

September 28, 2007

Mr. Christopher M. Crane
President and Chief Nuclear Officer
Exelon Nuclear
Exelon Generation Company, LLC
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: CLINTON POWER STATION
NRC SUPPLEMENTAL INSPECTION REPORT NO. 05000461/2007009(DRS)

Dear Mr. Crane:

On September 7, 2007, the U.S. Nuclear Regulatory Commission (NRC) completed a supplemental inspection at your Clinton Power Station. 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 enclosed inspection report documents the inspection results, which were discussed at the exit meeting on September 7, 2007, with Mr. B. Hanson and other members of your staff. The NRC was informed of your readiness for the inspection in June, 2007.

As required by the NRC Reactor Oversight Process Action Matrix, this supplemental inspection was performed in accordance with Inspection Procedure 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 the White finding involving inadequate consideration of vortexing in design calculations for the high pressure core spray system. This supplemental inspection was conducted to provide assurance that the root causes and contributing causes of the events resulting in the White finding are understood, to independently assess the extent of condition, and to provide assurance that the corrective actions for risk significant performance issues are sufficient to address the root causes and contributing causes, and to prevent recurrence. The inspection consisted of selected examination of representative records and interviews with personnel.

Based on the results of this supplemental inspection, no findings of significance were identified. The inspector determined that the cause evaluations and associated corrective actions were adequate.

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 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/

Julio F. Lara, Chief
Engineering Branch 3
Division of Reactor Safety

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

Enclosure: Inspection Report 05000461/2007009
w/Attachment: Supplement Information

cc w/encl: Site Vice President - Clinton Power Station
Plant Manager - Clinton Power Station
Regulatory Assurance Manager - Clinton Power Station
Chief Operating Officer
Senior Vice President - Nuclear Services
Vice President - Operations Support
Vice President - Licensing and Regulatory Affairs
Manager Licensing - Clinton Power Station
Senior Counsel, Nuclear, Mid-West Regional Operating Group
Document Control Desk - Licensing
Assistant Attorney General
Illinois Emergency Management Agency
State Liaison Officer, State of Illinois
Chairman, Illinois Commerce Commission

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Vice President - Licensing and Regulatory Affairs
Manager Licensing - Clinton Power Station
Senior Counsel, Nuclear, Mid-West Regional Operating Group
Document Control Desk - Licensing
Assistant Attorney General
Illinois Emergency Management Agency
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DATE	09/25/07		09/28/07		09/26/07			

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Inspection Report to Mr. C. Crane from Mr. J. Lara dated September , 2007.

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NRC SUPPLEMENTAL INSPECTION REPORT NO. 05000461/2007009(DRS)

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U.S. NUCLEAR REGULATORY COMMISSION

REGION III

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

Report No: 05000461/2007009

Licensee: AmerGen Energy Company, LLC

Facility: Clinton Power Station

Location: Clinton, IL 61727

Dates: August 28 - September 7, 2007

Inspector: R. A. Langstaff, Senior Reactor Inspector

Approved by: Julio F. Lara, Chief
Engineering Branch 3
Division of Reactor Safety

Enclosure

SUMMARY OF FINDINGS

IR 05000461/2007009(DRS); 08/28/2007 - 09/7/2007; Clinton Power Station; Supplemental Inspection IP 95001 - Mitigating Systems Cornerstone.

This report covered a supplemental inspection conducted by a regional inspector. No findings of significance were identified. The significance of most findings is indicated by their color (Green, White, Yellow, Red) using Inspection Manual Chapter (IMC) 0609, "Significance Determination Process (SDP)." Findings for which the SDP does not apply may be "Green" or be assigned a severity level after Nuclear Regulatory Commission (NRC) management review. The NRC's program for overseeing the safe operation of commercial nuclear power reactors is described in NUREG-1649, "Reactor Oversight Process," Revision 3, dated July 2000.

Cornerstone: Mitigating Systems

The NRC performed this inspection in accordance with Inspection Procedure 95001, "Inspection for One or Two White Inputs in a Strategic Performance Area." This inspection was conducted in response to a White Finding involving inadequate consideration of vortexing in design calculations for the high pressure core spray system.

