

Audit Summary
Review of Levy Nuclear Plant, Units 1 and 2
Design Change Related to the Containment
Condensate Return Pathway

September 2014

A. Background

By letter dated April 18, 2013, Progress Energy Florida, Inc., now Duke Energy Florida (DEF), submitted a request for exemption from the AP1000 rule and a description of associated design change departure from the AP1000 Design Control Document (DCD) Revision 19 as part of its application for a combined license (COL) for Levy Nuclear Plant Units 1 and 2 (Reference 1). The applicant determined that this design change required it to notify the Nuclear Regulatory Commission (NRC) for review of the proposed change in accordance with Interim Staff Guidance DC/COL-ISG-011, "Finalizing Licensing-basis Information." The Levy Nuclear Plant COL application incorporates the AP1000 DCD by reference.

The design change modifies the interior of the containment vessel in support of the condensate return portion of the passive core cooling system. The submittal includes a report developed for the AP1000 by Westinghouse Electric Company, LLC (Westinghouse) that provides a description of the change and the basis for the change. APP-GW-GLR-161, "Changes to Passive Core Cooling System Condensate Return," includes a regulatory evaluation of the updated condensate return design that addresses compliance with the applicable regulatory requirements.

An audit examining other documents related to the containment condensate return system departure and design change was conducted in 2013 (Reference 2).

B. Bases

This regulatory audit is based on the following:

- Title 10 *Code of Federal Regulations* (10 CFR), Part 52, Appendix D, Section VIII
- General design criteria (GDC) from Appendix A to 10 CFR Part 50
 - GDC 2, "Design bases for protection against natural phenomena"
 - GDC 4, "Environmental and dynamic effects design bases"
 - GDC 34, "Residual heat removal"
 - GDC 35, "Emergency core cooling"
 - GDC 36, "Inspection of emergency core cooling system"
- 10 CFR 50.46 and Appendix K to 10 CFR Part 50, as they relate to analysis of passive residual heat removal heat exchanger performance
- Standard Review Plan Section 6.2.2 "Containment Heat Removal Systems"
- DC/COL-ISG-011, "Finalizing Licensing-basis Information"
- Standard Review Plan Section 6.3, "Emergency Core Cooling System"

The primary purposes of the audit was to gain a better understanding of the detailed calculations, analyses, and bases underlying the aforementioned departure and design change and confirm the staff's understanding of the departure and design change.

The audit plan is available in the Agencywide Documents Access and Management System (ADAMS) under Accession Number ML14007A102.

C. Audit Location and Dates

Location: Westinghouse Electric Company, LLC
Washington Operations
12300 Twinbrook Parkway, Suite 150
Rockville, MD 20852

Dates: January 7, 2014, through July 31, 2014.

D. Audit Team Members

The following NRC staff members participated in substantive discussions during the audit:

Harry Wagage, NRC Audit Team Lead (Containment)
Boyce Travis (Containment)
John McKirgan (Containment)
Chris Van Wert (Reactor Systems)
Timothy Drzewiecki (Reactor Systems)
Jim Gilmer (Reactor Systems)
Shanlai Lu (Reactor Systems)
Yiu Law (Mechanical Engineering)
Sardar Ahmed (Mechanical Engineering)
Malcolm Patterson (Probabilistic Risk Assessment)
Donald Habib, NRC Project Manager

E. Applicant and Industry Staff Participants

| <u>Duke Energy Florida</u> | <u>Westinghouse</u> | <u>Other</u> |
|---|--|---|
| Bob Kitchen David Waters Robert Gamberg | Terry Schulz Sylena Smith Chuck Brockhoff Nicholas Powell Rick Ofstun Marko Randjelovic Rick Wright Ryan Burda Ed Monahan Alan Trupiano Rick Weber Chuck Brockhoff Matt Swartz Sean Miller Sunny Jhurani John Lojek Alan Macdonald | Steve Franzone, Florida Power and Light Chuck Herbst, Southern Nuclear Company |

F. Documents Audited

The audit focused on the availability and performance of the long-term, passive removal of decay heat from the reactor coolant system using the passive residual heat removal heat exchanger (PRHR HX). The audit team reviewed the following documents supporting APP-GW-GLR-161, Revision 1:

- TR-SEE-III-12-01, "AP1000 Condensate Return Test Report",
- APP-PXS-M3C-071, "Containment Response Analysis for the Long Term PRHR Operation"
- APP-PXS-M3C-072, "Condensate Return to IRWST for Long Term PRHR Operation"
- APP-PXS-M3C-020, "PRHR HX Sizing/Performance"
- APP-SSAR-GSC-536, "AP1000 Safe Shutdown Temperature Evaluation"
- APP-PXS-M3C-033, "Containment Floodup Volume Calculation"
- APP-PXS-M3C-034, "Containment Floodup Level"
- APP-PXS-M3C-002, "Passive Core Cooling System (PXS) Condensate Return Downspout Sizing"
- WCAP-12980, "AP600 Passive Residual Heat Removal Heat Exchanger Test Final Report"
- WCAP-14234-P, "LOFTRAN and LOFTTR2 AP600 Code Applicability Document"
- WCAP-15644, "AP1000 Code Applicability Report"

G. Description of Audit Activities and Summary of Observations

NRC staff visited the Westinghouse Twinbrook office to review documents on January 8, January 10, January 16, January 17, January 30*, February 21, April 24, May 15, May 30, June 2, and July 8, 2014.

Staff reviewed APP-SSAR-GSC-536, Revision 0 (supporting Rev. 15 of the DCD), "AP1000 Safe Shutdown Temperature Evaluation," APP-SSAR-GSC-111, "Film Holdup Volume Estimate for AP1000," TR-SEE-III-12-01, "AP1000 Condensate Return Test Report," and APP-PXS-M3C-034, "Containment Floodup Level." APP-SSAR-GSC-111 contains the information and methodology used to evaluate the amount of film held up on heat sinks and surfaces and resulted in Request for Additional Information (RAI) Question 06.03-5. TR-SEE-III-12-01 summarizes and captures the testing done to determine condensate losses over various shell attachments, and APP-PXS-M3C-034 outlines the elevations flooded following the release of steam into containment.

Current revisions of the documents supporting the calculations (APP-PXS-M3C-071, Revision 1, "Containment Response Analysis for the Long Term PRHR Operation," APP-PXS-M3C-072, Revision 1, "Condensate Return to IRWST for Long Term PRHR Operation," APP-SSAR-GSC-536, Revision 2, "AP1000 Safe Shutdown Temperature Evaluation," and APP-PXS-M3C-020, Revision 3, "PRHR HX Sizing/Performance") became available for staff audit on January 16 and 17, 2014.

Containment response is analyzed in APP-PXS-M3C-071 by modifying the WGOTHIC model used for peak pressure that is part of the licensing basis, and provides transient containment pressure, temperature, and condensate holdup volume inputs to the other calculations. APP-PXS-M3C-072 uses the parameters from WGOTHIC together with test results to provide a transient condensate loss fraction from the containment shell. The final two calculations both

model system behavior. One calculation using LOFTRAN (APP-SSAR-GSC-536) was used for shorter duration calculations of the PRHR HX performance leading up to safe shutdown, and another analysis (APP-PXS-M3C-020) incorporates the condensate behavior from the WGOthic calculation and the shell behavior providing the transient return rate that is used to determine the duration of the PRHR system performance using a spreadsheet.

On January 30, 2014, NRC staff met with DEF and Westinghouse staff for a more detailed explanation of the documents under audit.

Staff returned for subsequent review of documents on February 21, April 24, May 15, May 30, June 2, and July 8, 2014. Much of the review on these dates involved confirming data in the above calculation notes as part of the ongoing review, including the requests for additional information (RAIs) discussed below, as these documents were not submitted publicly due to their proprietary nature. Some additional review was conducted on other documents requested by the staff, detailed below.

H. Exit Briefing

NRC and staff agreed that an exit briefing was not necessary and did not conduct an exit briefing.

