jumpers. The licensee also performed recurring and similar event searches of their corrective action database over the past 5 years of Category 1 and 2 PIPs by searching

PIPs with the same event and cause codes. When bounding the search results to Emergency Power Equipment, three events were identified which the root cause team reviewed for similarities. As a result of this review, one issue related to repetitive maintenance preventable functional failures associated with auxiliary switches due to lack of proper maintenance was classified as an event with a similar cause per the definition in NSD 212, Cause Analysis, Appendix F. The licensee considered whether more broadly applied corrective actions were necessary to capture the repetitive nature of the inadequate preventive maintenance and determined that two initiatives already in place (i.e., the component categorization effort and the Keowee critical circuit review) addressed the issue.

The inspectors found that the licensee did not use all pertinent available information while investigating past failures of the Keowee units during the performance of extent of condition/cause reviews. The licensee primarily utilized searches of their corrective action data base to obtain examples of previous failures. A prior similar pole failure occurred in 1985 when Keowee was under the control of the Hydro organization. However, there was not a thorough evaluation of the failure and there were no corrective actions that would prevent recurrence. This failure, as well as a number of additional Keowee failures for the same time frame, were documented in the Oconee Nuclear Station Keowee Reliability Analysis that was performed to obtain PRA data. This document was not known to the licensee's root cause team; therefore, it was not used as a source for identification of early Keowee issues that may not have been appropriately evaluated or corrected. Corrective action 23 was added to PIP O-06-6105 to have the licensee review this document to highlight any potential issues not identified in the original scope of the extent of condition/cause. The scheduled completion date for this review is October 31, 2007.

e. Assessment

With respect to the Unit 3 RBES foreign material White finding, the inspectors considered the licensee's root cause analysis to be reasonably independent, thorough, and consistent with NSD 212, Cause Analysis. Overall, the licensee's extent of condition review was considered to be appropriately focused. However, based on a review of associated work history, the inspectors questioned the justifications for no further action on three systems potentially affected by legacy foreign material. Consequently, new corrective actions were written to perform FME-related inspections and/or flow tests on these systems. As such, the inspectors considered it appropriate that the licensee had already planned for the SRG to perform an independent assessment of potentially vulnerable flow paths.

Regarding the White SSF flood barrier finding, the licensee used standard root cause methods and determined a number of causal factors. One of the major causal factors identified by the inspectors, the Maintenance Rule Expert Panel downgrading the risk significance of the portion of the SSF flood barrier containing the access opening, had initially not been pursued under the licensee's extent of condition review. In addition, one aspect of the licensee's initial extent of condition review dealing with potential SSF flooding pathways was not adequately executed. By the end of the on-site inspection,

the licensee had appropriately addressed the above issues and successfully completed their extent of condition review.

The inspectors found the licensee's root cause analysis for the White EAC power system PI to be systematic and of sufficient detail to identify the appropriate root and contributing causes. In general, the extent of condition and extent of cause was performed in accordance with the licensee's guidance and identified a repetitive issue with respect to inadequate preventive maintenance. The inspectors identified where the root cause team did not utilize the pertinent available information contained in the Keowee Reliability Analysis when performing the extent of condition/cause investigation. Accordingly, a new corrective action was written to review this document in order to identify any potential issues that may not have been captured in the original scope of the licensee's extent of condition/cause determination.

02.03 Corrective Actions

a. Appropriateness of corrective action(s)

(1) Unit 3 RBES Foreign Material

The licensee's corrective actions for the Unit 3 RBES foreign material White finding were captured in PIP O-07-0937. The remedial/interim corrective actions included: photographing and analyzing foreign material found in the Unit 3 RBES; completing RBES strainer modifications in all three units; revising procedures OP/1,2,3/A/1103/002, Filling and Venting of Reactor Coolant System, OP/1,2,3/A/1102/028, Reactor Building Tour for Modes 6 and No Mode, and MP/0/A/1800/105[A], RBES - LPI Suction Line Flange Installation and Removal/Drain Line and Sump Inspections, to reflect the new strainer modifications and ensure proper FME controls; and establishing work orders to perform closeout FOSAR inspections of RBES suction lines up to valves LP19/20 during subsequent RFOs on all three units. (Note: The Unit 2 RBES closeout FOSAR inspection was performed in May 2007 during the EOC 22 RFO; the results are discussed in Section 02.04(1).)

As previously discussed in Section 02.02a.(1), the licensee determined that the root cause for the Unit 3 RBES foreign material White finding was legacy foreign material, due to inadequate procedural guidance during the time period from construction until September 2004. As such, PIP O-07-0937 indicated that the root cause has been addressed by: reinstatement of a maintenance FME technical procedure (MP/0/A/1800/001A, Open System or Component - Foreign Material Exclusion) in September 2004, in conjunction with the subsequent enhancements to it; NSD 104 (Materiel Condition/Housekeeping - Cleanliness/Foreign Material Exclusion and Seismic Concerns); FME-related training; and management field involvement. This conclusion was based on a noted decrease in incidents of foreign material intrusion due to human error, and an increase of technicians reporting legacy foreign material findings and potential foreign material incidents. Independent cause reviews of FME-related PIP trending data by the resident staff (documented in Inspection Report 05000269,270,287/ 2006003) and more recently by the inspectors, both discerned overall improvements

which can be attributable, in part, to the increased consistency in FME guidance and worker behavior.

