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Attached is the public version of the LAR-17-043, Containment Pressure Analysis, pre-submittal presentation for the public meeting scheduled for 11/30/17.

The proprietary presentation and required withholding affidavits will be submitted separately via letter.

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Building the future of nuclear power in America

VEGP LAR-17-043 (WEC LAR-079): Containment Pressure Analysis

November 30, 2017

Southern Nuclear

Georgia Power

Meeting Purpose and Agenda

Meeting Purpose

- Pre-submittal meeting to discuss the proposed changes in VEGP LAR-043 (WEC LAR-079), Containment Analyses
- Inform Staff of LAR Scope and gain feedback

Agenda

- Summary of Changes
- Background Information
- Discussion of proposed changes

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Summary of Changes

Proposed Changes

1. WGOTHIC Evaluation Model (EM) Updates
2. WGOTHIC WCAP-15846 Updates
3. Mass and Energy (M&E) Releases Updates
4. Containment Integrity Analyses Updates
5. Passive Containment Cooling System (PCS) ITAAC Updates
6 Containment Vessel (CV) Heat Transfer Elevation and Changes Related to Inorganic Zinc Application
7. Updates to Peak Clad Temperature (PCT) for Loss of Coolant Accident (LOCA) Analyses

Background Information

- The current licensing basis (CLB) containment integrity analysis is described in UFSAR Section 6.2
- The CLB analyses are based on the design configuration at the time of the amended AP1000 design certification (DCD Rev. 19)
- Accumulated design changes within containment have necessitated recalculation of inputs to WGOTHIC EM and revision of the WGOTHIC methodology for the AP1000 plant
- The LAR will be used to incorporate updated containment integrity analyses and methodological updates into the CLB

Background Information (cont.)

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Change 1

WGOTHIC EM Updates

Change 1 – WGOTHIC EM Updates

- Accumulated design changes within containment have necessitated recalculation of geometry input to the WGOTHIC EM used for containment integrity analyses
- The WGOTHIC EM has been updated to reflect the recalculation and incorporation of the following:
  - Passive Containment Heat Sinks
  - Control Volumes
  - Flow Paths

Change 1 – WGOTHIC EM Updates (cont.)

Updates to Passive Containment Heat Sinks

- Nominal dimensions from design drawings have been used to calculate metal volumes and surface areas for heat sink inputs
- Total metal volume has increased by approximately [ ]^{a,c} from current model
- Despite increase in total metal volume, conservatism is maintained:
  - More than [ ]^{a,c} of metal is conservatively "turned off" for heat transfer in WGOTHIC
  - [ ]^{a,c} air gap is assumed between steel and concrete
  - Heat transfer to horizontal, upward-facing surfaces is not credited
  - Condensation/convection on heat sinks in the dead-ended compartments below the operating deck are not credited after the blowdown period

Change 1 – WGOTHIC EM Updates (cont.)

- Tier 2* UFSAR Table 6.2.1.1-10 updated to summarize the range of required total volume (min and max) of metal heat sinks inside containment

Table 6.2.1.1-10	
*[Plant Requirements for Metal Heat Sinks Inside Containment] **	
Region	***Metal Volume (ft3) (minimum – maximum)***
Above the operating deck	*4973 - 7279*
Inside SG/Pressurizer compartments	*1002 - 1677*
Below the operating deck	*5246 – 8255*
Total	*11,811 (3) - 17,211*
Notes:	
1. Does not include the containment vessel.	
2. Only includes structures and equipment that are typically less than or equal to containment ambient temperature.	
3. The total minimum volume includes an additional 590 ft^3 of metal inside containment.	

Change 1 – WGOTHIC EM Updates (cont.)

Updates to Control Volumes

- The recalculated containment free volume remains 2.06E06 ft^3; consistent with current UFSAR model
  - Negligible difference of [ ]^{a,c}
- Changes include renodalization of the annulus downcomer and riser from torus control volumes to quadrant-specific control volumes and addition of the pressurizer compartment
- No direct changes to the CLB due to recalculation of control volumes

Change 1 – WGOTHIC EM Updates (cont.)

