Vogtle PEmails

From: Henderson, Ryan Donald <RDHENDER@SOUTHERNCO.COM>
Sent: Monday, April 1, 2019 10:14 AM
To: Patel, Chandu; Habib, Donald; Gleaves, Bill
Cc: Agee, Stephanie Y.; Arafeh, Yasmeen N.; Chamberlain, Amy Christine; Aughtman, Amy G.; 'harperzs@westinghouse.com'; Wu, Si
Subject: [External_Sender] 4/11/19 Public Meeting Slides for Tornado Missiles Topic
Attachments: APP-GW-GLY-171.pdf

Chandu, Don, and Billy:

The attached document is provided for the Public Meeting on Thursday, April 11, 2019.

Thank you,

Ryan Henderson
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Office: 205-992-6426
Cell: 205-613-0342

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From: Henderson, Ryan Donald

Created By: RDHENDER@SOUTHERNCO.COM

Recipients:
"Agee, Stephanie Y." <SYAGEE@southernco.com>
Tracking Status: None
"Arafeh, Yasmeen N." <YNARAFEH@southernco.com>
Tracking Status: None
"Chamberlain, Amy Christine" <ACCHAMBE@southernco.com>
Tracking Status: None
"Aughtman, Amy G." <AGAUGHTM@SOUTHERNCO.COM>
Tracking Status: None
"'harperzs@westinghouse.com'" <HARPERZS@WESTINGHOUSE.COM>
Tracking Status: None
"Wu, Si" <wu1s@westinghouse.com>
Tracking Status: None
"Patel, Chandu" <Chandu.Patel@nrc.gov>
Tracking Status: None
"Habib, Donald" <Donald.Habib@nrc.gov>
Tracking Status: None
"Gleaves, Bill" <Bill.Gleaves@nrc.gov>
Tracking Status: None

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Tornado Missile: Turbine Building First Bay Barriers and MSSV Stacks (WEC LAR 221)

Technical Exchange Meeting: 4/11/19

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Background Information

UFSAR Subsection 3.5.2:

- "Protection from external missiles… is provided by the walls and roof of the Seismic Category I (SCI) nuclear island structure."
- "Openings through these walls are evaluated on a case by case basis to provide confidence that a missile passing through the opening would not prevent safe shutdown and would not result in an offsite release exceeding the limits defined in 10 CFR 50.34."

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UFSAR Subsection 3.5.1.4

- Defines three AP1000 tornado missiles:
  - 1'' steel sphere (105 mph)
  - 8'', 275 lb. rigid artillery shell (105 mph horizontal, 74 mph vertical)
  - 4000 lb. deformable automobile (105 mph horizontal, 74 mph vertical)

Background Information

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Background Information

- LAR-15-021 (WEC LAR-30) was approved to credit the SCII Turbine Building First Bay (TBFB) for protecting the penetrations in the Auxiliary Building north wall (Wall 11) from postulated tornado missiles

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Background Information

- Total of 24 openings in roof – 12 per Main Steam Line
- Stack diameter is 24 inches
- Stacks extend ~9 feet above roof
- Diameter of MSSV discharge elbow is 10 inches
- No hard connection between MSSVs and stacks
- Conventional PWR design

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Background Information

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[redacted]

Missiles Impacting the MS Stacks (Horizontally)

Evaluation Summary:

- Assume all rooftop vent paths (stacks, PORV & roof vent) are disabled by tornado missiles
- Steam relieves into the MSIV compartment, though Wall 11 doors and vents, and into the TBFB
- Compartment pressure remains below limit
- Aligns with RAI response during design certification (RAI COL03.05.01.04-1)
- Unlikely that all rooftop vent paths could be disabled by tornado missiles

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Note: If a horizontal missile were to crimp only one stack, an imbalance force on the drip pan would occur causing a moment on the steam line. No break of the main steam line would be expected. However, any potential break would be bounded by the analysis performed in UFSAR 15.1.5. No passive safety features impacted and the plant achieves safe shutdown.

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Missiles Impacting the MS Stacks (Horizontally)

- Per UFSAR Table 3.5-1, Wall 11 doors are credited for stopping a postulated 8” artillery shell and 1” sphere
- Since Wall 11 doors are now being credited to open in the event all roof vents are disabled, one new small barrier must be added at EL. 100’in the TBFB (in front of the Valve/Piping Room Wall 11 door, 12306) a,c
- No additional barriers needed

Missiles Entering Down the MS Stacks (Vertically)

Evaluation Summary:

- Demonstrate that tornado debris falling into the stack, contacting the MSSV cactus arm, is within ASME pipe stress limits
- Demonstrate that the 8” (74 mph) artillery shell contacting the MSSV cactus arm will not break the MS boundary
- Demonstrate that even if a missile breaks a main steam, main feed, or startup feed line, the AP1000 passive safety features are not impacted and the plant still achieves safe shutdown.
- Unlikely that any missile could enter MS stack vertically

