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Serial: NPD-NRC-2014-016
June 12, 2014

10 CFR 52.79

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

LEVY NUCLEAR PLANT, UNITS 1 AND 2
DOCKET NOS. 52-029 AND 52-030
PARTIAL RESPONSE TO NRC RAI LETTER 116 – SRP SECTIONS 6.3 AND 15.2.6

References:
1. Letter from Donald Habib (NRC) to Christopher M. Fallon (DEF), dated March 6, 2014, "Request for Additional Information Letter No. 116 Related to SRP Sections 6.3 and 15.2.6."
2. Letter from Donald Habib (NRC) to Christopher M. Fallon (DEF), dated April 10, 2014, "Request for Additional Information Letter No. 117 Related to SRP Section 6.3."
3. Letter from Donald Habib (NRC) to Christopher M. Fallon (DEF), dated April 24, 2014, "Request for Additional Information Letter No. 118 Related to SRP Section 6.3."
4. Letter from Christopher M. Fallon (DEF) to Nuclear Regulatory Commission (NRC), dated April 17, 2014, "Partial Response to NRC RAI Letter 116 – SRP Sections 6.3 and 15.2.6," Serial: NPD-NRC-2014-012
5. Letter from Christopher M. Fallon (DEF) to Nuclear Regulatory Commission (NRC), dated May 5, 2014, "Partial Response to NRC RAI Letter 116 – SRP Sections 6.3 and 15.2.6," Serial: NPD-NRC-2014-014
6. Letter from Christopher M. Fallon (DEF) to Nuclear Regulatory Commission (NRC), dated May 19, 2014, "Partial Response to NRC RAI Letter 116 – SRP Sections 6.3 and 15.2.6," Serial: NPD-NRC-2014-015

Ladies and Gentlemen:

Duke Energy Florida, Inc. (DEF) hereby submits a partial response to the Nuclear Regulatory Commission's (NRC) request for additional information (RAI) cited in References 1, 2 and 3.

Enclosure 1 to this letter contains DEF's partial response consisting of responses to RAI Questions 06.03-2 and 06.03-3. Attachment A to Enclosure 1 contains the proprietary version of the response and Attachment B to Enclosure 1 contains a redacted, non-proprietary version of the response. Responses to questions provided previously are contained in References 4, 5 and 6.

As Attachment A to Enclosure 1 contains information proprietary to Westinghouse Electric Company, LLC, this enclosure is supported by an affidavit signed by Westinghouse, the owner of the information. The affidavit sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of Section 2.390 of the Commission's regulations. Accordingly, DEF respectfully requests that the information (Attachment A to Enclosure 1) which is proprietary to

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Westinghouse be withheld from public disclosure in accordance with 10 CFR Section 2.390 of the Commission's regulations.

Westinghouse's Application for Withholding Proprietary Information from Public Disclosure CAW-14-3960 and accompanying Affidavit, and Proprietary Information Notice and Copyright Notice are provided as Enclosure 2 and Enclosure 3 respectively.

If you have any further questions, or need additional information, please contact Bob Kitchen at (704) 382-4046, or me at (704) 382-9248.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on June 12, 2014

Sincerely,

Christopher M Fallon

Christopher M. Fallon
Vice President
Nuclear Development

Enclosures/Attachments:

1. Levy Nuclear Plant Units 1 and 2 (LNP) Response to NRC Request for Additional Information Letter No. 116 Related to SRP Sections 06.03 and 15.02.06 for the Combined License Application, Dated 03/06/2014
   A. Responses to NRC RAIs 06.03-2 and 06.03-3 on Condensate Return Licensing Submittal (Proprietary)
   B. Responses to NRC RAIs 06.03-2 and 06.03-3 on Condensate Return Licensing Submittal (Nonproprietary)
2. Westinghouse Application Letter CAW-14-3960 and Affidavit
3. Proprietary Information Notice and Copyright Notice

cc: U.S. NRC Region II, Regional Administrator
Mr. Donald Habib, U.S. NRC Project Manager

Levy Nuclear Power Plant Units 1 and 2
Response to NRC Request for Additional Information Letter Nos. 116, 117 & 118 Related to SRP Sections 06.03 and 15.02.06 for the Combined License Application, dated March 6, April 10 & April 24, 2014