Reflective of the relative importance placed on the maintenance technical procedure to the overall success of Oconee's FME program, the licensee implemented a Corrective Action to Prevent Recurrence (CAPR) which referenced PIP O-07-0937 in Maintenance Procedure MP/0/A/1800/001A to ensure that the MP doesn't get deleted like its predecessor did in 1996. Other corrective actions taken/planned include: performing an extent of condition review to identify systems required for event mitigation which require additional consideration for one time and/or periodic FME-related testing/inspection; providing system FME-related testing/inspection recommendations based on risk/consequence assessments; assigning SRG to perform an independent review of the potentially vulnerable systems; assignment of the RBES foreign material OE for inclusion into applicable training programs; and scheduling work orders for FME-related video inspections of the SSF letdown lines, fuel transfer canal and reactor vessel cavity drains to the normal sump, and the Unit 2 and 3 RBES to LPI suction headers (note: Unit 1 inspection was performed during the October 2006 EOC 23 RFO with no adverse findings). In addition, as a result of the inspectors' efforts discussed previously in Section 02.02d.(1), new corrective actions were written to perform FME-related inspections and/or flow tests for: (1) the station ASW system flow path (other than the normally tested pump recirculation test flow path); (2) the SSF ASW discharge header between valve CCW-458 and the EFW header on all three units; and (3) each unit's EFW cross-connection line.

The inspectors reviewed all the corrective actions depicted above, verifying that completed actions had been performed as indicated. Overall, corrective actions were considered to have adequately addressed compliance restoration, as well as the identified root cause. This determination of adequacy was heavily based on reviewed FME-related PIP trend data, as well as the newly added corrective actions for FME-related system inspections/flow tests and the planned independent SRG review of potentially affected systems.

(2) SSF Flood Barrier Breach

Based upon a review of the root cause analysis report, other associated corrective action documents, and personnel interviews, the inspectors determined that the corrective actions taken or planned to be performed were appropriate for the significant causal factors identified by the licensee. Corrective actions assigned to the licensee's root causes included:

- Development of a PCF Program for identifying, managing and controlling the design of risk significant passive features. This will include a Site Directive, training on the new directive, implementing procedures, changes to Design Basis Documents, placing signs on PCFs, modifying the Equipment Data Base to identify the feature, developing Selected Licensee Commitments, and the inclusion of any restrictions or special requirements for a PCF on design deliverable documents.

- Specific to the 4" x 7" access opening in the SSF exterior wall that is located below the 5-foot flood barrier, a modification will be implemented to set the effective flood height for this penetration, should it be open, to above 5 feet.

- Site processes and procedures for tracking and controlling the duration of temporary alterations will be reviewed for enhancements to ensure a safety evaluation is performed if the alteration is to remain beyond 90 days.

The inspectors reviewed the PCF corrective actions, both long-term and interim. With regard to the long-term actions, the inspectors confirmed that the site directive was being written, reviewed the corrective action documents designating the corrective actions, reviewed the existing Category C Action Plan for PCFs, and interviewed responsible personnel for implementing the Action Plan. The Category C Action Plan provided an integrated plan of the licensee's efforts, taken and planned. Two elements of the plan that have already been completed include identifying all PCFs on a list and inspecting the PCF to verify their proper configuration and physical condition. The inspectors noted the discovery of auxiliary building battery room wall penetrations not being included on structural drawings as documented in PIP O-07-04812 questioned the adequacy of these inspections. This matter is discussed further in Section 02.04(2).

The inspectors reviewed the interim corrective actions and recognized that various corrective actions had been taken, including: labeling of some PCFs; generating administrative controls for the main control room pressure boundary; and establishing Selected Licensee Commitments for auxiliary and turbine building flood barriers. These actions were narrowly focused to remedy specific control errors that had already occurred. Based, in part, on the inspectors' observation that interim corrective actions were insufficient (discussed in Section 02.02b.(2)) and coupled with the uncontrolled auxiliary building flooding curb removal on August 27, 2007, the licensee took additional interim corrective actions to control PCFs from a maintenance perspective. These actions were documented in PIP O-07-04694 and included:

- Creating an automatic software input into the risk profile for HPI pump work that included removal of the flood curb to transport pump parts to the hot machine shop.

- Placing a sign on the auxiliary building flood curbs to contact the work control coordinator senior reactor operator prior to removal.

- Having the work week manager review the work schedule for the week of September 1, 2007, to ensure no PCFs will be impacted.

- The imminent issuance of broad based communication within the Maintenance and Work Control Department discussing PCFs and the need for appropriate authorizations prior to their removal or breaching.

- Providing the draft of the PCF site directive, including the listing of PCFs, to the work control coordinator senior reactor operator and the shift technical advisor to

aid in identifying PCFs. A note was added to the turnover sheets to contact risk experts to ensure the risk is understood and managed correctly.

The inspectors determined the long-term and interim corrective actions covered other work activities that had previously not required a safety evaluation after the equipment was installed for more than 90 days. The licensee reviewed in-process work activities and was changing administrative controls to address this item. The inspectors confirmed that procedure PT/1/A/0115/014, Operations R&R Screening Review, was being developed. The procedure should provide direction for a safety evaluation in the event the equipment tag-out remains beyond 90 days. Interviews with cognizant personnel indicated that proper temporary power controls were now being implemented and electrical configuration considerations are to be formally implemented by October 2007. In addition, based upon interviews, weekly meetings now identify what work activities had been deferred or extended. These meetings highlight to planners which activities could challenge the 90 day limit.

Corrective action 9 in PIP O-07-1662 addressed a contributing cause identified by the licensee's root cause evaluation that involved the apparent lack of timeliness to resolve PCF issues. This was considered by the inspectors to be an important action, since it addressed the prolonged development and implementation of the PCF control program. The inspectors determined the significance of the inadequate interim corrective actions and resulting examples of PCFs that were not properly controlled were directly linked to the lengthy time period taken to implement an acceptable PCF control program. Whether other program improvements initiatives have similar timeliness issues should be reviewed/addressed by this corrective action. Corrective action 9 in PIP O-07-1662 had the following description, "Review of the various programs under which the Hazard Barrier/PCF issue was being tracked to determine if the processes worked as designed, if management emphasis was insufficient, or if changes are required." The action is scheduled to be completed by December 2007.

