UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION III
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LISLE, IL 60532-4352

August 28, 2014

Mr. Michael J. Pacilio
Senior VP, Exelon Generation Co., LLC
President and CNO, Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: CLINTON POWER STATION, UNIT 1 - NRC 95001 SUPPLEMENTAL INSPECTION REPORT 05000461/2014008 AND ASSESSMENT FOLLOW-UP LETTER

Dear Mr. Pacilio:

On July 11, 2014, the U.S. Nuclear Regulatory Commission (NRC) completed a supplemental inspection at your Clinton Power Station. The enclosed report documents the results of this inspection, which were discussed with Mr. Taber and other members of your staff during an exit meeting and a regulatory performance meeting on July 28, 2014.

As required by the NRC Reactor Oversight Process (ROP) Action Matrix, this supplemental inspection was performed in accordance with Inspection Procedure (IP) 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area." The purpose of the inspection was to examine the causes for, and actions taken related to, a White performance indicator in the Initiating Events Cornerstone at the Clinton Power Station, Unit 1. Specifically, the performance indicator for Unplanned Reactor Scrams per 7,000 Critical Hours exceeded the Green-to-White threshold as reported in your fourth quarter 2013 PI submittal.

By letter dated February 5, 2014, the NRC informed you that because of the change in your PI status, the performance at Clinton Power Station, Unit 1, was in the Regulatory Response Column of the ROP Action Matrix as of the fourth quarter of 2013 (ADAMS Accession No. ML14037A328). We also informed you of our intent to perform this supplemental inspection. The NRC was notified by your staff on June 23, 2014, of your readiness for this inspection.

This supplemental inspection was conducted to provide assurance that the root causes and contributing causes of the events resulting in the White performance indicator were understood, that the extent of condition and extent of cause of any performance issues were identified, and that the corrective actions for the any performance issues were sufficient to address the root causes and contributing causes to prevent recurrence.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations, and with the conditions of your license. The inspectors reviewed selected procedures and records and interviewed plant personnel.

The NRC determined that the root and apparent cause evaluations (ACEs) completed for four of the five individual unplanned reactor scrams that resulted in the White performance indicator, as well as the aggregate root cause evaluation (RCE) completed in preparation for this inspection, were conducted to a level of detail commensurate with the significance of the problems and reached reasonable conclusions as to the root and contributing causes of the events. One RCE, however, has not yet been completed by your staff due to the need for additional failure analyses and evaluations. Despite the preliminary state of this RCE, the NRC concluded that enough information was available to the inspectors to assess your overall response to the White performance indicator, and the results of the forthcoming RCE will be reviewed during a subsequent baseline inspection. The NRC also concluded that you identified reasonable and appropriate corrective actions for each root and contributing cause and that the corrective actions appeared to be prioritized commensurate with the safety significance of the issues. The NRC has determined that completed or planned corrective actions were sufficient to address the performance issue that led to the White performance indicator. Therefore, the NRC concluded that your actions met the objectives of Inspection Procedure 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area."

Based on the results of this inspection, one self-revealed finding of very low safety significance was identified. The finding did not involve a violation of NRC requirements. If you contest the subject or severity of this finding, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. NRC, ATTN: Document Control Desk, Washington, DC 20555 0001, with a copy to the Regional Administrator, U.S. NRC Region III, 2443 Warrenville Road, Suite 210, Lisle, IL 60532 4352; the Director, Office of Enforcement, U.S. NRC, Washington, DC 20555 0001; and the Resident Inspector Office at the Clinton Power Station.

If you disagree with the cross-cutting aspect assigned to the finding in this report, you should provide a response within 30 days of the date of this inspection report, with the basis for your disagreement, to the Regional Administrator, Region III, and the NRC Senior Resident Inspector at the Clinton Power Station.

As a result of quarterly review of plant performance, which was completed on July 31, 2014, the NRC updated its assessment of Clinton Power Station, Unit 1. The NRC's evaluation consisted of a review of performance indicators and inspection results. This letter informs you of the NRC's assessment of your facility. This letter supplements, but does not supersede, the Annual Assessment Letter issued on March 3, 2014 (ADAMS Accession No. ML14063A258).

The NRC's review of Clinton Power Station, Unit 1, identified that Unplanned Scrams per 7,000 Critical Hours performance indicator had returned to below the Green-to-White threshold in the second Quarter of 2014. In accordance with the guidance in Inspection Manual Chapter 0305, "Operating Reactor Assessment Program," the White performance indicator will only be considered in assessing plant performance through the first quarter of 2014. Therefore, as a result of the successful completion of the supplemental inspection and a Green Unplanned Scrams per 7,000 Critical Hours performance indicator, the NRC determined the performance at Clinton Power Station, Unit 1, to be within the Licensee Response column of the ROP Action Matrix as of the date of this letter.

In accordance with Title 10 of the *Code of Federal Regulations* 2.390, “Public Inspections, Exemptions, Requests for Withholding,” of the NRC's "Rules of Practice," a copy of this letter and its enclosure, and your response (if any) will be available electronically for public inspection in the NRC Public Document Room or from the Publicly Available Records System (PARS) component of NRC's Agencywide Documents Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html (the Public Electronic Reading Room).

Sincerely,

/RA/

Christine A. Lipa, Chief
Branch 1
Division of Reactor Projects

Docket No. 50-461
License No. NPF-62

Enclosure:
Inspection Report 05000461/2014008
w/Attachment: Supplemental Information

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

Docket No:	50-461
License No:	NPF-62
Report No:	05000461/2014008
Licensee:	Exelon Generation Company, LLC
Facility:	Clinton Power Station
Location:	Clinton, IL
Dates:	July 7 through 28, 2014
Inspectors:	R. Ruiz, Senior Resident Inspector, LaSalle Station E. Sanchez Santiago, Resident Inspector, Clinton Power Station
Approved by:	Christine A. Lipa, Chief Branch 1 Division of Reactor Projects

Enclosure

SUMMARY OF FINDINGS

Inspection Report 05000461/2014008; 07/7/2014 – 07/28/2014; Clinton Power Station; Supplemental Inspection 95001.