NRC RAI #	Duke Energy RAI #	Duke Energy Response
15.02.06-1	L-1081	Future Response
15.02.06-2	L-1082	Future Response
15.02.06-3	L-1085	Future Response
06.03-1	L-1086	NPD-NRC-2014-014, dated May 5, 2014
06.03-2	L-1087	Response enclosed – see following pages
06.03-3	L-1088	Response enclosed – see following pages
06.03-4	L-1089	Future Response
06.03-5	L-1090	Future Response
06.03-6	L-1091	NPD-NRC-2014-014, dated May 5, 2014
06.03-7	L-1092	NPD-NRC-2014-012, dated April 17, 2014
06.03-8	L-1093	NPD-NRC-2014-012, dated April 17, 2014
06.03-9	L-1094	NPD-NRC-2014-015, dated May 19, 2014
06.03-10	L-1096	Future Response
06.03-11	L-1097	Future Response
06.03-12	L-1099	Future Response

NRC Letter No.: LNP-RAI-LTR-116

NRC Letter Date: March 6, 2014

NRC Review of Section 06.03 - Emergency Core Cooling System

NRC RAI #: 06.03-2

Text of NRC RAI:

Levy submittal dated February 7, 2014, states that "Condensate Return to IRWST for Long Term PRHR Operation," APP-PXS-M3C-072, Revision 1, was used to characterize the transient condensate return rate from the containment shell given inputs from APP-PXS-M3C-071, including:

- Containment pressure and temperature
- Losses to pressurize the atmosphere, as condensation on passive heat sinks, and to containment leakage

The calculation also incorporated test data from "AP1000 Condensate Return Test Report," TR-SEE-III-12-01, to determine the losses over attachments to the containment shell. These inputs are used to determine the effects from the following phenomena:

- Dripping/"Rain out" from the inside surface of the upper dome of the containment
- Dripping from the inside surface of the upper dome due to misalignment of the containment plates
- Obstacle induced dripping from the shell, both along the containment dome and the sidewalls
- Water entrainment from the IRWST

While the submittal itself provides a summary of the test procedure and results, it does not state how each of the above phenomena was modeled and used to calculate the total condensate losses. For the staff to make a safety determination on PRHR heat exchanger with respect to General Design Criteria 34 of 10 CFR Part 50, Appendix A, please provide the following regarding APP-PXS-M3C-072 as response to this RAI:

a. Complete listing of important phenomena modeled.
b. Description of phenomena and methodology used to analyze the phenomena. For example, describe the method by which losses over attachment plates are derived from the testing.
c. Important assumptions used and their justification.
d. The resultant losses used in the final analyses, broken down by mechanism.

DEF RAI ID #: L-1087

DEF Response to NRC RAI:

See Attachment A for the proprietary version of the response to NRC RAIs 06.03-2 and 06.03-3.

See Attachment B for the nonproprietary, redacted version of the response to NRC RAIs 06.03-2 and 06.03-3.

Associated LNP COL Application Revisions:

None.

Attachments to Response to NRC:

A. Proprietary version of response to RAIs 06.03-2 and 06.03-3

B. Nonproprietary version of response to RAIs 06.03-2 and 06.03-3

NRC Letter No.: LNP-RAI-LTR-116

NRC Letter Date: March 6, 2014

NRC Review of Section 06.03 - Emergency Core Cooling System

NRC RAI #: 06.03-3

Text of NRC RAI:

In the APP-PXS-M3C-072, Revision 1, calculation ("Condensate Return to IRWST for Long Term PRHR Operation"), the transient behavior of the condensate is analyzed. Condensation on most of the heat sinks is directly analyzed in WGOTHIC, while condensation on other surfaces like the operating deck floor and non-fixed equipment has been incorporated into a horizontal film holdup volume assumed proportional to the cross sectional area of containment multiplied by a factor (one for Best Estimate and another for Design Basis cases) used for margin (Section 5.3, p. 128).

a. Justify the factor used in each analysis calculated.
b. The thickness of the film on these surfaces is based on the capillary radius of a droplet of water, which is the minimum thickness of the film. Explain how such a treatment is conservative.

DEF RAI ID #: L-1088

DEF Response to NRC RAI:

See Attachment A for the proprietary version of the response to NRC RAIs 06.03-2 and 06.03-3.

See Attachment B for the nonproprietary, redacted version of the response to NRC RAIs 06.03-2 and 06.03-3.

Associated LNP COL Application Revisions:

None.