Updates to Flow Paths

- WGOTHIC uses flow paths to connect the control volumes previously discussed
- Updates to the WGOTHIC flow paths from the CLB are analysis as follows:
  - Flow paths inside containment constrained by physical boundaries are recalculated based on design drawings
  - Flow paths outside containment and those linked to boundary conditions are calculated directly by WGOTHIC; these have not changed
- No direct changes to the CLB due to recalculation of flow paths

Change 2

WGOTHIC WCAP-15846 Updates

Change 2 - WGOTHIC WCAP-15846 Updates

- Current containment integrity methodology is defined in WCAP-15846, Rev. 1 with updates from the enhanced shield building design in APP-GW-GLR-096, Rev.3
  - WCAP-15846 is IBR in UFSAR Table 1.6-1
- WCAP-15846 Revisions:
  - Rev. 2 and 3 include only errata pages with updated PCS flowrates
  - Rev. 4 has majority of changes (next slide)
  - Rev. 5 has changes for PCS water stripping due to air baffle supports
- WCAP-15846, Rev. 5 includes all changes from previous revisions and reflects the methodology for the WGOTHIC EM used in the new analyses

Change 2 - WGOTHIC WCAP-15846 Updates (cont.)

- WCAP updates are summarized in its Record of Revisions:
  - Incorporated changes already in APP-GW-GLR-096, Rev. 3
  - Updated the heat sinks, flow paths and control volume nodalization in the WGOTHIC evaluation model
  - Removed specific input values in the evaluation model; clarified basis for calculating the input values
  - Updated WGOTHIC code information
    - Evaporation-limited PCS flow calculations are a new option that reduces post-processing/iterations that were previously needed
    - Alternate approach to accounting for 2-D conduction between wet and dry stripes on the containment shell for long-term transients
  - Editorial updates for clarification, such as:
    - All locations inside containment are examined to determine maximum vapor temperature (rather than break location)

Change 2 - WGOTHIC WCAP-15846 Updates (cont.)

- Update to the methodology document necessitates changes to various CLB sections to reflect the new WCAP revision; now Revision 5 (i.e., UFSAR Table 1.6-1, Subsections 6.2.7, 6A.5)
- Due to proprietary nature of the WCAP, the detailed description and technical evaluation of changes between Revisions 1 through 5 are provided as a standalone attachment to the LAR submittal

Change 3

Mass & Energy (M&E) Release Updates

Change 3 - M&E Release Updates

LOCA M&E Release Updates

- M&E releases have been recalculated using the approved methodology described in WCAP-10325-P-A and WCAP-15846 for:
  - Blowdown phase DEHLG
  - Blowdown phase DECLG
  - Long-term release for DECLG
- DECLG case is limiting for peak pressure and long-term containment response
- UFSAR updates are reflected in markups to Subsection 6.2.1.3.2, Tables 6.2.1.3-9 and 6.2.1.3-10, and Figures 6.2.1.3-1 through 6.2.1.3-4

Change 3 - M&E Release Updates (cont.)

- Update is made to UFSAR Subsection 6.2.1.3.2.2 for "Description of Blowdown Model"
  - The SATAN-VI code input contains a generic assumption of a constant overall heat transfer coefficient of [ ]a,c
  - This assumption causes an unrealistic spike in the break compartment temperature towards end of blowdown
  - DEHLG LOCA SATAN run is modified to use the reduced, natural convection heat transfer coefficient [ ]a,c when the quality of the vessel is greater than [ ]a,c steam
    - This is more representative of superheated releases at the end of the DEHLG blowdown

Change 3 - M&E Release Updates (cont.)