(3) EAC Power System Unavailability

The inspectors found that the licensee developed appropriate corrective actions, including corrective actions to prevent recurrence, for the root and contributing causes identified. These corrective actions are contained in PIP O-06-6105, which addresses the pole jumper failure, and PIP O-06-7416, which was written to capture the overall White PI issue. Corrective actions to prevent recurrence were to perform a 20X inspection of pole jumper connections to significantly enhance the capability to detect cracking prior to jumper failure. These inspections were performed for both KHUs during the October 2006 outage and were scheduled for KHU 2 at six and eighteen month intervals following return to service. If the inspection results are acceptable, the inspection (on both KHUs) will occur on a two year maintenance interval. The inspectors reviewed the licensee's KHU generator maintenance procedure MP/0/A/2005/001, Keowee Hydro Generator Inspection and Maintenance, to verify that this inspection was incorporated into the procedure. The inspectors found that a line item instruction was added to perform the 20X inspection of the pole jumpers during the scheduled biennial inspections. However, Duke Hydro personnel verses Oconee

nuclear maintenance personnel will be performing this inspection. There are no instructions, steps, or prerequisites in the procedure to ensure that the persons performing the inspection have the necessary training, skills, or sensitization to the importance of the inspections to ensure the consistency and quality of inspection as they continue during the life of the plant. As a result of this concern, the licensee has added a corrective action to determine the necessary steps to be added to the procedure to ensure that each inspection is performed in a repeatable and thorough manner.

The licensee also identified as part of their corrective actions that on-line monitoring capability of the pole/stator air gap is needed to provide real time data on a number of deterioration modes and to provide data for trending. The licensee has initiated engineering change packages to install this equipment for both Keowee units.

b. Prioritization of corrective actions

(1) Unit 3 RBES Foreign Material

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 groups/individuals and priority code appeared appropriate to facilitate timely performance that is commensurate with importance.

(2) SSF Flood Barrier Breach

The inspectors determined that corrective actions taken or scheduled, including those corrective actions that were added during the onsite inspection week, were sufficiently prioritized.

(3) EAC Power System Unavailability

The inspectors concluded that the licensee's corrective actions were properly prioritized to address the risk of the White PI.

c. Establishment of schedule for implementing and completing corrective actions

(1) Unit 3 RBES Foreign Material

Following initial discussions with the licensee and their subsequent agreement to begin the performance of FME-related station ASW system inspections/flow tests in Fall 2008, the inspectors considered all corrective actions to be appropriately scheduled and formally tracked in associated PIPs.

(2) SSF Flood Barrier Breach

The inspectors determined that the current corrective action schedule established within the licensee's corrective action system was acceptable. This was based, in part, by the

additional interim corrective actions that were implemented during the week of the onsite inspection.

(3) EAC Power System Unavailability

The licensee's PIP corrective actions appropriately identified responsible individuals, and assigned corrective action due dates that were commensurate with the risk of the issue. The inspectors did note that there was some uncertainty related to the date of implementation of the on-line monitoring equipment due to the licensee's modification process and availability of funds. The inspectors reviewed the licensee's modification process and determined that the appropriate priority was given to these modifications to ensure they would be implemented in a timely manner.

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

(1) Unit 3 RBES Foreign Material

Subsequent to inquires by the inspectors, the licensee established CA 8 to associated PIP O-07-0937 for Maintenance to develop and document an effectiveness review plan for the aforementioned root cause CAPR.

(2) SSF Flood Barrier Breach

Through review of PIP O-07-1662, which documented the licensee's root cause report, the inspectors determined that a future corrective action was to establish an effectiveness review plan.

(3) EAC Power System Unavailability

Corrective action 12 in PIP O-06-7416 specifies that a Level II assessment be performed after 24 months to validate the effectiveness of corrective actions. Quantitative measures of effectiveness are provided in the MSPI calculation (return to Green) and maintenance rule programs (return to a(2) status).

e. Assessment

Overall, the corrective actions for the Unit 3 RBES foreign material White finding were adequate to address compliance restoration, as well as the identified root cause. This determination of adequacy was heavily based on reviewed FME-related PIP trend data, as well as the newly added corrective actions for FME-related system inspections/flow tests and the planned independent SRG review of potentially vulnerable systems. Corrective actions were found to be appropriately prioritized, and with the decision to begin the performance of FME-related station ASW system inspections/flow tests in Fall 2008, they were considered to be appropriately scheduled and formally tracked in associated PIPs. Accordingly, the White Unit 3 RBES foreign material finding [including associated violation (VIO) 05000287/ 2007006-01 and LER 50-269/2006-03] is considered closed.

For the White SSF flood barrier breach finding, the inspectors observed inadequate interim corrective actions that had been implemented while a new PCF control program was being developed. Additional interim corrective actions were established during the week of the on-site inspection after the inspectors made this observation. Based on these actions and implementation of the PCF control program planned for the end of 2007, the inspectors considered that controls were in place to prevent unintended breaches of PCFs. Sufficient corrective actions had been taken so that a safety evaluation will be performed for temporary configurations in excess of 90 days. The long-term corrective action to establish a comprehensive PCF control program contained the necessary elements to maintain the integrity of PCFs. However, the discovery during this inspection of penetrations in auxiliary building battery room walls that were not included in applicable design documents, questioned the adequacy of previous walk-downs that were intended to verify the configuration of PCFs. This item was entered into the licensee's corrective action program. The inspectors determined that the corrective actions that had been implemented or had been entered into the corrective action program at the completion of the on-site inspection were acceptable. Accordingly, the White SSF flood barrier breach finding [including associated VIO 05000269,270,287/2006017-01] is considered closed.