Attachments to Response to NRC:

A. Proprietary version of response to RAIs 06.03-2 and 06.03-3

B. Nonproprietary version of response to RAIs 06.03-2 and 06.03-3

Serial: NPD-NRC-2014-016

Attachment B to Enclosure 1 (Nonproprietary)

(19 pages including cover page)

Responses to NRC RAIs 06.03-2 and 06.03-3 on Condensate Return

June 2014

Responses to NRC RAIs 06.03-2 and 06.03-3 on Condensate Return

Information Requested:

06.03-2

Levy submittal dated February 7, 2014, states that "Condensate Return to IRWST for Long Term PRHR Operation," APP-PXS-M3C-072, Revision 1, was used to characterize the transient condensate return rate from the containment shell given inputs from APP-PXS-M3C-071, including:

- *Containment pressure and temperature*
- *Losses to pressurize the atmosphere, as condensation on passive heat sinks, and to containment leakage*

The calculation also incorporated test data from "AP1000 Condensate Return Test Report," TR-SEE-III-12-01, to determine the losses over attachments to the containment shell. These inputs are used to determine the effects from the following phenomena:

- *Dripping/"Rain out" from the inside surface of the upper dome of the containment*
- *Dripping from the inside surface of the upper dome due to misalignment of the containment plates*
- *Obstacle induced dripping from the shell, both along the containment dome and the sidewalls*
- *Water entrainment from the IRWST*

While the submittal itself provides a summary of the test procedure and results, it does not state how each of the above phenomena was modeled and used to calculate the total condensate losses. For the staff to make a safety determination on PRHR heat exchanger with respect to General Design Criteria 34 of 10 CFR Part 50, Appendix A, please provide the following regarding APP-PXS-M3C-072 as response to this RAI:

d. Complete listing of important phenomena modeled.
e. Description of phenomena and methodology used to analyze the phenomena. For example, describe the method by which losses over attachment plates are derived from the testing.
f. Important assumptions used and their justification.

The resultant losses used in the final analyses, broken down by mechanism.

Response Information:

Assuming long-term PRHR HX operation, the In-containment Refueling Water Storage Tank (IRWST) will heat up to saturated conditions in several hours after transient initiation (exact time is dependent on assumptions of the transient analysis). At this time steam will be generated in the IRWST, which will be vented into the containment. As a result, the containment pressure and temperature will increase. The pressure increase will result in the actuation of the Passive Containment Cooling System (PCS). The PCS actuation will cause water to be delivered over the outside of the steel containment vessel. The PCS water flow provides evaporative cooling for the containment shell. In addition to increasing the containment pressure, the steam will condense on the heat sinks inside the containment and on the containment shell. The steam that condenses on the shell is collected and returned by gutters and down spouts to the IRWST. The collection efficiency from the containment shell is not perfect and some condensate will be lost from the containment shell due to dripping and splashing over various obstructions before being collected at the gutter locations. The condensate on other heat sinks (walls, floors, etc.) will not return to the IRWST and will drain down to the lowest containment levels. The water that drains down to the lowest containment elevations will come in contact with the hot reactor vessel after enough water has accumulated. This water will heatup and boil as it passes through the Reactor Vessel (RV) insulation, and discharge into the Reactor Coolant System (RCS) loop compartments. From there, the steam could condense in these compartments or circulate up into the containment volume above the operating deck and condense on the containment shell.

Responses to NRC RAIs 06.03-2 and 06.03-3 on Condensate Return

List of Important Phenomena Modelled

As indicated in the brief description above, there are a variety of important phenomena which are needed to be quantified to accurately analyze for the long-term operation of the PRHR HX. Some of the phenomena have a high state of knowledge associated with them, and can be easily analyzed in the calculations. Other phenomena have a low state of knowledge, and are therefore analyzed with bounding assumptions and conservative analysis approaches. The list of important phenomena analyzed is as follows:

High Importance Phenomena Modelled

1. Near-horizontal surface dripping (rain out)
2. Condensation on passive heat sinks
3. Steam stored in the containment atmosphere
4. Interference losses due to circumferential weld seams in the dome region
5. Obstacle-induced losses (Dome and Vertical Wall)

Loss Phenomena Description and Analysis Methodology

In this section, each of the aforementioned phenomena is discussed in further detail. A description of the phenomenon is provided, as well as the methodology for the analysis of the specific phenomenon in the design calculations.

1. Near-horizontal surface dripping (rain out)

Steam which is generated from the IRWST condenses on cold surfaces throughout the containment, and on the containment shell which is cooled via the Passive Containment Cooling System (PCS). Based on the geometry of the containment vessel, the top dome portion of the CV has a horizontal or very shallow angle associated with the design that will result in dripping from the surface. This dripping phenomenon is referred to as "rain out" in Reference 1. Figure 1 shows a schematic of this phenomenon.