The licensee performed two root cause evaluations and one focused area self-assessment pertinent to the White finding. The licensee's evaluations identified weaknesses in the design process and the process used for addressing regulatory issues. Based on the results of this inspection, the inspector determined that the licensee evaluations and associated corrective actions taken were adequate.

A. Inspector-Identified and Self-Revealed Findings

None

B. Licensee-Identified Violations

None

REPORT DETAILS

01 INSPECTION SCOPE

The purpose of this supplemental inspection was to assess the licensee's evaluation associated with the White finding involving inadequate consideration of vortexing in design calculations for the high pressure core spray system (HPCS).

The inspector reviewed the licensee's evaluation of the original design, and their response to the design issue. The inspector also reviewed a sample of corrective actions, the extent of condition review performed in response to the design issue, and conducted interviews with licensee personnel involved with the evaluations.

01.01 Background Information

In response to a 1994 NRC inspection, the licensee performed a calculation to evaluate the effects of vortexing in the reactor core isolation cooling (RCIC) tank upon the HPCS pump suction intake. In December 2005, the NRC identified that the methodology used by the 1994 calculation was inappropriate (documented in Inspection Report 05000461/2005002(DRS)), and that there was a potential for vortexing at the RCIC tank HPCS pump suction intake. The NRC subsequently determined that the issue represented a White finding (documented in Inspection Reports 05000461/2006011(DRS) and 05000461/2007006(DRS)). To evaluate the 1994 analysis methodology error, the licensee performed a root cause evaluation (RCE), "Inadequate High Pressure Core Spray (HPCS) Vortex Calculation," under action request 589228 (hereafter referred to as the primary RCE). The licensee's nuclear oversight organization reviewed the primary RCE, and identified that organizational and programmatic issues associated with how the vortexing issue was addressed after it was identified in December 2005 was not covered by the primary RCE. In response, the licensee performed an additional RCE, "Post August 2006 Organization Weakness Not Addressed," under action request 603347 (hereafter referred to as the follow-up RCE).

02 EVALUATION OF INSPECTION REQUIREMENTS

02.01 Problem Identification

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

The primary RCE documented that the NRC had identified the potential for vortexing at the RCIC tank HPCS pump suction intake during a 2005 inspection, which was consistent with the inspector's understanding. There were no events or incidents which involved actual vortexing within the RCIC tank. The issue was based on the methodology used to evaluate the potential for vortexing.

- b. *Determine that the evaluation documents how long the issue existed, and prior opportunities for identification.*

The primary RCE traced the issue to pre-construction events such as the General Electric HPCS specification omitting vortexing as a design consideration. The primary RCE also discussed prior opportunities for identification such as the 1998 revision of the original vortexing calculation. In the case of the 1998 revision, the primary RCE identified a failed barrier associated with the lack of an independent review. The primary RCE noted that engineering procedures had since been revised to require a more independent review.

- c. *Determine that the evaluation documents the plant specific risk consequences (as applicable) and compliance concerns associated with the issue.*

The primary RCE documented that the inappropriate engineering methodology for evaluating vortexing resulted in a White finding. The primary RCE also documented the compliance concerns associated with the finding. The inspector considered the documentation of risk consequences and compliance concerns to be sufficient.

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

- a. *Determine that the problem was evaluated using a systematic method(s) to identify root cause(s) and contributing cause(s).*

The primary RCE identified that the root cause associated with the 1994 analysis methodology was that the engineering organization failed to evaluate analytical margin of the end product against the uncertainties associated with the methodology used to develop the engineering product. The follow-up RCE identified weaknesses in the process used for addressing regulatory issues. Procedure weaknesses were specifically identified as root cause for the organizational and programmatic issues associated with how the vortexing issue was addressed after it was identified in December 2005. For both the primary and follow-up RCE's, the licensee used the TapRoot® Root Cause Tree® analysis method, developed an events and causal factors charts, and performed a cause tree analyses to arrive at their conclusions.