The inspectors determined that the corrective action to do a timeliness review of the various programs under which the Hazard Barrier/PCF issue was being tracked, was crucial in fully understanding the issues related to this finding. This review is scheduled to be completed by December 2007. The inspectors determined that the significance of the inadequate interim corrective actions and resulting examples of PCFs which were not properly controlled, were directly linked to the lengthy time period taken to implement an acceptable PCF control program. Whether other program improvement initiatives have similar timeliness issues should be reviewed/addressed by this corrective action.

Regarding the White EAC power system PI, corrective actions to address root and contributing causes were identified and prioritized commensurate to their risk significance. The inspectors did identify that the corrective action to implement a 20X inspection of pole jumpers did not provide measures to ensure the consistency and quality of the inspections throughout the life of the plant. The new corrective action to address this concern and other planned corrective actions were scheduled with appropriate completion dates. A Level II assessment was included to validate effectiveness of the corrective actions.

02.04 Independent Assessment of Extent of Condition and Generic Implications

(1) Unit 3 RBES Foreign Material

In addition to the independent cause reviews of FME-related PIP trending data previously discussed in Section 02.03a.(1), the inspectors independent extent of condition/cause assessment for the Unit 3 RBES foreign material White finding included three additional parts. The first of which involved the observation of FME-related practices during a preventive maintenance (PM) activity on the KHU 2 governor. In accordance with NSD 104, Keowee is a cleanliness level 3 area. The inspectors found

the FME practices being employed during the PM to be consistent with the cleanliness level 3 requirements/guidance of NSD 104 and maintenance technical procedure MP 0/A/1800/ 001A (i.e., the establishment/maintenance of an FME control area through the appropriate utilization of specified barrier markings, an FME monitor, and a personnel/ materials/tools control log).

PIP O-07-02513 was the focus of the next part of the inspectors' independent extent of condition/cause assessment. This PIP documented the May 2007 Unit 2 EOC 22 RFO RBES closeout FOSAR inspection and the discovery of a nail that was previously identified during the EOC 21 RFO RBES pre-modification FOSAR inspection. As indicated in Section 02.03a.(1), this closeout FOSAR inspection of the Unit 2 RBES was performed as one of the remedial/interim corrective actions for the Unit 3 RBES foreign material White finding. Since this inspection was tied to the next RFO for each Unit, its performance in Units 1 and 3 is still pending. Consequently, the inspectors were concerned with the extent of condition implications the previously identified Unit 2 nail had on Units 1 and 3. Further review revealed that unlike the related RBES modification efforts in Units 1 and 3, the previously identified foreign material in Unit 2 was not physically accounted for (due to radiological concerns) and an additional/closeout FOSAR inspection of the Unit 2 RBES was not performed. Similar to previous analysis, the nail was not considered to adversely affect any ECCS functions and was dispositioned as a licensee identified violation in Inspection Report 0500269,270,287/ 2007008. A corrective action was established in PIP O-07-02513 for Maintenance to evaluate if a "final" inspection is needed during special applications of FOSAR on other significant systems. The due date for this action was October 24, 2007. Accordingly, with steps already added to MP/0/A/1800/105A to ensure FOSAR inspections are performed prior to final closure of the RBES strainer assembly, the inspectors had no further concerns on this issue

The last part of the inspectors' extent of condition/cause assessment involved a review of additional event mitigating systems selected by the inspectors to be potentially vulnerable to foreign material due to their low and/or no flow conditions. The selected systems were: (1) SSF standby makeup pump(s) flow path(s) to reactor coolant pump seals; (2) EFW cross-connection lines; (3) EFW alternate flow paths around valves FDW-315/316; (4) HPSW to the HPI pump motor bearings and turbine driven EFW pump(s) motor cooler(s); (5) siphon seal water and vacuum system(s) supply from HPSW standby header B and back feed via the SSF submersible pump; (6) elevated water storage tank emergency fill path; (7) reactor head vents; and (8) HPI/LPI piggyback. After considering existing test procedures in conjunction with a selected listing of associated pre-2005 work orders, the inspectors expressed concern with the EFW cross-connection lines. Consequently, the licensee established CA 6 in associated PIP O-07-0937 to perform FME-related inspections and/or flow tests for each Unit's EFW cross-connection line.

In comparison, the licensee's extent of condition review for the Unit 3 RBES foreign material White finding focused on primary and secondary systems required for event mitigation that have flow paths not being tested periodically or have only received a one time test. As indicated in Section 02.02d.(1), both the licensee's extent of condition review, as well as a similarly focused NAID-related review, assessed the EFW system

as not being vulnerable due to periodic full flow testing. The inspectors' independent extent of condition/cause review found that this wasn't the case for the "one time tested" EFW cross-connection lines; which, when taken in conjunction with the systems' work history, revealed them to be vulnerable. As such, the inspectors considered the licensee's plans for an SRG independent assessment of potentially vulnerable flow paths to be appropriate.

(2) SSF Flood Barrier Breach

The inspectors' independent extent of condition/cause assessment for this finding included the following items:

- Sampled other RISs to determine whether they were under review or if corrective actions required for resolution had been completed.

- Sampled work orders associated with non-design basis, active, risk-significant components to determine if they were correctly designated as risk significant.

- Performed walk-downs of PCFs to determine if the licensee's draft listing of PCFs was complete and whether there were any uncontrolled breaches of PCFs.

- Reviewed other down-grading of risk significance for Maintenance Rule components to determine if non-conservative decisions existed.

Previously the NRC resident inspectors independently evaluated the 5-foot SSF PCF for other ways it could be compromised. Therefore, this aspect of independent extent of condition review had already been performed.

Through a combination of record review, walk-downs and interviews, the inspectors determined that:

- All RIS dispositions sampled were completed with no outstanding actions.