MSLB M&E Release Updates

- MSLB M&E releases are discussed in UFSAR Subsection 6.2.1.4 and have been recalculated
- Calculation documents analysis of steam line break (SLB) double-ended rupture (DER) cases at various power levels:

  0% 30%

  70% 101%
- Updates to the CLB supporting the changes to MSLB M&Es are reflected in markups to UFSAR Subsection 6.2.1.4 and Tables 6.2.1.4-2 through 6.2.1.4-4

Change 3 - M&E Release Updates (cont.)

- Additional penalty against the SLB analysis is taken to account for metal energy transferred to the fluid in the steam generators as the fluid temperature drops below the metal temperature
  - Includes only steam generator metal in contact with secondary side fluid

Change 4

Containment Integrity Analyses Updates

Change 4 - Containment Integrity Analyses Updates

Updates to LOCA Peak Pressure Analysis

- LOCA containment integrity analysis updated to incorporate Changes 1 through 3
- Calculated peak containment pressure (TS P_a) decreased from 58.3 psig to 58.1 psig for DECLG
- Calculated peak containment vapor temperature decreased from 411.3 °F to 385.8 °F for DEHLG
- GDC 38 requires containment pressure be reduced below half of design pressure (29.5 psig) within 24 hours
  - Updated analyses confirm that DECLG pressure is reduced below 27 psig after 24 hours

Updated LOCA peak pressure analysis remains bounded by containment design pressure

Change 4 - Containment Integrity Analyses Updates (cont.)

5.5.8 Containment Leakage Rate Testing Program

a. A program shall be established to implement the leakage rate testing of the containment as required by 10 CFR 50.54(o) and 10 CFR 50, Appendix J, Option B, as modified by approved exemptions. This program shall be in accordance with the guidelines contained in Regulatory Guide 1.163, "Performance-Based Containment Leak-Test Program, dated September 1995," as modified by approved exceptions.

b. The calculated peak containment internal pressure for the design basis loss of coolant accident, P_a, is ~~58.3~~ 58.1 psig. The containment design pressure is 59 psig.

Proposed markup to TS Administrative Control 5.5.8

Change 4 - Containment Integrity Analyses Updates (cont.)

MSLB Peak Pressure Analysis Updates

- MSLB containment integrity analysis updated to incorporate Changes 1 through 3
- Peak containment pressure decreased from 58.2 psig to 57.2 psig for DER initiated from 30% power
- Peak containment vapor temperature increased from 374.7°F to 383.6°F for DER initiated from 101% power
- Updates to the CLB due to MSLB analyses updates are reflected in markups to UFSAR Subsection 6.2.1.1.3, Tables 6.2.1.1-1 and 6.2.1.1-3, and Figures 6.2.1.1-1 and 6.2.1.1-2

Change 4 - Containment Integrity Analyses Updates (cont.)

Vapor

Peak Containment

Table 6.2.1.1-1
Summary of Calculated Pressures and Temperatures

Break	Peak Pressure (psig)	Available[1] Margin (psi)	Peak Temperature (°F)
Double-ended hot leg guillotine	~~50.4~~ 49.8	~~8.6~~ 9.2	~~411.3~~ 385.8
Double-ended cold leg guillotine	~~58.3~~ 58.1	~~0.7~~ 0.9	~~206.7~~ 357.8
Full main steam line DER, 30% power, MSIV failure	~~58.2~~ 57.2	~~0.8~~ 1.8	~~373.2~~ 381.8
Full main steam line DER, 101% power, MSIV failure	~~54.2~~ 54.4	~~4.8~~ 4.6	~~374.7~~ 383.6

Note:
1. Design Pressure is 59 psig

Proposed markups to UFSAR Table 6.2.1.1-1

Change 5

Passive Containment Cooling System (PCS) ITAAC Updates

Change 5 - PCS ITAAC Updates

- Supplemental CLB changes proposed to capture lessons learned from preoperational testing conducted in China
- ITAAC acceptance criterion is proposed to allow for analysis showing as-tested performance of the PCS is greater than that assumed in peak pressure analyses
  - Plant remains safe
- Updates necessary to the following:
  - ITAAC 2.2.03.7.a.i
  - ITAAC 2.2.03.7.a.ii
  - UFSAR Subsection 6.2.2.4.2

Change 5 - PCS ITAAC Updates (cont.)