Responses to NRC RAIs 06.03-2 and 06.03-3 on Condensate Return

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Figure 1: "Rain-out" Schematic

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As a result of the open literature review, it was concluded that there will be a transition from a droplet condensation regime to a film flow regime in CV dome region as the angle of inclination increases. [

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2. Condensation on passive heat sinks

The methodology used to analyze losses due to condensation on heat sinks is addressed by using the output from the Containment Analysis. This model was adjusted from the DCD Rev. 19 analysis to conservatively calculate a containment response for long-term operation of the PRHR HX, allowing for the code to provide the integrated mass of steam which condenses on heat sinks as a function of time as an output.

During normal power operation, the internal atmosphere of the containment is kept between 50°F and 120°F. Therefore, the metal mass and concrete within containment will initially be within this temperature range once the PRHR HX is put into operation. Once steaming of the IRWST begins, it is discharged through a series of vents in the roof of the IRWST and out to the containment atmosphere. At this point, the steam begins to heat containment and increase the containment pressure. As a result, steam condensation occurs on any colder surface within containment, until these heat sinks reach some equilibrium temperature. For the Best Estimate (BE) and Design Basis (DBA) analyses, 85°F was established as the initial heat sink temperature.

Heat sinks within containment can be separated into two basic types, metallic heat sinks and concrete heat sinks. All of the internal containment heat sinks were activated in the WGOTHIC model used for the containment response analysis in The Containment Analysis. In addition to activating all the heat sinks, additional margin was provided to account for additional heat sink volumes which were not originally in the containment model and various unquantified metallic heat sink volumes within the design.

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The methodology used to analyze losses due to condensation on heat sinks is addressed by using the output from the Containment Analysis. This output is organized in Reference 1 into smaller tables to be used as input to the PRHR HX Sizing / Performance calculation. These tables are then interpolated as a function of time to track the mass of steam which is condensing on cold surfaces within containment.

3. Steam stored in the containment atmosphere

As the IRWST inventory begins to steam, the steam generated from the tank increases the pressure of the containment. As the containment pressure increases, there is a mass of steam trapped in the containment atmosphere in the form of vapor which is unrecoverable and contributes to losses. For this phenomenon, the containment response developed in WGOTHIC is used to provide the mass of steam throughout the transient which is trapped in the containment atmosphere.

The methodology used to analyze losses due to steam stored in the containment atmosphere is addressed by using the output from the Containment Analysis. This output is organized in Reference 1 into smaller tables to be used as input to the PRHR HX Sizing / Performance calculation. These tables are then interpolated as a function of time to track the mass of steam which is contributing to the pressurization of containment.

4. Interference losses due to circumferential weld seams in the dome region

The containment vessel is designed to use a series of large subassemblies to form the two heads and the three ring sections. Each of the sections consists of a series of plates welded together to form their respective section, resulting in vertical and horizontal weld seams. The CV dome as a result is comprised of a number of plates welded together, resulting in three circumferential welds at separate elevations.
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Figure 2: Approximate CV Dome Weld Locations

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Figure 3: CV Dome Circumferential Weld

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5. Obstacle-induced losses (Dome and Vertical Wall)

Testing was conducted to determine the losses from attachment plates located on the vertical portions of the containment vessel shell. [

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In the "Condensate Return to IRWST for Long Term PRHR Operation" calculation, Reference 1, the condensation distribution varies based on the elevation in containment. [

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Figure 4: Attachment Plate Losses Approach

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Figure 5: Attachment Plate with Mounted Structure

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As a result, a table assembling the losses associated with the CV shell is assembled as a function of flow. The loss model is able to establish a specific total flowrate as an input, and determine the percent of condensation lost from the CV shell. This table was also created in APP-PXS-M3C-072 and is used as an input to the PRHR HX Sizing / Performance calculation.

Important Assumptions

Many of the important assumptions used in APP-PXS-M3C-072, along with their justification were discussed in the previous section. In this section, the specific important assumptions are re-visited, and either discussed specifically or pointed to in their respective section above.

<u>Assumptions</u>

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The polar crane girder and internal stiffener are large structures in containment, located at EL 220' and EL 170' respectively. These structures are used as intermediate condensation collection locations, as they are used to essentially form large "gutters" and have the PXS downspouts welded to their bottom surfaces to serve as drainage pipes. [

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A review in Appendix 2 of APP-PXS-M3C-072 was conducted to look at attachments located at elevations near the polar crane girder and internal stiffener. Figures 6 and 7 give examples of attachments located at the polar crane girder and internal stiffener elevations.