- The work orders associated with one active, non-design basis, risk-significant component were not designated as PRA (the risk significance designation). The licensee initiated PIP O-07-04815 to address this observation. The particular components were fire hydrants HY-7 and HY-26. These components are used as a backup method for refilling the elevated water storage tank.

- Although the inspectors did not identify any PCF breaches while on-site, the senior resident inspector questioned the integrity of a PCF based on the discovery of a penetration in the auxiliary building battery room wall. The licensee initiated PIP O-07-04812 to address this observation, and subsequently identified four additional penetrations through various walls of auxiliary building battery rooms. The penetrations appeared to be existing configurations associated with heating ventilation and air conditioning duct work and not associated with maintenance activities. None of the penetrations were reflected in the applicable structural drawings. The licensee subsequently concluded the

walls were operable. However, it was unclear why the previous Category C Action Plan walk-downs of PCFs had not previously identified the penetrations and the PIP as initially written did not address this aspect.

- A sampling of other Maintenance Rule component risk significance down-grades by the Expert Panel were appropriate.

The resident inspectors previously identified in January 2006 a sanitary sewer pathway that compromised the SSF flood barrier to potential external floods. To address this issue not being identified in their initial extent of condition review efforts, the licensee performed the following actions: (1) conducted a March 16, 2006, walk-down of the SSF by a multi-disciplined engineering team and no open flood pathways were identified; (2) civil engineers began performing routine walk-downs of the SSF for flood barrier breaches in the Fall of 2006, along with the initiation of a trimester SSF flood barrier walk-down; (3) the SSF flood barrier was included in the daily operator rounds for the SSF; and (4) conducted an additional SSF civil engineer walk-down in December 2006 following the identification of degraded wall penetration seals at the Catawba Station.

The inspectors reviewed the output document surrounding the March 2006 multi-disciplined engineering team walk-down and questioned its comprehensiveness. As a result of the interaction with the inspectors, the licensee added an additional action as CA 27 in PIP O-07-1662 for an external group to perform an independent audit/review of the walk-down activity, scope, results, and corrective actions.

(3) EAC Power System Unavailability

To independently assess the extent of condition, the inspectors selected two equipment failures identified in the Keowee Reliability Analysis of early Keowee failures that were not processed through Oconee's corrective action program, to determine if the conditions described could be latent uncorrected problems such as the pole jumper cracking issue. One issue was a start failure due to a corroded latch release plunger in the generator supply breaker. This specific breaker (Westinghouse DB50), was removed as part of the voltage regulator replacement in 2004. The licensee was able to show that all other Westinghouse DB50 breakers at Keowee were replaced in 1999 and are now on a 10 year refurbishment schedule based on vendor and EPRI recommendations, which is considered sufficient to identify this condition prior to problems.

The second condition reviewed as part of the extent of condition were multiple failures to start due to excitation breaker X-relay failures. The inspectors found that the X-relays were redesigned in 1997 and a search of the licensee's corrective action data base confirmed that this issue is no longer a problem.

The inspectors also reviewed drawing details for the SSF diesel generator to determine if the pole connection arrangement could be vulnerable to the same failure mechanism as the Keowee generator. The inspectors found that the SSF eight pole generator has poles, where the core and coil are manufactured as an integrated component that is not susceptible to coil movement (one of the possible failure mechanisms). The poles are

also secured in a double dovetail arrangement that is less likely for movement. Furthermore, the pole connections occur in the hub of the rotor in a parallel arrangement where they are not exposed to cyclic stresses even if there was some pole to pole movement. As such, the inspectors concluded that the SSF generator pole connections are not exposed to the same vulnerability as the KHU generators.

To independently assess the extent of cause, the inspectors reviewed PIP searches of Keowee issues for Category 3 and 4 PIPs with similar cause codes and selected four issues for further inspection to determine if the problems would indicate a broader extent of cause than that identified by the licensee. The inspectors found that while the issues were maintenance related, they were not indicative of inadequate preventive maintenance.

In summary, the inspectors' independent assessment of the extent of condition/cause for the White EAC power system PI did not result in any conclusions that differed from the licensee's assessment.

02.05 Safety Culture Consideration

This aspect of the inspection determined whether the licensee's root cause evaluations properly considered safety culture when reviewing the three issues. To accomplish this, the inspectors independently assessed for applicability each of the safety culture components listed in NRC Inspection Manual Chapter (IMC) 0305, Operating Reactor Assessment Program, to determine if one or more of the components could have reasonably been a root cause or significant contributing cause to the three issues that were the subject of this inspection. The inspectors then compared the results of this assessment to the results of the licensee's safety culture evaluations. The licensee's safety culture evaluations had the following results:

- No safety culture components were identified as common to any of the issues.

- EAC Power System Unavailability - No safety culture components significantly contributed to the failure of KHU 2.

- Unit 3 RBES Foreign Material - The safety culture component for thorough evaluation of problems (under the Problem Identification and Resolution (PI&R) heading) significantly contributed to the White Unit 3 foreign material finding. This determination was made because a more thorough evaluation of the Unit 2 sump debris would have led to more timely identification of debris in the Unit 3 and Unit 1 sump piping.

- SSF Flood Barrier Breach - The safety culture component for complete, accurate and up-to-date design documentation and procedures (under the Resources section of the Human Performance heading) significantly contributed to the SSF barrier finding. This was based on design documentation not recognizing that the access opening was within the flood barrier and that plant procedures failed to properly control PCFs.

In addition to the above safety culture components that significantly contributed to the issues, the licensee identified other components that also contributed, but to a lesser degree.