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

The inspector determined that both the primary and follow-up RCE's were conducted in sufficient detail commensurate with the significance of the problem. Specifically, both evaluations provided detailed discussions of the issues, timelines of relevant events, identified specific contributing causes, and provided extent of condition reviews to address individual contributing causes.

- c. *Determine that the RCE included a consideration of prior occurrences of the problem and knowledge of prior operating experience.*

The primary RCE discussed operating experience information. However, the operating experience prior to this event was relating to facilities which had not considered vortexing versus facilities not using the correct methodology for considering vortexing. As such, there were no operating experience events which were directly related to the finding involving the inappropriate methodology.

- d. *Determine that the RCE addresses the extent of condition and the extent of cause of the problem.*

The inspector reviewed the extent of condition review performed by the licensee for the primary RCE. As part of the extent of condition review, the licensee reviewed a sample of 53 design calculations out of a population of 394 calculations to identify inappropriate methodology or calculations involving empirically correlated data. Of the 53 calculations reviewed, the licensee identified three calculations as being historical, removed the historical calculations from the sample population, and reviewed three additional randomly selected calculations from the sample population. Although the licensee identified some errors in the calculations which had been reviewed, the licensee had not identified any technical oversights resulting in a potential or actual reduction in design margin.

The inspector reviewed the following calculations during this inspection which were among the 53 calculations reviewed by the licensee:

- 01HP08; Determination of NPSH for Pump 1E22C01 at Source Switchover; Revision 0;
- 3C10-0877-001; Elevation vs. Time for Poolswell in Clinton Plant; Revision 1;
- IP-M-0085; Drywell Post LOCA Vacuum Relief Valves Design: Drywell Leakage Area Limit Determination; Revision 1; and
- VD-7; Time-Temperature History Calc. for Diesel Generator Rooms; Revision 1.

Based on questions from the inspector, the licensee determined that calculation VD-7 was a historical calculation and initiated corrective action (action request 00562699-29) to change the classification of the calculation accordingly.

Based on review of calculation 01HP08, the inspector identified a minor technical deficiency. The inspector determined that a velocity head term was inappropriately used in the calculation for net positive suction head (NPSH). The term was applied in the calculation non-conservatively so as to give NPSH credit for losses associated with velocity. After discussing this issue with licensee engineering management, the licensee agreed that the use of the term in the calculation was inappropriate. The inspector noted that the error had not been identified by the licensee even though the calculation had been reviewed as part of the extent of condition review. Although the error was non-conservative, the inspector considered the error to be a minor deficiency because the error amounted to less than two percent of available margin. The licensee initiated

condition reports 00666222, "Non-Consequential Error in Calculation 01HP08," and 00668414, "Calc Sample Review Per IR 589228-31 Missed Error in 01HP08," to address this issue.

The inspector considered the corrective actions taken by the licensee to modify engineering procedures to be sufficient to address extent of cause for the primary RCE. The licensee had revised engineering procedures CC-AA-309, "Control of Design Analyses," and CC-AA-309-101, "Engineering Technical Evaluations," to require that engineers verify that margins are adequate to bound the uncertainties associated with analysis methodology and the actual calculations.

- e. *Determine that the RCE, extent of condition, and extent of cause appropriately considered the safety culture components as described in IMC 0305.*

The licensee addressed safety culture components as part of a focused area self-assessment (documented in action request 642769-04). The inspector reviewed the assessment and did not identify any concerns.

2.03 Corrective Actions

- a. *Determine that appropriate corrective action(s) are specified for each root/contributing cause or that there is an evaluation that no actions are necessary.*

Based on review of the primary RCE, the inspector determined that either actions were specified for each of root and contributing causes or there was a brief justification for not specifying a corrective action. The inspector noted that the licensee did not specify corrective actions for contributing causes which were historical in nature, including engineering culture. The licensee provided justifications which showed that processes in place at the time of the RCE was performed addressed the contributing cause considered historical in nature. The inspector considered the justifications provided to be acceptable.

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

The inspector did not identify any corrective actions associated with the primary RCE which were considered untimely. The inspector noted that once the inappropriate methodology for evaluating vortexing was brought to the licensee's attention in 2005, the licensee shifted HPCS and RCIC suction alignment from the RCIC tanks to the suppression pool to address immediate operability.