This report covers a one-week period of an announced supplemental inspection of a White performance indicator (PI) for unplanned scrams in the Initiating Events cornerstone. The inspection was conducted by a senior resident inspector and a resident inspector. One self-revealed Green finding was identified. The significance of most findings is indicated by their color (i.e., green, white, yellow, or red) using the NRC Inspection Manual Chapter (IMC) 0609, "Significance Determination Process." Cross-cutting aspects are determined using IMC 0310, "Aspects within the Cross-Cutting Areas." The Nuclear Regulatory Commission's (NRC) program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 5.

This inspection was conducted in accordance with IP 95001, "Supplemental Inspection for One or Two White Inputs in a Strategic Performance Area," to assess the licensee's evaluation of one White PI in the Initiating Events Cornerstone. The PI for Unplanned Reactor Scrams per 7,000 Critical Hours exceeded the Green-to-White threshold, which was reported in the licensee's fourth quarter 2013 PI submittal. As discussed in the Annual Assessment Letter dated March 4, 2014 (ADAMS Accession No. ML14063A258), this change in PI status caused Clinton Unit 1 to transition from the Licensee Response column to the Regulatory Response column of the ROP Action Matrix in the fourth quarter of 2013. The NRC informed the licensee of this transition in a letter dated February 5, 2014, (ADAMS Accession No. ML14037A328).

In preparation for the inspection, the licensee performed a root cause evaluation (RCE) to address the White PI. This aggregate RCE was reviewed during the inspection to address the objectives of the inspection procedure. In addition, the inspectors also reviewed the licensee's root or apparent cause evaluations (ACEs) conducted for each of the five individual unplanned reactor scrams. The inspectors determined that the licensee's aggregate RCE was conducted to a level of detail commensurate with the significance of the problem and reached reasonable conclusions. The inspectors also concluded that the licensee identified reasonable and appropriate corrective actions and that the corrective actions appeared to be prioritized commensurate with the safety significance of the issue.

The aggregate RCE reviewed the five unplanned reactor scrams that contributed to the White PI and an additional two reactor scrams over the previous five years (i.e., from 2009 to present), as well as an near-miss event that had the potential to lead to a reactor scram. The evaluation discussed the conclusions that were drawn when those events were reviewed in aggregate. The conclusions from the licensee's root cause team included one contributing cause and one observation. The root, apparent, direct and contributing causes, and factors associated with the eight scrams reviewed were sufficiently diverse such that no commonality was identified that met the licensee's definition of a root cause. As such, this aggregate evaluation did not reveal a root cause.

The Unplanned Scrams per 7,000 Critical Hours PI returned below the Green-to-White threshold in the second quarter 2014. Therefore, given the licensee's acceptable performance in addressing the White PI, in accordance with the guidance in IMC 0305, "Operating Reactor Assessment Program," the White PI will only be considered in assessing plant performance through the first quarter of 2014. As a result, the NRC determined the performance at Clinton

Power Station, to be in the Licensee Response Column of the ROP Action Matrix as of the date of this inspection report and assessment follow-up letter.

NRC-Identified and Self-Revealed Findings

Cornerstone: Initiating Events

Green. The inspectors documented a self-revealing Green finding associated with the failure to follow procedures when performing power ascension testing on the digital feedwater (DFW) system. Specifically, contrary to procedure CPS 2894.01, "Digital FWLCS [feedwater level control system] Modifications Test - Power Ascension," Section 9.1, the licensee did not declare a Level 1 criterion failure when unacceptable oscillations were noted during a transition in the power ascension test. This resulted in the licensee declaring the test successful and returning the system to service without taking the appropriate corrective actions to address the oscillations. This contributed to the subsequent scram caused by reactor water level oscillations.

The failure to follow procedures when performing power ascension testing on the digital feedwater system was a performance deficiency. The performance deficiency was more than minor because it was associated with the design control attribute of the Initiating Events Cornerstone and adversely affected the cornerstone objective to limit the likelihood of those events that upset plant stability and challenge critical safety functions during shutdown as well as power operations and is therefore a finding. Using IMC 0609, Attachment 4 "Initial Characterization of Findings," and Appendix A "The Significance Determination Process for Findings at Power", issued June 19, 2012, the finding was determined to be of very low safety significance (Green) because it did not cause a reactor trip with a coincident loss of mitigating equipment. The inspectors determined this finding affected the conservative bias aspect of the of human performance cross-cutting area described as being present when the organization uses decision making practices that emphasize prudent choices over those that are simply allowable. Specifically, the licensee used non-conservative assumptions when determining whether the condition identified during the power ascension test was allowable (H.14). This finding does not involve enforcement action because no violation of regulatory requirements was identified. (Section 4OA4.2.01.d)

Licensee-Identified Violations

None

REPORT DETAILS

4. OTHER ACTIVITIES

4OA4 Supplemental Inspection (95001)

.1 Inspection Scope

This inspection was conducted in accordance with IP 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area," to assess the licensee's evaluation of one White Unplanned Reactor Scrams per 7,000 Critical Hours PI in the Initiating Events Cornerstone. The PI exceeded the Green-to-White threshold as reported in the licensee's fourth quarter 2013 PI submittal. The inspection objectives were to:

- provide assurance that the root causes and contributing causes of risk-significant performance issues are understood;
- provide assurance that the extent of condition and extent of cause of risk-significant issues are identified; and
- provide assurance that licensee corrective actions to risk significant performance issues are sufficient to address the root causes and contributing causes, and to prevent recurrence.

The five unplanned reactor scrams that caused the PI to exceed the Green-to-White threshold are briefly described below:

- Reactor Scram Due to Main Generator Trip

  On March 7, 2013, an automatic reactor scram occurred due to a main generator trip followed by a turbine trip. The cause of the generator trip was determined to be a degraded fuse on the 'C' phase of the main generator's voltage regulating potential transformer. The plant was in Mode 1 and at 96.9 percent reactor power at the time of the scram.