The results of the inspectors' independent assessment of safety culture component generally agreed with the licensee's conclusion. Differences were reviewed and determined to be caused by assessment approaches, rather than fundamental disagreements. For example, the inspectors identified that the safety culture component for thorough evaluation of a problem clearly contributed the KHU 2 pole jumper failure, in that a nearly identical failure occurred in 1985. However, the inspectors recognized that the control and maintenance of the KHUs have significantly improved since 1985 and the inadequate corrective action for the 1985 failure was not indicative of current licensee performance. The licensee indicated that they did not consider this particular PI&R safety culture component applicable for their safety culture evaluation due to the legacy aspect and that it did not reflect their current performance. In addition, the inspectors determined that the corrective actions either already taken or those planned adequately address the safety culture consideration identified in these evaluations.

3.0 Exit Meeting

The inspectors presented the inspection results to Mr. Bruce Hamilton, Oconee Site Vice President, and other members of the licensee management at the conclusion of the inspection on August 31, 2007. 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

E. Burchfield, Nuclear Engineering Manager
N. Clarkson, Regulatory Compliance
F. Eppler, Mechanical/Civil Engineering
K. Grayson, Standby Shutdown Facility System Engineer
R. Hester, Civil Engineer
L. Kanipe, PRA Engineer
D. King, Keowee Hydroelectric Unit System Engineer
C. Little, Major Projects Integration Manager (Engineering)
P. Mabry, Mechanical/Civil Engineering
R. Masters, FME Coordinator
L. Nicholson, Safety Assurance Manager
J. Ratliff, Power Systems Engineer
J. Robertson, Design Bases Engineering
S. Severance, Regulatory Compliance
J. Smith, Regulatory Compliance
J. Weast, Regulatory Compliance
A. Wells, Civil Engineering Supervisor

NRC

C. Casto, Director, Division of Reactor Projects (DRP)
J. Moorman, Chief, Reactor Projects Branch 1, DRP

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

None

Previous Items Closed

05000287/2007006-01	VIO	Inadequate Foreign Material Exclusion Controls for the Unit 3, A and B Train Reactor Building Emergency Sump Suction Lines (Section 02.03e.)
05000269,270,287/2006017-01	VIO	Inadequate Control of SSF Flood Barrier Resulting in a Breach of the Barrier (Section 02.03e.)
50-269/2006-03	LER	Foreign Objects Discovered In RBES Outlet Piping - Units 1, 2, and 3 (Section 02.03e.)

Discussed

None

DOCUMENTS REVIEWED

Unit 3 RBES Foreign Material

PIPs
O-02-5815, Foreign Material Found in U2 Upper Surge Tank
O-05-0965, Level II Test Acceptance Criteria (TAC) Assessment
O-05-3770, SSF Risk Reduction
O-05-6024, FME Issues Raised during NAID Review
O-05-6829, Inspect Unit 2 RBES Suction Piping
O-06-2468, Inspect Unit 3 RBES Suction Piping
O-06-3928, Inspect Unit 1 RBES Suction Piping
O-06-4515, A1 classification of LPI system per Maintenance Rule
O-06-5479, U2 MTOT Temperature Increase
O-07-0937, Unit 3A & B RBES FME Corrective Actions
O-07-2513, Nail Found in LPI Piping when Performing U2 EOC22 FOSAR
O-07-4692, FME Discovered Inside RCW Valve
O-07-4770, Investigate PIP category for PIPs 05-6829 and 06-3928
O-07-0937, Root Cause Evaluation for Unit 3 RBES Foreign Material White Finding
O-07-4600, Spring found in 1A Condensate Booster Pump

Nuclear System Directives
NSD 104, Materiel Condition/Housekeeping - Cleanliness/Foreign Material Exclusion and Seismic Concerns, Rev. 27
NSD 208, Problem Investigation Process, Rev. 28
NSD 212, Cause Analysis, Rev. 15

Operating Procedures
OP/0/A/1102/028, Reactor Building Tour, Rev. 029
OP/0/A/1660/009, SSF Auxiliary Service Water System, Rev. 28; Enclosure 4.9, Fill and Vent of Piping Downstream of 1CCW-268 Using Demineralized Water
OP/1/A/1103/002, Filling and Venting, Rev. 092
OP/1/A/1104/004, Low Pressure Injection System, Rev. 115; Enclosure 4.37, Alternate Suction Flowpath Via 1LP-105 and 1LP-19 During Normal Decay Heat Removal
OP/1-2/A/1104/006/A, SFP and BWST Purification, Rev. 15

Maintenance Procedures
MP/0/A/1705/022, Fire Protection - Fire Hydrants and Post Indicator Valves - Semi-Annual and Annual Inspection, Rev. 003
MP/0/A/1800/001A, Open System or Component - Foreign Material Exclusion, Rev. 004
MP/0/A/1800/105A, RBES - LPI Suction Line Flange Installation and Removal, Drain Line and Sump Inspections, Rev. 010

Permanent Test Procedures
PT/0/A/0250/010A, Fire Protection Systems Monthly Check, Rev. 065
PT/0/A/0250/024, Fire Protection System Three Year Flow Test, Rev. 029
PT/0/A/0251/010, Auxiliary Service Water Pump Test, Rev. 56

PT/0/A/0251/029, Siphon Seal Water System Test, Rev. 023
PT/1/A/0150/022L, TDEFW Pump Backup Cooling Water Supply Test, Rev. 033
PT/1/A/0201/005, High Point Vent Flow Test, Rev. 011
PT/1/A/0201/006, Reactor Vessel Head Vent Flow Test, Rev. 004
PT/1/A/0204/007, Reactor Building Spray Pump Test, Rev. 087
PT/1/A/0204/008, Reactor Building Spray Header Air Test, Rev. 001
PT/1/A/0230/015, High Pressure Injection Motor Cooler Flow Test, Rev. 030
PT/1/A/0251/024, H.I. Full Flow Test, Rev. 031
PT/1/A/0251/014, Feedwater Check Valve Functional Test, Rev. 004
PT/1/A/0400/010, SSF-RC Makeup System Check Valve Stroke Test, Rev. 023
PT/1/A/0600/018, Emergency Feedwater Train Operability Test, Rev. 008