Table 2.2.2-3 (cont.)
Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7.a) The PCS delivers water from the PCCWST to the outside, top of the containment vessel.	i) Testing will be performed to measure the PCCWST delivery rate from each one of the three parallel flow paths.	i) When tested, each one of the three flow paths delivers water at greater than or equal to: - 469.1 gpm at a PCCWST water level of 27.4 ft + 0.2, - 0.0 ft above the tank floor - 226.6 gpm when the PCCWST water level uncovers the first (i.e. tallest) standpipe - 176.3 gpm when the PCCWST water level uncovers the second tallest standpipe - 144.2 gpm when the PCCWST water level uncovers the third tallest standpipe
	ii) Testing and or analysis will be performed to demonstrate the PCCWST inventory provides 72 hours of adequate water flow.	ii) When tested and/or analyzed with all flow paths delivering and an initial water level at 27.4 + 0.2, - 0.00 ft, the PCCWST water inventory provides greater than or equal to 72 hours of flow, and the flow rate at 72 hours is greater than or equal to 100.7 gpm.
	ection will be performed to the PCCWST standpipes .	iii) The elevations of the standpipes above the tank floor are: - 16.8 ft ± 0.2 ft - 20.3 ft ± 0.2 ft - 24.1 ft ± 0.2 ft

or a report exists and concludes that the as-measured flow rates bound the 72 hour containment peak pressure and temperature results.

or a report exists and concludes that the as-measured flow rates bound the 72 hour containment peak pressure and temperature results.

Proposed markups ITAAC 2.2.03.7.a.i & 2.2.03.7.a.ii

Change 6

Containment Vessel (CV) Heat Transfer Elevation and Changes Related to Inorganic Zinc Application

Change 6 – CV Heat Transfer ITAAC

- ITAAC 2.2.02.07.b.iii acceptance criterion indicates the CV interior surface is coated with an inorganic zinc (IOZ) coating 7’ above the operating deck
  - Implies CV surface between the operating deck up to 7’ above the deck is not coated with IOZ
- ITAAC 3.3.00.02.g states that the CV provides a heat transfer surface for cont. t greater than 7’ above the operating deck
  - Implies CV surface between the operating deck up to 7’ above the deck does not provide a credited heat transfer surface
- This CV portion is coated with IOZ and is credited as transferring heat from inside cont. to the atmosphere, consistent with NRC-approved methodology
- Clarification to ITAAC and UFSAR text is proposed to prevent misinterpretation

Change 6 – CV Heat Transfer ITAAC (cont.)

Proposed markups to ITAAC 2.2.02.07.b.iii

Table 2.2.2-3 (cont.)
Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7.b) The PCS wets the outside surface of the containment vessel. The inside and the outside of the containment vessel above the operating deck are coated with an inorganic zinc material.	i) Testing will be performed to measure the outside wetted surface of the containment vessel with one of the three parallel flow paths delivering water to the top of the containment vessel.	i) A report exists and concludes that when the water in the PCCWST uncovers the standpipes at the following levels, the water delivered by one of the three parallel flow paths to the containment shell provides coverage measured at the spring line that is equal to or greater than the stated coverages. - 24.1 ± 0.2 ft above the tank floor; at least 90% of the perimeter is wetted. - 20.3 ± 0.2 ft above the tank floor; at least 72.9% of the perimeter is wetted. - 16.8 ± 0.2 ft above the tank floor; at least 59.6% of the perimeter is wetted.
	ii) Inspection of the containment vessel exterior coating will be conducted.	ii) A report exists and concludes that the containment vessel exterior surface is coated with an inorganic zinc coating above elevation 135'-3".
	iii) Inspection of the containment vessel interior coating will be conducted.	iii) A report exists and concludes that the containment vessel interior surface is coated with an inorganic zinc coating ~~above 7'~~ above the operating deck.