- Reactor Scram Due to Loss of Electro Hydraulic Control (EHC) Fluid

  On April 26, 2013, the operators manually scrammed the reactor due to rapidly decreasing level in the Main EHC oil reservoir. The cause was determined to be the failure of a socket head cap screw that was used to attach a hydraulic shutoff valve to a main steam control valve. The plant was in Mode 1 and at 97 percent reactor power at the time of the scram.

- Reactor Scram Due to a Transformer Failure

  On December 8, 2013, the operators manually scrammed the reactor as a result of degrading conditions caused by a loss of 480V Division 1 power caused by a fault on a 4160V-to-480V transformer. The most probable cause was determined to be a turn to turn failure of the high side windings due to insulation breakdown. The plant was in Mode 1 and at 97.3 percent reactor power at the time of the scram.

- Reactor Scram Due to Reactor Water Level Oscillations

  On December 13, 2013, the operators manually scrammed the reactor due to reactor vessel level approaching the high level set point while the licensee was transitioning from the motor driven reactor feed pump to a turbine driven reactor feed pump. The cause was determined to be software errors in the new DFW control system. The plant was in Mode 1 and at 18 percent power at the time of the scram.

- Reactor Scram Due to Loss of Condenser Vacuum

  On March 25, 2014, the operators manually scrammed the reactor due to the failure of a Steam Jet Air Ejector (SJAE) controller that resulted in lowering the condenser vacuum. The cause was determined to be the unstable pressure control of the 'B' SJAE due a system resonance or instability. The plant was in Mode 1 and at 85 percent power at the time of the scram.

On June 23, 2014, the licensee notified the NRC that applicable corrective actions to address the White PI had either been completed or initiated, and that it was ready for the NRC to conduct its supplemental inspection to review the actions taken to address the PI. In preparation for the inspection, the licensee performed a root cause evaluation RCE 1615306, "CPS [Clinton Power Stations] Exceeded Threshold for Initiating Events – White PI," to address the White PI. This aggregate RCE was reviewed during the inspection to address the specific requirements of the IP. Additionally, the licensee completed a focused area self-assessment (FASA), dated June 17, 2014, to validate its readiness for this inspection.

In addition to the aggregate RCE for the White PI mentioned above, the inspectors also reviewed the licensee's RCEs/apparent cause evaluation (ACE) conducted for each of the five individual unplanned reactor scrams. The following ACE and RCEs were also the subject of this inspection:

- ACE 1484624, "Main Generator Experienced a Trip that Resulted in a Reactor Scram";
- RCE 1506929, "Manual Scram Due to Loss of EHC Fluid";
- RCE 1594407, "Manual Scram Due to Transformer Failure";
- RCE 1596987, "Manual Scram Due to Reactor Feedwater Oscillations"; and
- RCE 1638433, "Manual Scram Due to Loss of Condenser Vacuum".

The inspectors reviewed corrective actions that were taken or planned to address the identified causes. The inspectors also held discussions with licensee personnel to ensure that the root and contributing causes, and the contribution of safety-culture components, were understood and that corrective actions taken or planned were appropriate to address the causes and preclude repetition. The inspectors did not review RCE 1594407 for the transformer failure event because at the time of this inspection, the RCE was not yet completed by the licensee due to pending failure analyses and evaluations, scheduled in mid-2015. This RCE will be reviewed during a

subsequent baseline inspection and is being tracked as an unresolved item (see Section 4OA5).

The following inspection results are organized by the specific inspection objectives of IP 95001.

.2 Evaluation of Inspection Requirements

02.01 Problem Identification

a. *Determine whether the evaluation documented who identified the issue (i.e., licensee, self-revealing, or NRC-identified), and under what conditions the issue was identified.*

The inspectors determined that the licensee's RCE adequately identified when the Unplanned Reactor Scrams per 7,000 Critical Hours PI crossed the Green-to-White threshold after the fourth reactor scram occurred. The unplanned reactor scram on December 13th, 2013, caused by the reactor water level oscillations, was the fourth unplanned reactor scram in 2013 and resulted in exceeding the White PI threshold. Each of the five unplanned scrams described above that contributed to the PI was the result of self-revealed events.

The inspectors determined that the RCEs adequately documented who identified the issues and under what conditions the issue was identified.

b. *Determine whether the evaluation documented how long the issue existed and prior opportunities for identification.*

The Unplanned Reactor Scrams per 7,000 Critical Hours PI exceeded the Green-to-White threshold as reported in the licensee's fourth quarter 2013 PI submittal. The licensee's evaluation correctly documented that this occurred with the fourth unplanned reactor scram on December 13, 2013. As discussed in the licensee's evaluation, each of the five reactor scrams was sufficiently unique, such that there was no prior opportunity for identification and actions to preclude the PI exceeding the White threshold.

With regards to each individual RCE, the licensee determined there was prior opportunity for identification and actions to preclude two of the five reactor scrams. These were: (1) the manual scram due to feedwater oscillations, because similar reactor water level oscillations occurred during power ascension testing following installation of the DFW level control, and (2) the manual scram due to loss of condenser vacuum, because there were multiple reports of unstable 'B' SJAE dilution steam flow that was identified as early as 1988.

The inspectors determined that the RCEs adequately documented how long the issue existed and whether there were any prior opportunities for identification.

c. *Determine whether the evaluation documented the plant specific risk consequences and compliance concerns associated with the issue.*

The licensee performed a risk assessment of the White PI, taking into consideration the plant specific risk consequences in the areas of industrial safety, nuclear safety, chemical/radiological safety and regulatory impact. The licensee determined there was

no impact to industrial safety or chemical/radiological safety. In the case of nuclear safety, as noted in the licensee's evaluation, the White PI represented performance outside an anticipated range of industry performance, thus indicating an increase in the frequency of those events that challenge safety functions during power operations. The inspectors determined that nuclear safety significance and risk was appropriately discussed in the licensee's evaluation for the White PI. The licensee's RCE also appropriately identified the regulatory impact of the White PI, recognizing that this resulted in Clinton Power Station moving from the Licensee Response column to the Regulatory Response Column of the Action Matrix, which necessitated additional inspection as well as a Regulatory Performance Meeting.