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Figure 6: Attachment Above Polar Crane Girder

Figure 7: Attachment Above Stiffener

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Resultant losses used in the final analysis, broken down by mechanism

In the final analysis, one effective return rate is developed to include the losses for the aforementioned phenomena. This allows for a transient array of return rates to be used as input to the **AP1000** Shutdown Temperature Evaluation. The losses which are included in the effective return rate can be broken down into four specific categories.

1) Steam to the Containment Atmosphere
2) Steam to Heat Sinks
3) Losses from the CV Shell
4) Containment Leakage

Losses due to items 1, 2, and 4 are generated directly from WGOTHIC as a function of time. Losses due to item 3 include the losses due to the phenomenon discussed in this response based on the methodology used in Reference 1. CV shell losses are calculated by specific flowrate to form a table which is in turn used in the PRHR HX Sizing / Performance calculation to determine the losses from the CV shell as a function of the mass flow which gets to the shell, after losses within the specific timestep due to steam to the containment atmosphere, steam to heat sinks, and containment leakage are removed. The table below gives a breakdown of the losses due to specific mechanisms associated with the CV shell.

Table 1: CV Shell Loss Breakdown by Mechanism					
Location	Elevation	Flow without losses	Actual flow	Lost Flow	Percentage Lost
	(ft)	(gpm)	(gpm)	(gpm)	(%) a,c
Losses due to rain out [, angle < 12.02 degrees]a,c	279.52				
Attachment Plates Losses on CV Dome	244.21				
Plate Losses from CV Dome to PCG	228.02				
Flow Inside PCG	220.00				
Plate Losses from PCG to Stiffener	170.20				
Plate Losses from Stiffener to Gutter	133.25				
Total flow in the IRWST (including 0.98% margin)	133.25				

Table 1 is an example of the loss break down by mechanism as a function of elevation. This portrays the losses at each location based on the contributions either due to losses from rain-out or by the losses from attachment plates with each section of the CV shell.

These losses are calculated over the full range of condensation flowrates, for use in the PRHR HX Sizing / Performance calculation. In the PRHR HX Sizing / Performance calculation, losses due to each of the four mechanisms identified in this section are evaluated to determine the overall effective return rate.