Change 6 – CV Heat Transfer ITAAC (cont.)

Proposed markups to ITAAC 3.3.00.02.g

Table 3.3-6 (cont.)
Inspections, Tests, Analyses, and Acceptance Criteria

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
		ii.f) A report exists that concludes that the as-built concrete thicknesses of the turbine building sections conform to the building sections defined in Table 3.3-1.
2.b) Site grade level is located relative to floor elevation 100'-0" per Table 3.3-5.	Inspection of the as-built site grade will be conducted.	Site grade is consistent with design plant grade within the dimension defined on Table 3.3-5.
2.c) The containment and its penetrations are designed and constructed to ASME Code Section III, Class MC.(1)	See Tier 1 Material, Table 2.2.1-3, Items 2a, 2b, 3a, and 3b. .	See Tier 1 Material, Table 2.2.1-3, Items 2a, 2b, 3a, and 3b. .
2.d) The containment and its penetrations retain their pressure boundary integrity associated with the design pressure.	See Tier 1 Material, Table 2.2.1-3, Items 4a and 4b..	See Tier 1 Material, Table 2.2.1-3, Items 4a and 4b.
2.e) The containment and its penetrations maintain the containment leakage rate less than the maximum allowable leakage rate associated with the peak containment pressure for the design basis accident.	See Tier 1 Material, Table 2.2.1-3, Items 4a, 4b, and 7.	See Tier 1 Material, Table 2.2.1-3, Items 4a, 4b, and 7.
2.f) The key dimensions of nuclear island structures are defined on Table 3.3-5.	An inspection will be performed of the as-built configuration of the nuclear island structures.	A report exists and concludes that the key dimensions of the as-built nuclear island structures are consistent with the dimensions defined on Table 3.3-5.
2.g) The containment vessel ~~greater than 7 feet~~ above the operating deck provides a heat transfer surface. A free volume exists inside the containment shell above the operating deck.	The maximum containment vessel inside height from the operating deck is measured and the inner radius below the spring line is measured at two orthogonal radial directions at one elevation.	The containment vessel maximum inside height from the operating deck is 146'-7" (with tolerance of +12", -6"), and the inside diameter is 130 feet nominal (with tolerance of +12", -6").

Change 7

Updates to Peak Clad Temperature (PCT) for LOCA Analyses

Change 7 – Updates to PCT for LOCA Analyses

LOCA PCT Impacts

- There are no direct impacts to PCT for LBLOCA or SBLOCA as a result of the updated containment integrity analyses
- However, outstanding 10 CFR 50.46 PCT rackups for LBLOCA & SBLOCA rebaseline efforts are included in LAR as they are tracked against containment integrity analyses updates
  - WGOTHIC-calculated minimum backpressure is an input to LOCA analyses

Change 7 – Updates to PCT for LOCA Analyses (cont.)

PCT Impacts from VEGP LAR-17-043			
LBLOCA		**SBLOCA**	
AOR PCT [°F]	1936	AOR PCT [°F]	663.5
50.46 Annual Report 2016 PCT [°F]	1970	50.46 Annual Report 2016 PCT [°F]	708.5

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[redacted]

*Note: PCT value does not include VEGP LAR-17-009 (WEC LAR-133) impact of +144 °F

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LAR Submittal Format

- **Large submittal package**
- **Due to proprietary nature of the WGOTHIC WCAP-15846 methodology, LAR package includes 4 Attachments supporting Change 2**
  1. Technical evaluation including tracked-changes of WCAP-15846 from Revisions 1 through 5 (Proprietary)
  2. Technical evaluation including tracked-changes of WCAP-15846 from Revisions 1 through 5 (Non-Proprietary)
  3. WCAP-15846, Revision 5 (Proprietary)
  4. WCAP-15862, Revision 5 (Non-Proprietary)

Questions?

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