The current licensee procedure for performing RCEs does not require a risk assessment be performed if the root cause of the issue has been identified. Therefore, a risk evaluation was not documented in each individual root cause. During the performance of the FASA, the licensee noted this discrepancy between their procedure and the aspects covered by the IP 95001 procedure and determined the risk consequences of each individual event, documenting the results in both the FASA and the aggregate root cause evaluation. The licensee concluded that none of the five events significantly challenged safety systems. The event that represented the highest conditional core damage probability (CCDP) was the December 8, 2013, event, resulting from the shutdown and unavailability of the Low Pressure Core Spray system and secondary containment caused by the transformer failure, with a CCDP of 6.9E-6.

During their review at the time of each event, the resident inspectors evaluated plant parameters, operator actions, risk-significance, and overall plant status including the availability of mitigating systems. For each of the scrams, the inspectors determined that all safety systems responded as designed, the scrams were not complicated by material condition deficiencies, and no human performance errors complicated the event response.

Upon reviewing the risk assessments for the individual root causes as well as the aggregate root cause, the inspectors had the following observation:

- Regarding RCE 1638433, "Manual Scram Due to Loss of Condenser Vacuum," the inspectors noted that the risk assessment section was not performed in accordance with corrective action program (CAP) procedure PI-AA-125-1006, "Investigations Techniques Manual," Attachment 18. Specifically, the procedure provides guidance to perform a risk assessment of both the backwards-looking consequences of the event in a manner that adequately captures the change in risk resulting from the event, e.g., CCDP, as well as the risk going forward with an issue whose root cause is yet to be determined. The inspectors noted that in this particular RCE, the backwards-focused assessment of consequences was not performed as part of this RCE. The aggregate RCE and FASA did, however, provide enough detail to satisfy this objective of the 95001 procedure.

Based upon the above documented observations, the inspectors concluded that the licensee appropriately documented the risk consequences and compliance concerns associated with the issue.

b. Findings

Failure to Identify a Level 1 Test Criterion Failure

Introduction: The inspectors documented a self-revealed Green finding associated with the failure to follow procedures when performing power ascension testing on the DFW system. Specifically, contrary to procedure CPS 2894.01 ”Digital FWLCS Modifications Test - Power Ascension,” Section 9.1, the licensee did not declare a Level 1 criterion failure when unacceptable oscillations were noted during a transition in the power ascension test. This resulted in the licensee declaring the test successful and returning the system to service without taking the appropriate corrective actions to address the issue. This contributed to a subsequent scram caused by reactor water level oscillations.

Description: During the last refueling outage (C1R14), the licensee installed a DFW system. On October 30, 2013, the licensee performed power ascension testing, which was a portion of the required post modification testing. When transitioning between test segments, the licensee was in the process of securing the motor driven feedwater pump when reactor water level diverged from setpoint and became unstable. This level-transient was not documented as a test failure even though the diverging level did not meet Level 1 test acceptance criteria, as specified in CPS 2894.01. Level 1 Test Criterion states that when in automatic mode of control, the response of the feedwater level control to any input or disturbance must not diverge. The Level 1 Criterion is also described in the Updated Safety Analysis Report, Section 14.2.12.20.4A, and is considered to be a criterion associated with plant safety.

The steps required to resolve Level 1 Criterion failures include placing the plant in a hold condition that is judged to be satisfactory and safe, pursuing resolution of the identified problem and repeating the applicable actions to verify that the Level 1 requirements are satisfied following resolution. These test control items were not followed to resolve the identified problem and validate acceptable resolution.

Subsequently on December 13, 2013, during power ascension, when the reactor was at approximately 18 percent power, operators were preparing to transition from the motor driven feed pump to the turbine driven feed pump when flow from the two feed pumps began to oscillate causing the reactor water level to oscillate. This subsequently led to the operators manually scramming the reactor due to reactor water level approaching the high level trip set point.

The licensee performed a RCE in order to determine why this had occurred and concluded the failure to identify the level divergence noted during the power ascension testing as a Level 1 test failure was a contributing cause. This issue was documented in action request 1686250.

Analysis: The failure to follow procedures when performing power ascension testing on the DFW system was a performance deficiency. Specifically, contrary to procedure CPS 2894.01 ”Digital FWLCS Modifications Test - Power Ascension,” Section 9.1, the licensee did not declare a Level 1 criterion failure when unacceptable oscillations were noted during a transition in the power ascension tests. The performance deficiency was more than minor because it was associated with the design control attribute of the Initiating Events Cornerstone and adversely affected the cornerstone objective to limit

the likelihood of those events that upset plant stability and challenge critical safety functions during shutdown as well as power operations and is therefore a finding. Using IMC 0609, Attachment 4 "Initial Characterization of Findings," and Appendix A "The Significance Determination Process for Findings at Power", issued June 19, 2012, the finding was screened against the Initiating Events Cornerstone and determined to be of very low safety significance (Green) because the finding did not cause a reactor trip with a coincident loss of mitigating equipment relied upon to transition the plant from the onset of the trip to a stable shutdown condition. The inspectors determined this finding affected the conservative bias aspect of the human performance cross-cutting area where the organization uses decision making practices that emphasize prudent choices over those that are simply allowable. Specifically, the licensee used non-conservative assumptions when determining whether the condition identified during the power ascension test was allowable. (H.14)

Enforcement: This finding does not involve enforcement action because no violation of a regulatory requirement was identified. Because this finding does not involve a violation and is of very low safety significance, it is identified as a finding.
(FIN 05000461/2014008-01, "Failure to Identify a Level 1 Test Criterion Failure")

2.02 Root Cause, Extent of Condition, and Extent of Cause Evaluation

a. Determine whether the problem was evaluated using a systematic methodology to identify the root and contributing causes.