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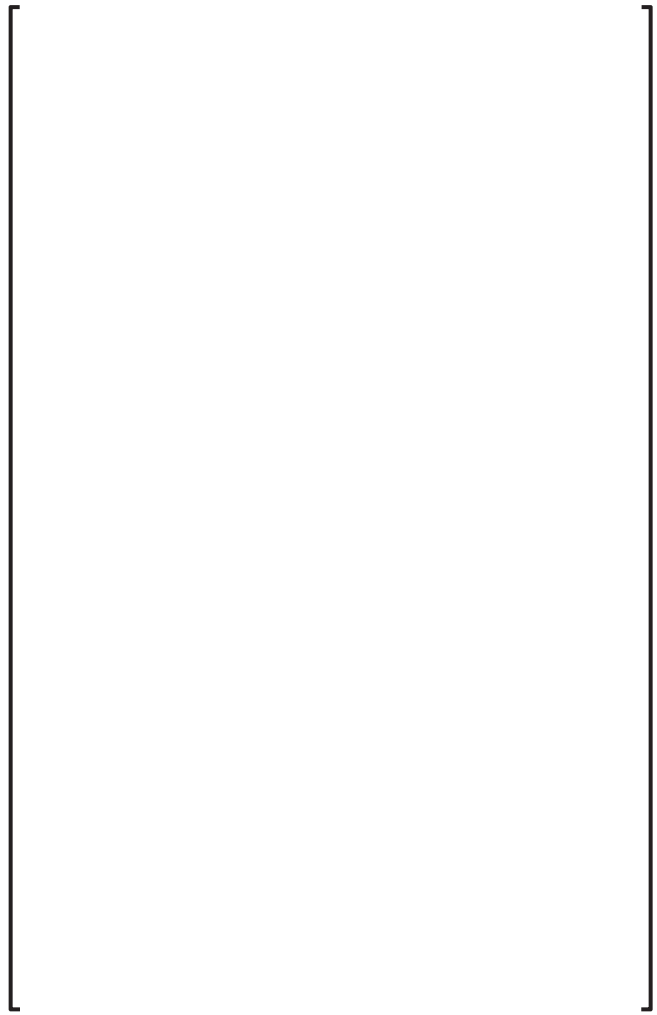

Missiles Entering Down the MS Stacks (Vertically)

- Demonstrate that tornado debris falling into the stack, contacting the MSSV cactus arm, is within ASME pipe stress limits
  - Missile load is analyzed in a linear elastic model, using equivalent static load method and a conservative dynamic load factor of 2
  - Pipe stress is at Level C allowable limits for a missile load of 18,000 lbf
  - 18,000 lbf missile load correlates debris size of 7” (50 lbs) steel sphere dropped 32 feet (31 mph)

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Missiles Entering Down the MS Stacks (Vertically)

- Demonstrate (LS-Dyna) that the 8” (74 mph) artillery shell contacting the MSSV cactus arm will not break the MS boundary
- Analysis Results
  - If the shell catches the top edge of the vent arm, the arm plastically deforms but stops the missile
  - If the shell falls directly down the center of the arm, it will puncture the arm and exit with low velocity
  - The steam boundary is not breached as a result of an artillery shell missile traveling down an MSSV stack
  - The stress generated in the MSSV branch connection and the MSL is less than the strength of these components

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Missiles Entering Down the MS Stacks (Vertically)

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Missiles Entering Down the MS Stacks (Vertically)

- Demonstrate that even if a missile breaks a main steam, main feed, or startup feed line, the AP1000 passive safety features are not impacted and the plant still achieves safe shutdown.
- Hypothetical vertical artillery shell through MSSV stack does not impact AP1000 passive safety systems and the potential breaks are analyzed
  - Main steam line break - UFSAR 15.1.5
  - Main feedwater line break - UFSAR 15.2.8 (Bounds a startup feedwater line break)

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TBFB Automobile Barriers

Evaluation Summary

- Continue to credit barriers that prevent the 1” sphere and 8” artillery shell from passing through Wall 11 openings (method approved in LAR-15-021)
  - SCII TBFB structure
  - Wall 11 doors
  - Existing barrier within the TBFB at EL 117’-6”
  - New barrier within the TBFB at EL 100’
- Remove the large TBFB automobile barriers from the plant design
  - Torturous path a deformable automobile must take to arrive at a Wall 11 opening is not credible due to intervening structures and equipment

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TBFB Automobile Barriers

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Proposed licensing changes

A case-by-case evaluation has been performed for openings through the SCI MSIV compartment walls to provide confidence that a missile would not prevent safe shutdown. The following licensing basis changes are proposed:

Horizontal Missile Impacting the Stack

- Add a small missile barrier in front of the Wall 11 door at EL. 100' (UFSAR Table 3.5-1)
- Clarify tornado missiles are not a design basis load on the stacks (UFSAR Subsection 3.5.2)

Vertical Missile down the Stack

- Clarify the 8" artillery shell missile is not an ASME design basis load on the MS line (UFSAR Subsection 3.5.2)
- Clarify the automobile missile is not a design basis load on the main steam stacks(UFSAR Subsection 3.5.2)

Deformable Automobile through the TBFB

- Remove the large TBFB automobile barriers since they are not needed (UFSAR Subsection 3.5.2 and Table 3.5-1)
- Clarify that the automobile is not a credible missile for Wall 11 openings (UFSAR Subsection 3.5.2)

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Applicable Regulatory Requirements

- GDC 2 - Design bases for protection against natural phenomena
- GDC 4 - Environmental and dynamic effects design bases
- 10 CFR 100.10(c) - Physical characteristics of the site, including seismology, meteorology, geology, and hydrology
- RG 1.76, Rev. 0 - Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants
- RG 1.117, Rev. 1 - Protection Against Extreme Wind Events and Missiles for Nuclear Power Plants
- SRP 3.5.1.4, Rev. 2 - Missiles Generated by Tornadoes and Extreme Winds

Questions / Discussion