I. Requests for Additional Information Resulting from Audit

Staff issued RAIs based on the material under audit (questions under Standard Review Plan Section 6.03, "Emergency Core Cooling Systems," and Section 15.2.6, "Loss of Non-Emergency AC Power to the Station Auxiliaries," as part of RAIs 7439, 7440, 7475, and 7484). Most of these RAIs concerned clarifications of the material at audit, including the following:

- Making additional information available for audit to be added to the docketed information (RAI Questions 6.03-01, -02, and -09)
- Justification of the condensate film and losses used (RAI Questions 6.03-03, -05, and -06)
- Reasoning for choice of initial conditions (RAI Question 6.03-04)
- Clarifications concerning the test facility and modification design (RAI Questions 6.03-07 and -08)
- Requests for clearer statements concerning operator action as applied to the actuation of automatic depressurization system (ADS) and need for makeup (RAI Questions 15.02.06-1 and -3)
- Justification of the most limiting event and timeline associated with that event (RAI Question 15.02.06-2)
- Requests to refine and clarify the mission time associated with the PRHR and the safety-related functions associated with the system, especially as they apply to the use of "indefinite" in the DCD (RAI Questions 6.03-10, -11, and -12)

The RAIs are available in ADAMS under the following accession numbers:

- ML14077A609 and ML14065A362: Letter No. 116, Questions 06.03-1 through 06.03-9 and 15.02.06-1 through 15.02.06-3, dated March 26, 2014
- ML14100A040: Letter No. 117, Questions 06.03-10 and -11, dated April 10, 2014

- ML14114A050: Letter No. 118, Question 06.03-12, dated April 24, 2014

The RAI responses are available in ADAMS under the following accession numbers:

| Response Date and ADAMS Accession No. | RAI Questions |
|---------------------------------------|---|
| April 17, 2014 ML14112A371 | 06.03-7 and -8 |
| May 5, 2014 ML14126A699 | 06.03-1 and -6 |
| May 19, 2014 ML14141A015 | 06.03-9 |
| June 12, 2014 ML14164A444 | 06.03-2 and -3 |
| June 19, 2014 ML14171A453 | 15.02.06-1 and -3 |
| June 27, 2014 ML14182A106 | 15.02.06-2 and 06.03-5, -10, -11, and -12 |
| July 1, 2014 ML14183B342 | 06.04-4 |
| July 24, 2014 ML14206A951 | 15.02.06-1 (supplement) |

J. Open Items and Proposed Closure Paths

Open items related to the RAIs listed above have been resolved in applicant submittals available in ADAMS under the above listed accession numbers.

K. Deviations from the Audit Plan

Additional documents (referenced in the documents under audit) were added, including:

- APP-SSAR-GSC-111, "Film Holdup Volume Estimate for AP1000"
- "DCD Revision 19 WGOTHIC AP1000 Containment model nodding changes for Condensation Return Analyses"
- CN-TA-14-19, "Data Extraction for Revision 2 of the AP1000 Safe Shutdown Temperature Evaluation"
- TS-SEE-III-11-03, Revision 1, "AP1000 PXS Condensate Drain Gutter Test Specification"
- Assorted piping and instrumentation diagrams for new system changes
- 1100-S0C-001, Revision 7, "Containment Volume and Heat Sinks"
- APP-SSAR-GSC-600, Revision 0, "Revision of Loss of Normal Feedwater, loss of AC power and feedline break transient analyses, following revision of pressure drops in AP1000 vessel"

Additionally, the audit duration was extended to account for changes and revisions by the applicant during the period of interest.

L. References

1. Levy Nuclear Plant, Units 1 and 2, "Submittal of Exemption Request and Design Change Description for Departure from AP1000 DCD Revision 19 To Address Containment Condensate Return Cooling Design," dated April 18, 2013 (ADAMS Accession Number ML13109A533)
2. "Staff Regulatory Audit Summary for Review of Levy Nuclear Plant, Units 1 and 2, Design Change Related to the Containment Condensate Return Pathway," June 19, 2013 dated (ADAMS Accession Number ML14219A169)
3. NRO-REG-108, "Regulatory Audits," dated April 2, 2009 (ADAMS Accession Number ML081910260)