In its aggregate root cause analysis, the licensee used the Pareto Analysis method to determine whether any commonality existed between the five scrams. The licensee also used other methods when determining the individual root/apparent causes such as, Event and Causal Factors charting, TapRoot methodology, Barrier Analysis, Evaluation Guide for Equipment Issues, and the Support/Refute matrix.

The inspectors determined that the aggregate RCE, as well as the individual RCEs, adequately applied systematic methodologies to identify the root and contributing causes.

b. Determine whether the root cause evaluation was conducted to a level of detail commensurate with the significance of the problem.

The licensee's evaluation reviewed the five unplanned reactor scrams that contributed to the White PI, an additional two reactor scrams over the previous three years (i.e., from 2009 to present), as a well as a near-miss event that had the potential to lead to a reactor scram. The evaluation discussed the conclusions that were drawn when those events were reviewed in aggregate. The root, apparent, direct and contributing causes, and factors associated with the eight scrams reviewed were considered by the licensee to be sufficiently diverse such that no commonality was identified that met its definition of a root cause or a contributing cause. The evaluation did not reveal a common root cause. The individual causal analysis reports for the five scram events associated with the White PI were also reviewed by inspectors.

The inspectors determined that the RCEs and ACE were conducted to a level of detail commensurate with the significance of the problem.

c. *Determine whether the root cause evaluation included a consideration of prior occurrences of the problem and knowledge of prior operating experience.*

The licensee's aggregate and individual RCEs/ACE included a review of prior occurrences and internal/external operating experience.

The aggregate RCE concluded that prior to the current unacceptable frequency of scrams, there were no similar occurrences and no new information was identified during its internal/external operating experience review that could have been used to predict/prevent the White PI. Therefore, no additional corrective actions were developed as a result of this review.

For two of the five individual event evaluations (RCE 1596987, "Manual Scram Due to Reactor Feedwater Oscillations," and RCE 1638433, "Manual Scram Due to Loss of Condenser Vacuum"), the licensee concluded there were various opportunities to identify the issues prior to them occurring. These conclusions were entered into the licensee's CAP to address any underlying issues from the previous occurrences and operating experience review process. Additionally, operating experience existed from Braidwood with respect to the manufacturing defect of the fuse associated with ACE 1484624, "Main Generator Experienced a Trip that Resulted in a Reactor Scram." However, there was no reasonable prior opportunity to prevent this event at Clinton Power Station because the Nuclear Event Report, a licensee's internal operating experience document, was not distributed by Braidwood until one day before the Clinton event occurred.

The inspectors determined that the causal evaluations included consideration of prior occurrences of the problem and knowledge of prior operating experience.

d. *Determine whether the root cause evaluation addressed extent of condition and extent of cause of the problem.*

The aggregate RCE did not identify any root or contributing causes, therefore no extent of cause review was performed by the licensee and no additional corrective actions were developed for these specific areas. The aggregate RCE did briefly address the extent of condition, looking specifically at unplanned scrams per 7,000 hours and determined that there was no other occurrence where they were close to exceeding the White PI, based on the established scope.

Each of the five unplanned reactor scrams was individually evaluated by a RCE or ACE, and each of those evaluations addressed the extent of condition and extent of cause of the problem that resulted in the scrams. Corresponding corrective actions appeared to be appropriate to address the problems.

The specific root/apparent cause of each scram event (as determined by the licensee), as well as the scope of the extent of condition/cause review are listed below:

- ACE 1484624, "Main Generator Experienced a Trip that Resulted in a Reactor Scram," determined the cause to be a manufacturing defect whose extent of cause affected all fuses manufactured by Eaton-Cutler-Hammer in the Dominican Republic facility produced after April 1, 2001. The extent of condition review revealed that this same type of fuse was installed in 15 other locations

throughout the plant at the time, including some safety-related applications. All such fuses have since been replaced.

- RCE 1506929, "Manual Scram Due to Loss of EHC Fluid," determined the cause to be inadequate work instructions, which led to a failure to install appropriate lock washers, resulting in socket head cap screw failure due to fatigue. The extent of condition review did identify one additional instance of a missing lock washer in the EHC system, but the fasteners were verified to still have enough torque to maintain the seal leak tight.

  The inspectors noted during their review of the extent of cause for the individual RCEs that a narrow scope was applied by the licensee when addressing the extent of cause for RCE 1506929. Specifically, the inspectors noted that the extent of cause review performed by the licensee was limited solely to the EHC system, and did not include a broader look at other systems that had the potential to scram the reactor, in order to determine whether the causes identified during the RCE potentially extended beyond the affected system. The licensee captured this observation in an action request.

- RCE 1594407, "Manual Scram Due to Transformer Failure," was not reviewed by the inspection team due to the preliminary status of the causal evaluation. Specifically, the failed transformer still needs to be removed and sent offsite for in-depth failure analysis to determine the root cause of the failure. This is being tracked for future inspection as an unresolved item (See Section 4OA5).

- RCE 1596987, "Manual Scram Due to Reactor Feedwater Oscillations," identified that the root cause was that system and component level critical characteristics and parameters were embedded within the application software and were not identified, evaluated, and mitigated in the engineering change package.

  The licensee's extent of condition and extent of cause reviews focused on the methods and procedures utilized in the development of the modification package and identified a number of gaps. Specifically, a number of causal factors were present when the extent of condition scope was investigated. For example, the DFW system places the motor driven reactor feedwater pump in automatic and parallels with a turbine driven reactor feed pump without a permissive of stable level. In addition, the same DFW software algorithm error was found in three more sections that are used to calculate flow through the feedwater regulator valve. Corrective actions were developed to address each of the gaps identified in the extent of condition evaluation. The investigation also considered Operations' preparation prior to the event, and their response during and after the event.