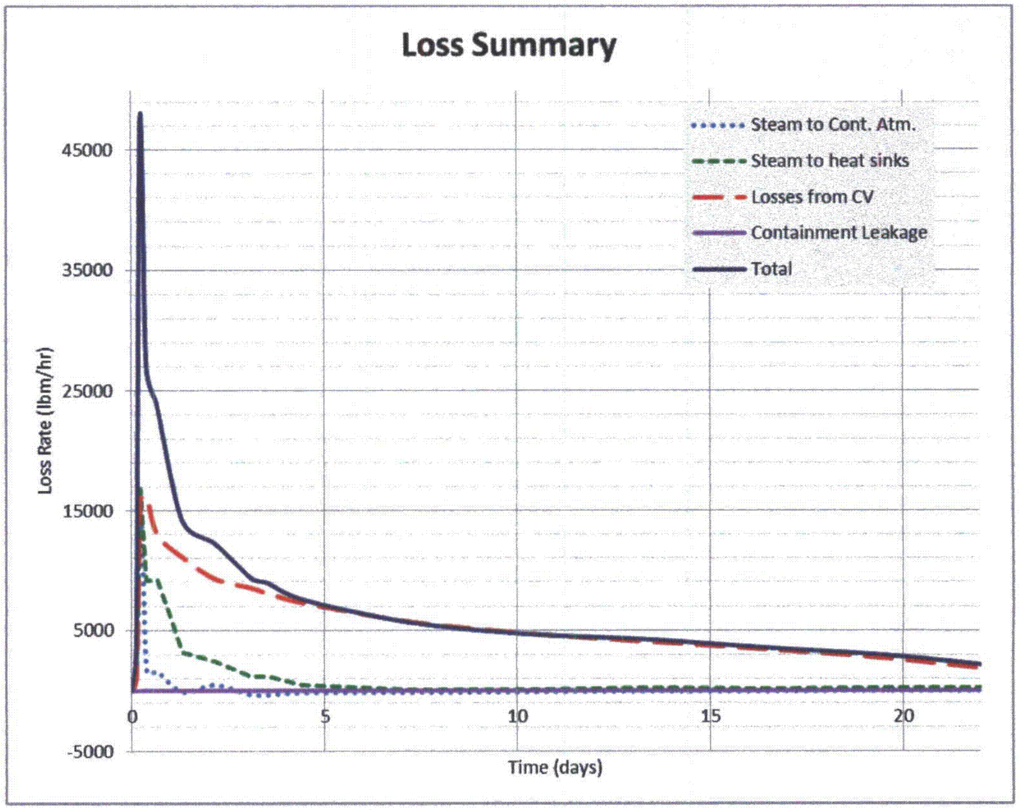

Figure 8: Breakdown of Condensate Losses by Mechanism

Figure 8 shows the resultant loss rate broken down by mechanism as analyzed in the PRHR HX Sizing / Performance calculation. As can be seen from the figure, losses due to heat sinks and steam to the containment atmosphere are important in the first 5 hours of the transient, though then the containment reaches a relatively stable temperature and pressure where losses are dominated by the mass lost from the CV shell. An effective return rate in the form of a percent loss is developed for use in the **AP1000** Shutdown Temperature Evaluation from these loss mass flows.

References

1. APP-PXS-M3C-072 Rev. 1, "Condensate Return to IRWST for Long Term PRHR Operation"
2. "Condensation in the Presence of a Non-condensable Gas: Effect of Surface Orientation", Llpo K. Huntiniemi, Michael L. Corradini, J.J. Barry, 1989.
3. "Experimental Analysis of the Heat Transfer Within the AP600 Containment Under Postulated Accident Conditions", Mark H. Anderson, Luis E. Herranz, Michael L. Corradini, May 1998.
4. "Condensation in the Presence of a Non-condensable Gas", Llpo K. Huntiniemi, Michael L. Corradini, October 1992

5. "Steam Condensation on the Cold Walls of the Advanced PWR Containments", Mark H. Anderson, Michael L. Corradini, University of Wisconsin - Madison, 1998.

Responses to NRC RAIs 06.03-2 and 06.03-3 on Condensate Return

Information Requested:

06.03-3
In the APP-PXS-M3C-072, Revision 1, calculation ("Condensate Return to IRWST for Long Term PRHR Operation"), the transient behavior of the condensate is analyzed. Condensation on most of the heat sinks is directly analyzed in WGOTHIC, while condensation on other surfaces like the operating deck floor and non-fixed equipment has been incorporated into a horizontal film holdup volume assumed proportional to the cross sectional area of containment multiplied by a factor (one for Best Estimate and another for Design Basis cases) used for margin (Section 5.3, p. 128).

b. Justify the factor used in each analysis calculated.

The thickness of the film on these surfaces is based on the capillary radius of a droplet of water, which is the minimum thickness of the film. Explain how such a treatment is conservative.

Response Information:

In revision 1 of the APP-PXS-M3C-072, the holdup volume on the horizontal surfaces of the heat sinks was calculated by correlating the horizontal surface area that could potentially hold up some water to the cross sectional area of the containment. The resulting surface area of 13,272 ft^2 was then increased by applying a best estimate (BE) multiplication factor and a design basis analysis (DBA) multiplication factor for the BE and DBA cases, respectively. As explained in APP-PXS-M3C-072, these multiplication factors were based on the assumption the main contributors for the holdup volume would be the operating deck and maintenance floor (at 107'). A correlation for the film thickness based on the capillary droplet radius was used to calculate the holdup volume.

An internal review was performed, during which the previously described analysis was challenged. This review determined the existing calculation may not have been fully conservative. Extensive research was performed on film thickness models. The conclusion of this research was the film thickness model applied in the APP-PXS-M3C-072, revision 1 did not provide sufficiently conservative results. Although the impact of the holdup volume on the overall results is small, action has been taken to perform a more detailed and bounding calculation of the horizontal surface areas and the film thickness.

BE and DBA multiplication factors are not used in the revised calculation. Instead of using the previously applied approximation, the revised approach is based on the heat sinks surface areas built in to the WGOTHIC model. Additionally, the most recent model provides an updated physical and mathematical basis for the thickness of a puddle of water on the horizontal surfaces. The following summarizes application of the new approach; and compares the new results to the previously applied results to demonstrate the impact of the holdup volumes on the analysis result when the new approach is applied remains small.