Temporary Test Procedures

TT/0/A/0600/019, SSF Submersible Pump Flow Test to U2 CCW Pipe and to U2 CCW Pump Seal Water Supply Header, Rev. 0
TT/0/A/325/01, Emergency Feedwater Flow Test (with pen and ink changes), 05/07/79
TT/1/1/0600/13, SSF ASW Pump Discharge to “B” EFDW Header Flow Path Test, 6/20/1994
TT/1/A/02004/002, Reactor Building Spray System Post-Mod Test for NSM ON-13105, Rev.003
TT/1/A/0400/24, Flow Balance Test of SSF ASW Valves Using the 1B Motor Driven Emergency Feedwater Pump”, Rev. 001
TT/1/A/150/071, ON-18851 Unit 1 PIM-LPI System flow Instrument Orifice Replacement Post-Modification Test, Rev. 0
TT/1/A/251/50, ASW to H.I. Pump Motor Cooler Flow Test, 10/21/95
TT/2/A/251/50, ASW to H.I. Pump Motor Cooler Flow Test, 01/29/96
TT/3/A/0150/068, ON-33093 LPI Cross Connect Post-Modification Test, Rev. 0
TT/3/A/251/50, ASW to H.I. Pump Motor Cooler Flow Test, 06/28/95

Abnormal Procedures

AP/1/A/1700/033, Loss of SSW, Rev. 3

Emergency Procedures

EP/1/A/1800/001, Emergency Operating Procedure, Rev. 35; Enclosure 5.31, Temporarily Charging the HPSW System

Station Drawings

O-477, Piping Layout Spray System Reactor Building - Unit 1, Rev. 14
OCFD-OPS-HPSW-1, Flow Diagram Composite Diagram of the High Pressure Service Water System

OFD 101A-1.3, Flow Diagram of High Pressure Injection System (Charging System), Rev. 20
OFD 101A 1.4, Flow Diagram of High Pressure Injection System (Charging Section), Rev. 36
OFD 101A-1.5, Flow Diagram of High Pressure Injection System, Rev. 20
OFD 102A-1.1, Flow Diagram of Low Pressure Injection System (Borated Water Supply & LPI Pump Suction), Rev. 50
OFD 102A-1.2, Flow Diagram of Low Pressure Injection, Rev. 46
OFD 102A-2.1, Flow Diagram of Low Pressure Injection, Rev. 43
OFD 102A-2.2, Flow Diagram of Low Pressure Injection, Rev. 39
OFD 102A-2.3, Flow Diagram of Low Pressure Injection, Rev. 19
OFD 102A-3.1, Flow Diagram of Low Pressure Injection, Rev. 52
OFD 102A-3.2, Flow Diagram of Low Pressure Injection, Rev. 32
OFD 102A-3.3, Flow Diagram of Low Pressure Injection, Rev. 19
OFD 103A-1/1, Flow Diagram of Reactor Building Spray System, Rev. 16
OFD 104A-1.1, Flow Diagram of Spent Fuel Cooling System, Rev. 46
OFD 104A-1.2, Flow Diagram of Spent Fuel Cooling System (Purification Loop), Rev. 14
OFD 121D-1.1, Flow Diagram of Emergency Feedwater System, Rev. 31
OFD 121D-2.1, Flow Diagram of Emergency Feedwater System, Rev.29
OFD 129A-1.1, Flow Diagram of Siphon Seal Water System, Rev. 9
OFD 133A-2.5, Flow Diagram of Condenser Circulating Water System (SSF Aux. Services), Rev. 43

Work Orders

01678527, Unit 3 I/R Suspected Leak in Buried CCW, 06/24/2006
01679826, Unit 1, FOSAR of ECCS Suction Lines
01768221, Perform FME Inspection of Unit 1 RBES Pipe up to LP-19/20
01649247, Perform FME Inspection of Unit 2 RBES Pipe up to LP-19/20
01732901, Unit 2, FOSAR of ECCS Suction Lines
01730670, Perform FME Inspection of RBES Pipe up to LP-19/20
01732904, Unit 3, FOSAR of ECCS Suction Lines

Work Requests

00930017, Inspection of Unit 1 Canal and Cavity Drain Pipe for FME
00930038, Inspection of Unit 1 SSF Letdown Pipe for FME
00930023, Inspection of Unit 2 Canal and Cavity Drain Pipe for FME
00930063, Inspection of Unit 2 SSF Letdown Pipe for FME
00930024, Inspection of Unit 3 Canal and Cavity Drain Pipe for FME
00930067, Inspection of Unit 3 SSF Letdown Pipe for FME

Training Documents

TTN-911, Nuclear System Directive (NSD) 104 Computer Based Training, 03/07/05
TTC-337, NSD 104 FME Monitor/Worker Roles and Responsibilities, Initial
Duty Area Continuing Training, FME Refresher 2006
MT-OC-MNT-ADM-FME06, Maintenance Training - FME Refresher 2006, 06/20/2006
MT-OC-MNT-ADM-FME04, FME – Focus on Prevention, 06-08-04

Miscellaneous Documents

EM 5.1- Engineering Emergency Response Plan, Part C "Refill the EWST, Rev. 24
Licensee Event Report 05-269/2006-03, Foreign Objects Discovered in RBES Outlet Piping - Units 1, 2 and 3, Rev. 0
Duke Energy Company Correspondence, Subject: Reply to Notice of Violation 05000269,270, 287/2007006, March 15, 2007