- RCE 1638433, "Manual Scram Due to Loss of Condenser Vacuum," determined the cause of the event to be unstable pressure control of the 'B' SJAE. The most probable cause of the unstable performance of the system is still the subject of future in-depth evaluation by the licensee, but is believed to be due to a system resonance or instability in the 'B' SJAE system. The extent of condition review included the 'A' SJAE, as it is the same design and performs the same function (redundant trains). Actions were assigned to address the 'A' train, including updating the controller. The extent of cause review of historical data indicated

that similar operating characteristics have been observed with 'A' SJAE but the magnitude of the oscillations was significantly lower. Lessons-learned with regards to tuning, etc., will be applied to both trains.

Overall, the inspectors concluded that the licensee's analysis appropriately addressed extent of condition and extent of cause of the problems.

e. *Determine whether the root cause evaluation, extent of condition, and extent of cause evaluations appropriately considered the safety culture components as described in IMC 0310.*

The inspectors reviewed the RCEs and validated the licensee had systematically considered each of the safety culture components. Five safety culture components, Resources, Inadequate Work Instructions, Design Documentation, Decision Making and Resolution, were identified. Only the Resources cross-cutting aspect was identified in more than one RCE. Therefore, the licensee concluded that there was no commonality as a result of the safety culture review. The licensee did consider the insights obtained during the individual RCEs when addressing the root and contributing causes. Associated corrective actions contained appropriate elements to improve overall human performance.

The inspectors determined that, the root cause, extent of condition, and extent of cause evaluations appropriately considered the safety culture components as described in IMC 0310, "Aspects Within Cross Cutting Areas," dated December 19, 2013.

f. *Findings*

No findings were identified.

2.03 Corrective Actions

a. *Determine whether appropriate corrective actions are specified for each root/contributing cause or that the licensee has an adequate evaluation for why no actions were necessary.*

The inspectors reviewed each of the five causal evaluations and their associated corrective actions. The specific causes identified by the licensee for each of the issues were discussed above in section 2.02.d. A summary of the main corrective actions for each of the events is listed below:

- ACE 1484624, "Main Generator Experienced a Trip that Resulted in a Reactor Scram," documented that corrective actions were completed to replace all suspect fuses identified in the extent of cause, and to remove from stock any of the suspect fuses.

- RCE 1506929, "Manual Scram Due to Loss of EHC Fluid," documented that corrective actions were completed to address any existing field conditions where lock washers were not installed. Also, corrective actions were completed to address the bill of materials used for future recurring work orders.

- RCE 1594407, "Manual Scram due to Transformer Failure," was not reviewed by the inspection team due to the preliminary status of the causal evaluation.

However, corrective actions are open to remove the failed transformer and to send offsite to the vendor for failure analysis. This is being tracked for future inspection as an unresolved item (See Section 4OA5).

- RCE 1596987, "Manual Scram Due to Reactor Feedwater Oscillations," documented corrective actions to address issues identified within the engineering change process, to resolve issues with plant system performance, and to revise and issue station procedures as appropriate to correct any issues found.

- RCE 1638433, "Manual Scram Due to Loss of Condenser Vacuum," documented planned corrective actions that are open to address the resonance/instability issues following detailed system analysis, troubleshooting, and plant modifications.

The inspectors concluded that the corrective actions were clearly described and were entered into the licensee's corrective action program tracking system. The inspectors further concluded that the corrective actions appropriately addressed the root, apparent, and contributing causes of the events, and if properly implemented would address the problems identified within each of the evaluations. No concerns were identified.

b. *Determine whether corrective actions have been prioritized with consideration of risk significance and regulatory compliance.*

The inspectors determined that the licensee adequately prioritized the corrective actions with consideration of the risk significance and regulatory compliance. The inspectors reviewed the prioritization of the corrective actions and verified that, within reason, actions of a generally higher priority were scheduled for completion ahead of those of a lower priority. While many of the corrective actions were completed, some have not yet been completed.

c. *Determine whether a schedule has been established for implementing and completing the corrective actions.*

The inspectors determined that the licensee adequately established a schedule for implementing and completing the corrective actions. The schedule is tracked in the licensee CAP database. As discussed above, while many of the corrective actions were completed, some have not yet been completed. The remaining corrective actions have been scheduled along with effectiveness reviews. The inspectors concluded the timeline for completion of corrective actions was appropriate.

d. *Determine whether quantitative or qualitative measures of success have been developed for determining the effectiveness of the corrective actions to prevent recurrence.*

The inspectors determined that the licensee adequately developed quantitative or qualitative measures of success for determining effectiveness of the corrective actions to prevent recurrence.

Under the aggregate RCE 1615306, the licensee identified that an effectiveness review of the RCE would be conducted with the success criteria of having no further scrams in the interim of the review, and the restoration of Clinton Power Station to the Licensee Response column of the NRC Action Matrix. This review has a due date of September 27, 2014.

The licensee also identified effectiveness reviews associated with each of the root causes identified.

- RCE 1506929, "Manual Scram Due to Loss of EHC Fluid" identified an effectiveness review action to verify that all main steam control valve shutoff valves have lock washers installed and to verify that all model work orders have been updated to include the appropriate work steps (lock washers, lubrication) and include the correct washers in the bill of materials. This review has a due date of April 1, 2015.

- RCE 1594407, "Manual Scram due to Transformer Failure," was not reviewed by the inspection team due to the preliminary status of the causal evaluation. Specifically, the failed transformer still needs to be removed and sent offsite for in-depth failure analysis to determine the root cause of the failure and to complete the RCE process. This is being tracked for future inspection as an unresolved item (See Section 4OA5).