As previously stated, the heat sink surface area data from the WGOTHIC containment model was used. The WGOTHIC model does not break down each heat sink into horizontal and vertical surface areas, but uses only the total surface area as an input. Because the horizontal surface area is unknown, the total surface area of the relevant heat sinks was used for the following approximation. For this calculation, all of the heat sink areas were used except for the walls, the metallic conductors located in the PXS-A, PXS-B and CVS rooms, the compartment floors of the flooded volumes, compartment ceilings, the core makeup tanks, the polar crane girder and the internal stiffener. Although a small amount of residual moisture could remain on the ceilings, walls, polar crane girder and internal stiffener, the conservatism associated with the use of the total surface areas (as opposed to using only horizontal areas) of the remaining conductors far outweighs neglecting this residual moisture on the walls and ceilings.

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Design Basis Analysis:

For the DBA case, a maximum contact angle [ ]^{a,c} was used. Using this value for the contact angle maximizes the thickness of a puddle. Along with maximizing the contact angle, the DBA horizontal surface area taken from the WGOTHIC model was applied for the film holdup calculation. Table 1 shows the results for the DBA film holdup calculation.

Table 1: DBA film holdup volume results							
Pres	Temp	Density	Surface Tension	Film Thickness		Holdup Volume	Holdup Mass
(psia)	(°F)	(lb_m/ft^3)	(lb_f/ft)	(ft)	(in)	(ft^3)	(lb_m)
15.70	85.00	62.173	4.89E-03	[			]^{a,c}
19.79	160.54	60.985	4.40E-03				
25.75	193.12	60.274	4.17E-03				
31.01	212.28	59.810	4.04E-03				
32.87	217.90	59.668	3.99E-03				
34.30	221.90	59.565	3.96E-03				
35.41	224.87	59.488	3.94E-03				
36.26	227.06	59.431	3.93E-03				

Best Estimate Analysis:

For the BE analysis case, a moderate contact angle [ ]^{a,c} was used. For the BE calculation, the BE horizontal surface area taken from the WGOTHIC model was applied for the film holdup calculation. Table 2 shows the result for the BE film holdup volume.

Table 2: BE film holdup volume results							
Pres	Temp	Density	Surface Tension	Film Thickness		Holdup Volume	Holdup Mass
(psia)	(°F)	(lb_m/ft^3)	(lb_f/ft)	(ft)	(in)	(ft^3)	(lb_m)
15.70	85.00	62.173	4.89E-03	[			]^{a,c}
19.79	160.54	60.985	4.40E-03				
25.75	193.12	60.274	4.17E-03				

Table 2: BE film holdup volume results							
Pres	Temp	Density	Surface Tension	Film Thickness		Holdup Volume	Holdup Mass
(psia)	(°F)	(lb_m/ft^3)	(lb_f/ft)	(ft)	(in)	(ft^3)	(lb_m)
31.01	212.28	59.810	4.04E-03				
32.87	217.90	59.668	3.99E-03				
34.30	221.90	59.565	3.96E-03				
35.41	224.87	59.488	3.94E-03				
36.26	227.06	59.431	3.93E-03				

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<u>Holdup volume results in the calculation note APP-PXS-M3C-072, revision 1:</u>

Revision 1 of APP-PXS-M3C-072 estimated the holdup volume for the DBA and BE cases based on the cross sectional area of the containment with additional multiplication factors and film thickness based on the following equation:

$$e = \sqrt{\frac{2\gamma}{\rho g}}$$

[ ]a,c Table 3 shows the resulting BE and DBA holdup volumes used in APP-PXS-M3C-072, revision 1.

Table 3: Previously Calculated DBA and BE Holdup Volumes									
Pres	Temp	Density	Surface Tension	Radius / Thickness		Best Estimate		DBA	
						Holdup Volume	Holdup Mass	Holdup Volume	Holdup Mass
(psia)	(°F)	(lb_m/ft^3)	(lb_f/ft)	(ft)	(in)	(ft^3)	(lb_m)	(ft^3)	(lb_m)
15.70	120.00	61.715	4.89E-03						
19.79	160.54	60.985	4.40E-03						
25.75	193.12	60.274	4.17E-03						
31.01	212.28	59.810	4.04E-03						
32.87	217.90	59.668	3.99E-03						
34.30	221.90	59.565	3.96E-03						
35.41	224.87	59.488	3.94E-03						
36.26	227.06	59.431	3.93E-03						

a,c

Comparing new calculations of the holdup volumes (Tables 1 and 2) to the previous calculation (Table 3), one can see that the updated holdup volumes are higher. In fact, the updated DBA holdup volume is about 3.5 times higher than that used in APP-PXS-M3C-072, revision 1. The updated BE holdup volume is about 3 times higher than the holdup volume used in the APP-PXS-M3C-072, revision 1.