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

The inspector noted that a schedule was developed for the corrective actions associated with the primary RCE and that the corrective actions were completed at the time of this inspection.

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

As part of the primary RCE, the licensee had scheduled an effectiveness review to be performed by April 2008. The effectiveness review would consist of reviewing a sample of engineering products, including calculations, to verify that uncertainties were addressed.

03 MANAGEMENT MEETINGS

Exit Meeting Summary

On September 7, 2007, the inspectors presented their issues and observations to Mr. B. Hanson and other members of licensee staff in an exit meeting. The licensee confirmed that no proprietary information was reviewed during the inspection.

Regulatory Performance Meeting

On September 7, 2007, as part of the exit meeting associated with the 95001 inspection, the NRC met with the licensee to discuss their performance in accordance with Section 06.05.a.1 of IMC 0305. During this meeting, the NRC and licensee discussed the issues related to the White finding that resulted in Clinton Power Station 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

B. Hanson, Site Vice-President
S. Gackstetter, Regulatory Assurance Manager
F. Kearney, Plant Manager
R. Peak, Site Engineering Director
C. VanDenburgh, Nuclear Oversight Manager
R. Weber, Sr. Manager, Design Engineerig

Nuclear Regulatory Commission

J. Lara, Branch Chief
D. Thorp, Resident Inspector

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened and Closed

None

Discussed

None

LIST OF DOCUMENTS REVIEWED

The following is a 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 of 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 inspection report.

Action Requests

589228-04; Inadequate High Pressure Core Spray (HPCS) Vortex Calculation; dated March 2, 2007

603347; Post August 2006 Organization Weakness Not Addressed; dated May 24, 2007

642769-04; Self-Assessment in Preparation for NRC Supplemental Inspection on WHITE Finding for the High Pressure Core Spray (HPCS) Pump Suction Line to Preclude Vortex Formation and Subsequent Air Entrainment in the Pump's Suction; dated July 23, 2007

Action Requests Initiated as a Result of Inspection

00562699-29; Diesel Generator Time Temperature History; dated August 30, 2007

00666222; Non-Consequential Error in Calculation 01HP08; dated August 30, 2007

00666888; NRC 95001 Inspection, RCIC Tank Switchover Timing; dated August 31, 2007

00666942; NRC Identified a Potential Problem with HPCS Calculation; dated August 31, 2007

00668414; Calc Sample Review Per IR 589228-31 Missed Error in 01HP08; dated September 6, 2007

Calculations

01HP08; Determination of NPSH for Pump 1E22C01 at Source Switchover; Revision 1

01HP08; Determination of NPSH for Pump 1E22C01 at Source Switchover; Revision 1/A

01HP13; NPSH Calculation - HPCS Suction From Suppression Pool; Revision 1A

3C10-0877-001; Elevation vs. Time for Poolswell in Clinton Plant; Revision 1

IP-M-0085; Drywell Post LOCA Vacuum Relief Valves Design: Drywell Leakage Area Limit Determination; Revision 1

IP-M-0761; Evaluation of Vortex in the RCIC Storage Tank For HPCS and RCIC Suction Lines; Revision 1

IP-M-0761; Evaluation of Vortex in the RCIC Storage Tank For HPCS and RCIC Suction Lines;
Revision 1-A

VD-7; Time-Temperature History Calc. for Diesel Generator Rooms; Revision 1

Procedures

CC-AA-309; Control of Design Analyses; Revision 17

CC-AA-309-101; Engineering Technical Evaluations; Revision 9

LIST OF ACRONYMS USED

ADAMS	Agencywide Documents and Access Management System
CFR	Code of Federal Regulations
DRS	Division of Reactor Safety
HPCS	High Pressure Core Spray
IMC	Inspection Manual Chapter
LLC	Limited Liability Corporation
NPSH	Net Positive Suction Head
NRC	U.S. Nuclear Regulatory Commission
RCE	Root Cause Evaluation
RCIC	Reactor Core Isolation Cooling
SDP	Significance Determination Process