- RCE 1596987, "Manual Scram Due to Reactor Feedwater Oscillations," identified that its corrective action to prevent recurrence will be considered effective by verifying no significant events occur as a result of software errors from unverified critical characteristics and assumptions after implementing required design changes to the DFW Digital Control System in C1R15 and in implementing any other digital upgrades during fuel cycle 15. This review has a due date of June 20, 2015.

- RCE 1638433, "Manual Scram Due to Loss of Condenser Vacuum," determined that, contingent upon a future modification to the system, an effectiveness review would be performed to validate that 'B' SJAE can be put in service and operate successfully with acceptable control (minimal oscillations and proper pressure control). This review is due June 1, 2017.

The inspectors concluded the effectiveness reviews, overall, appeared to be appropriate. Additionally, the inspectors noted that although ACE 1484624 did not include discussion or actions to implement a formal effectiveness review, the corrective actions taken appeared to be sufficient to preclude the need for an effectiveness review.

e. Findings

No findings were identified.

4OA5 Other Activities

.1 (Opened) Unresolved Item: Evaluation of RCE 1594407 Against Inspection Procedure 95001 Objectives

Introduction: The inspectors identified an unresolved item (URI). During the initial review of RCE 1594407, "Automatic Trip of Breaker 1AP07EJ-0AP05E2 Transformer," it was determined that the IP 95001 objectives could not be evaluated at the time of the on-site inspection due to the pending nature of final failure analysis of the failed transformer, and the incomplete state of the RCE.

Description: The IP 95001 objectives of providing assurance that the root causes and contributing causes of risk-significant performance issues are understood; that the extent of condition and extent of cause of risk-significant performance issues are identified; and that the licensee's corrective actions for risk-significant performance issues are sufficient to address the root and contributing causes and prevent recurrence, could not be evaluated for acceptability because the RCE was incomplete pending future failure analysis, scheduled for mid-2015. As a result, the inspectors were unable to evaluate this RCE against the IP 95001 inspection objectives.

Specifically, a root cause was not yet identified by the licensee, so a complete extent of condition and extent of cause review could not be performed; nor could corrective actions to prevent recurrence be generated. Rather, a Special Plant Condition (SPC) was generated by the licensee. This SPC specified that, after the failure analysis by the vendor (ASEA Brown Boveri) is performed, this RCE will be revised to include the results of the failure analysis and the necessary additional information will be added within the body of RCE, corrective actions, extent of cause, extent of condition and effectiveness review, as applicable. Ultimately, per the SPC, the licensee will document the results and create additional actions as necessary by August 6, 2015.

The inspectors identified this as an issue of concern about which more information is required to determine if a performance deficiency exists. As defined in IMC 0612, this item is considered a URI until such time as the licensee's failure analysis is performed, the RCE is completed in such a manner that the NRC can evaluate its adequacy in accordance with the inspection objectives of IP 95001, and the follow-up review is completed by the NRC through the baseline inspection program.

This issue is a URI pending NRC evaluation of the additional information being developed by the licensee. **(URI 05000461/2014008-02, "Evaluation of RCE 1594407 Against Inspection Procedure 95001 Objectives")**

4OA6 Management Meetings

.1 Exit Meeting Summary

The inspectors presented the inspection results to Mr. K. Taber, the Site Vice-President, and other members of licensee management on July 28, 2014. The inspectors asked licensee management whether any materials examined during the inspection should be considered proprietary. No documents provided to the NRC contained proprietary information.

.2 Regulatory Performance Meeting

On July 28, 2014, as part of the exit meeting for the 95001 supplemental inspection, NRC management met with the licensee to discuss regulatory performance, in accordance with Section 10.02.b.4 of IMC 0305. During this meeting, the NRC and licensee discussed the primary issues related to the White Unplanned Scrams per 7000 Critical Hours PI that resulted in Clinton Power Station, Unit 1, being placed in the Regulatory Response column of the Action Matrix. This discussion included the causes, corrective actions, extent of condition, extent of cause, and other planned licensee actions.

SUPPLEMENTAL INFORMATION

KEY POINTS OF CONTACT

Licensee

D. Avery, Regulatory Assurance
K. Baker, Regulatory Assurance Manager
C. Dunn, Training Director
R. Frantz, Regulatory Assurance
M. Heger, Sr. Manager Plant Engineering
D. Kemper, Operations Director
D. Koons, Manager Site Project Manager
C. Propst, Nuclear Oversight Manager
J. Stovall, Maintenance Director
K. Taber, Site Vice President

Nuclear Regulatory Commission

C. Lipa, Branch Chief
R. Ruiz, Senior Resident Inspector - LaSalle, Team Lead
E. Sanchez Santiago, Resident Inspector
W Schaup, Senior Resident Inspector

LIST OF ITEMS OPENED, CLOSED, DISCUSSED

Opened

05000461/2014008-01	FIN	Failure to Identify a Level 1 Test Criterion Failure (Section 4OA4.2.01.d)
05000461/2014008-02	URI	Evaluation of RCE 1594407 Against Inspection Procedure 95001 Objectives (Section 4OA5.1)

Closed

05000461/2014008-01	FIN	Failure to Identify a Level 1 Test Criterion Failure (Section 4OA4.2.01.d)

Discussed

None

LIST OF DOCUMENTS REVIEWED

The following is a partial list of documents reviewed during the inspection. Inclusion on this list does not imply that the NRC inspectors reviewed the documents in their entirety, but rather that selected sections or portions of the documents were evaluated as part of the overall inspection effort. Inclusion of a document on this list does not imply NRC acceptance of the document or any part of it, unless this is stated in the body of the IR.