It should be noted that the holdup water volume on the horizontal surface areas inside the containment is not a direct water inventory loss from the IRWST. The holdup water volume has an indirect/delaying impact on the IRWST level. During prolonged PRHR HX operation, some of the steam released to the containment atmosphere condenses on the heat sinks inside the containment. The horizontal surface areas of different structures would tend to retain some of the condensate produced by steam condensation on the heat sinks. Steam condensation on the heat sinks has already been accounted for in the WGOTHIC calculation. The water holdup volume shown in the previous tables affects how fast the condensate reaches the reactor vessel cavity and how much of this condensate is steamed from the reactor vessel cavity.

The impact of the recalculated higher water holdup volume was input to the PRHR HX Sizing / Performance calculation. The time when reactor vessel steaming begins, the time to uncover the topmost horizontal PRHR HX tubes and the time when the reactor coolant system (RCS) reheats to 420°F is shown in Table 4 for the BE and DBA cases using the old and the new film holdup approaches.

Table 4: Comparison of Results of the Old and New Holdup Calculation

	Old DBA*	New DBA**	Old BE*	New BE**
Reactor vessel steaming time (hrs)	5.5	8.5	4.3	5.5
PRHR HX tube uncovery time (hrs)	14.0	13.9	16.7	16.6
Time to reheat RCS to 420°F (days)	13.3	13.0	20.4	20.3

* Old relates to the transient with the initial water holdup volume calculated in APP-PXS-M3C-072 revision 1.
** New relates to the transient with the recalculated water holdup volume (~3 times higher than the initial).

The main conclusions of this evaluation are as follows:

- Higher water holdup volume delays the reactor vessel steaming by about 3 hours for the DBA case and about 1.2 hours for the BE case.
- Top PRHR HX tubes are uncovered 0.1 hours earlier when the holdup volume is about 3 times higher.
- The RCS reheats about 0.3 days (~ 7 hours) earlier when the recalculated hold up volume is used in the analysis.

These results show that the impact of the newly calculated, higher holdup volume on the overall analysis result is negligible.

Enclosure 2
Westinghouse Application Letter CAW-14-3960
and Affidavit
(7 pages including cover page)

Westinghouse

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Project letter: APC_APG_000142

Our ref: CAW-14-3960

June 11, 2014

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: Responses to NRC RAIs 06.03-2 and 06.03-3 on Condensate Return (Proprietary) and (Non-Proprietary)

The proprietary information for which withholding is being requested in the above-referenced letter is further identified in the affidavit signed by Westinghouse Electric Company LLC. The affidavit accompanying this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and address with specificity the considerations listed in paragraph (b) (4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying affidavit by APOG.

Correspondence with respect to the proprietary aspects of this application for withholding or the accompanying affidavit should reference CAW-14-3960 and should be addressed to J. A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, Suite 310, 1000 Westinghouse Drive, Cranberry Township, Pennsylvania 16066.

Very truly yours,

Robert B. Sisk

Robert B. Sisk
Program Manager APR1400 Licensing Support,
International Licensing Programs

CAW-14-3960
June 11, 2014

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared **Robert B. Sisk**, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

Robert B. Sisk
Program Manager APR1400 Licensing Support,
International Licensing Programs

Sworn to and subscribed
before me this 11th day
of June 2014.

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Linda J. Bugle, Notary Public
City of Pittsburgh, Allegheny County
My Commission Expires June 18, 2017
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

Notary Public

COMMONWEALTH OF PENNSYLVANIA
Notarial Seal
Linda J. Bugle, Notary Public
City of Pittsburgh, Allegheny County
My Commission Expires June 18, 2017
MEMBER, PENNSYLVANIA ASSOCIATION OF NOTARIES

(1) I am Program Manager APR1400 Licensing Support, International Licensing Programs, Westinghouse Electric Company, LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse "Application for Withholding" accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitute Westinghouse policy and provide the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390; it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld from within the Responses to NRC RAIs 06.03-2 and 06.03-3 on Condensate Return, and may be used only for that purpose.

The information requested to be withheld reveals details of the AP1000 design; sequence and method of construction; and timing and content of inspection and testing. This information was developed and continues to be developed by Westinghouse. The information is part of that which enables Westinghouse to manufacture and deliver products to utilities based on proprietary designs.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar commercial power reactors without commensurate expenses.

The information requested to be withheld is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

Enclosure 3
Proprietary Information Notice and Copyright Notice
(2 pages including cover page)

June 11, 2014

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

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