SSF Flood Barrier Breach

PIPs

G-01-0140, Review of NRC RIS 2001-09 by OEA, NGO, and site personnel
O-01-0815, Rivets and sheet metal screws on East Penetration room blowout panels exterior
O-02-3645, Apparent cause evaluation on Passive Civil Features 02-MCE-001-02 Assessment
O-02-7269, Passive Civil Features classified Maintenance Rule a(1)
O-03-7314, Evaluate current plant processes for Maintenance Rule a(4)
O-05-1255, Risk Reduction Team walk-down of SSF
O-05-2885, Auxiliary Building flood retention barrier
O-05-3770, SSF Risk Reduction Review
O-05-3820, SSF Housekeeping observations
O-05-4978, Ramifications of SSF opening
O-05-8363, Review of Regulatory Information Summary 2005-25, Clarification of NRC Guidelines for Control of Heavy Loads
O-06-0025, Review of Regulatory Information Summary 2005-29, Anticipated Transients that could Develop into More Serious Events
O-06-0740, SSF sewage lift station vent line elevation too low to prevent backflow
O-06-5375, Maintenance Rule Functional Failure Evaluation of SSF Flood Protection System
O-07-1662, Root Cause evaluate of SSF wall breach
O-07-4694, Unit 2 Low Pressure Injection Hatch flood curb found removed
O-07-4812, Openings in HELB Barriers not on drawings
O-07-4815, Potential problem with Mra(4) program in refard to fire hydrants HY-7 & HY-26

Work Orders
0165384401 Unit 2
0168021401 Unit 2
0164463501 Unit 1
0167087601 Unit 1
0162263401 Unit 0
0166294201 Unit 3
0163438501 Unit 3
0170812401 Unit 0
0173498001 Unit 0

Procedures
PT/1/A/0115/014, Operation R&R Screening Review
WPG 6.16, Risk Assessment Guideline
WPM 609, On-Line Risk Assessment utilizing ORAM-SENTINEL

EAC Power System Unavailability

Procedures
MP/0/A/2005/001, Keowee Hydro Generator Inspection and Maintenance
IP/0/A/5180/001, Cutler-Hammer Type M Relay Installation and Maintenance
PT/0/A/0620/019, Keowee Over Frequency Protection Functional Test
Nuclear Site Directive NSD 208, Problem Investigation Process (PIP)
Nuclear Site Directive NSD 212, Cause Evaluation
BM-200, Nuclear Generation Department Non-Routine Work Prioritization Process

Drawings
A-64605, Wound Rotor Pole Assembly (SSF Generator)
A-66951, 8 Pole Rotor Connection, 4 Parallel Circuits (SSF Generator)

Evaluation Reports
Root Cause Evaluation Report - Keowee Hydro Unit 2 2006 Emergency Lockout
Duke Energy Metallurgy File Report #3667 - Keowee Unit 2 Pole Jumpers

Miscellaneous
Keowee Critical Circuit Review - Circuit Spread Sheet
MSPI Margin Report - Emergency AC Power System
Keowee Supersystem Health Report - 2007Q2

Calculation OSC-9174, Risk Assessment Input to the July 2007 95002 Inspection at Oconee

ONS Keowee Reliability Analysis, Volume 1, Table 5.2-1, Keowee PRA Unit Emergency Start/Run Failures (1984-1993)

PIPs

O-97-2983, Keowee Unit 2 Field Breaker Closing Coil Failure
O-02-0626, Keowee Unit 1 Generator Inner Shield Support Broken
O-04-4896, Keowee Unit 2 ACB-2 Connecting Rod Failure
O-04-5079, Inadequate Planning for Keowee Electrical Generator Work
O-05-5118, Keowee Unit 2 Emergency Lockout During Normal Start
O-05-5365, Keowee Unit 2 Emergency Lockout During Emergency Start
O-05-5625, Keowee System/Component Ownership Assessment
O-06-0223, Track Performance of Keowee Critcal Circuit Review
O-06-2162, Broken Lock Washers on Main Hinge Pin Jam Nuts on ACB-2
O-06-6105, Keowee Unit 2 Generator Pole Jumper Failure
O-06-6401, Release Request of Pole Insulating Collars Prior to QA Acceptance
O-06-7416, Keowee Generator Supersystem and Emergency Overhead Power Path are Maintenance Rule a(1)
O-06-8100, Maintenance Critique Results Following Keowee Unit 2 Generator Forced Outage
O-06-8298, Air Supply/Storage Equipment Problems Affecting Keowee ACBs
O-07-4496, White Finding Extent of Condition/Extent of Cause Review

LIST OF ACRONYMS

ASW	-	Auxiliary Service Water
CA	-	Corrective Action
CAPR	-	Corrective Action to Prevent Recurrence
CARB	-	Corrective Action Review Board
CCW	-	Condenser Circulating Water
EAC	-	Emergency Alternating Current
ECCS	-	Emergency Core Cooling System
ECCW	-	Emergency Condenser Circulating Water
EFW	-	Emergency Feedwater
EOC	-	End-Of-Cycle
FME	-	Foreign Materials Exclusion
FOSAR	-	Foreign Object Search And Retrieval
HPI	-	High Pressure Injection
HPSW	-	High Pressure Service Water

LER	-	Licensee Event Report
LOCA	-	Loss Of Coolant Accident
LPI	-	Low Pressure Injection
LPSW	-	Low Pressure Service Water
NAID	-	Nuclear Assessment and Issues Division
NSD	-	Nuclear System Directive
OE	-	Operating Experience
PCF	-	Passive Civil Feature
PI	-	Performance Indicator
PIP	-	Problem Investigation Process report
PI&R	-	Problem Identification and Resolution
RBES	-	Reactor Building Emergency Sump
RFO	-	Refueling Outage
RIS	-	Regulatory Issue Summary
SDP	-	Significance Determination Process
SRG	-	Safety Review Group
SSC	-	Structures, Systems, and Components
SSF	-	Safe Shutdown Facility