4OA4 Supplemental Inspection (95001)

- AR 1596987; Manual SCRAM on High Water Level during FW Transient in Auto, December 13, 2013
- AR 1506929; Loss of MEHC Causes Manual Reactor SCRAM; April 26, 2013
- AR 1615306; CPS Has Exceeded Threshold for Initiating Events - White PI; December 13, 2013
- AR 1157942; Individual Effectiveness Review; September 30, 2011
- AR 1578832; DFW – Feedwater Oscillations Between PAT Test Steps; October 30, 2013
- ACE 11157942; Apparent Cause Evaluation; January 3, 2011
- FASA 1617782; Focused Area Self-Assessment for White PI; June 17, 2014
- WO 1637538; Loss of MEHC Causes Manual Reactor SCRAM; April 26, 2013
- CPS 3004.01; Turbine Startup and Generator Synchronization; Revision 32c
- CPS 2894.01; Digital FWLCS Modification Test – Power Ascension; Revision 1
- CPS 1302.02; Conduct of Clinton Power Station Testing; Revision 13b
- LS-AA-125; Corrective Action Program (CAP) Procedure; Revision 17
- CC-AA-107; Post Modification Acceptance Testing; Revision 4
- EC 380150; Design Consideration Summary; Revision 4
- AR 1686285; NRC 95001 Observation – RCR Risk Assessment; July 28, 2014
- AR 1686284; NRC 95001 Observation – CAP Product Quality; July 28, 2014
- AR 1686252; NRC 95001 URI for Tracking Transformer Failure Analysis; July 28, 2014
- AR 1686250; NRC 95001 Finding for FW Level Control; July 28, 2014
- AR 1680574; 95001: RCR 1506929 Extent of Cause Narrowly Focused; July 10, 2014
- AR 1488214; Fleet Fuse Quality Impacted Plant Operation; March 15, 2013
- AR 1494489; 1AP05EH: Create WO To Inspect PT Fuses for Date Code; March 29, 2013
- AR 1494494; 1RR02EC: Create WO To Inspect PT Fuses for Date Code; March 29, 2013
- AR 1347942; 1CA002B: Condition of SJAEs; March 30, 2012
- AR 1677566; NOS ID: NIRB Recs for 95001 Inspection Readiness; July 1, 2014
- AR 1680574; 95001: RCR 1638433 Extent of Cause Narrowly Focused; July 10, 2014
- Procedure LS-AA-120; Issue Identification and Screening Process; Revision 15
- Procedure LS-AA-125; Corrective Action Program (CAP) Procedure; Revision 17
- Procedure PI-AA-120; Issue Identification and Screening Process; Revision 0
- PI 1E01; Unplanned Scrams per 7,000 Critical Hours Performance Indicator, July 1, 2013 – June 30, 2014
- WO 1634994-01; 1AP09E: Create WO to Replace PT Fuses; August 27, 2013
- WO 1634995-01; EM – Replace 4160V Bus 1A1 DG 1A Feed PT Fuses (DG 1A)
- RCE 1484624; IR 1484624; Reactor Scram Due to Generator Trip; March 7, 2013
- LER 2013-002-00; Deficient Fuse Causes Main Generator Trip, Turbine Trip and Reactor SCRAM; May 2, 2013
- AR 1680350; 95001: Wrong WO Number Referenced in Root Cause 1506929; July 10, 2014
- RCE 1506929; Root Cause Investigation Report: Manual Scram Due To Loss of EHC Fluid; Event Date: April 26, 2013

- LER 2013-003-00; Manual Reactor Scram Due to Main Electro-Hydraulic Control System Failure
- AR 1594407 Assignments 1-43; Automatic Trip of Breaker 1AP07EJ; December 9, 2013
- AR 1594407; MCR Received Multiple Alarms Due To Trip of 4160V 1A1 Breaker 1AP07EJ, 480V XFMR 1A and A1 Breaker; December 9, 2013
- RCE 1594407; LER 2014-008-00; Failure of Division 1 Transformer Leads to Isolation of Instrument Air Supply to Containment, Lowering Scram Pilot Air Header Pressure, and Manual Reactor Scram; February 3, 2014
- RCE 1596987; Manual Scram on High Water Level During FW Transient in Auto; December 13, 2013
- LER 2013-009-00; Software Errors in New Digital Feedwater Control System Result in Manual Reactor Scram Due to Approaching High Reactor Pressure Vessel Water Level Setpoint; February 10, 2014
- Root Cause Investigation Manual SCRAM Due to Reactor Water Level Oscillations While Initiating the Digital Feedwater (DFW) “Bring Pump Online” Command; January 15, 2014
- AR 1578482; 5019-5E Locked In When Should Be Reset; October 30, 2013
- AR 1602808; 1CA002B Install SJAE Isolation Bypass Switch; January 1, 2014
- Meeting Notes of Plant Health Committee Decisions/Action Items; February 27, 2012
- PHC Top Ten Issue Action Plan, OG/CA System Reliability; February 9, 2013
- System Health Report Unit 1, Condenser Vacuum; July 7, 2014
- System Health Reports Unit 1, Condenser Vacuum; 1st Quarter 2013, 2nd Quarter 2013, 3rd Quarter 2013, and 4th Quarter 2013
- WO 1337047; CM 1CA01AB: Inspect 1st and 2nd Stage Nozzles/ Diffusers; January 31, 2014
- WO 1500215; 1CA002B: Failed to Close After C/S Taken to Close; January 22, 2014

LIST OF ACRONYMS USED

ACE	Apparent Cause Evaluation
ADAMS	Agencywide Documents Access and Management System
CAP	Corrective Action Program
CCDP	Conditional Core Damage Probability
CPS	Clinton Power Station
DFW	Digital Feedwater
EHC	Electro Hydraulic Control
FASA	Focused Area Self-Assessment
FWLCS	Feedwater Level Control System
IMC	Inspection Manual Chapter
IP	Inspection Procedure
NRC	U.S. Nuclear Regulatory Commission
PARS	Publicly Available Records System
PI	Performance Indicator
RCE	Root Cause Evaluation
ROP	Reactor Oversight Process
SJAE	Steam Jet Air Ejector
SPC	Special Plant Condition
URI	Unresolved Item

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Sincerely,

/RA/

Christine A. Lipa, Chief
Branch 1
Division of Reactor Projects

Docket No. 50-461
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