

ENCLOSURE 6

**Response to Pending NRC Audit Observations Associated with  
Non-Metallic Insulation Equivalency Determination**

**(Non-Proprietary)**



# Response to Pending NRC Audit Observations Associated with Non-Metallic Insulation Equivalency Determination

# Overview of NMI Suitable Equivalency Testing Program - Summary

**NMI to be a suitable equivalent replacement for MRI: No debris production during or following a LOCA**

Sequence of events



**Exposure to environmental conditions (aging):** demonstrate effects of aging to be unimportant to debris production

**Jet impingement:** demonstrate the robustness of the encapsulation by showing no debris generation due to jet impinged

**Submergence:** demonstrate the effectiveness of the encapsulation to prevent debris generation during submergence



**3 separate items: when integrated will demonstrate no debris production**

## NRC General Concerns – Encapsulation

- **Concern**

- The encapsulation of the upper neutron shielding (UNS) and lower neutron shielding (LNS)
  - Does the seam welded foil meet the original intent of DCD wording?
    - “encapsulated in stainless steel that is seam welded so that LOCA jet impingement does not damage the insulation and generate debris”

- **Response**

- Our non-metal material is encapsulated in stainless steel and seam welded. Testing will be performed to show that debris isn't generated



## NRC General Concerns – Test Repeatability

- **Concern**

- Repeatability and uncertainty in testing

- NRC's opinion is that one sample per test can be problematic
- NRC said that if only one sample is used we will have to provide a justification for how the test results are repeatable

- **Response**

- Jet impingement testing

- One test will subject two shielding panel samples to a jet
- 3 different configurations of shielding panels will be tested

- Submergence testing

- Not FOAK testing
- Consistent with EQ testing practices and previous PWROG's testing, only one submergence test is required

# Jet Impingement Testing Concerns – Acceptance Criteria

- **Concern**

- The acceptance criteria for the jet impingement testing were unclear
  - Test plan Rev. A acceptance criteria
    - The samples will have successfully passed the jet impingement testing if non-metal material is not exposed after being subjected to the simulated LOCA jet
  - The staff questioned the level of allowable damage that still constitutes an acceptable test

- **Response**

- Rev. 0 acceptance criteria
  - The specified initial conditions for the jet impingement facility water supply tank are met prior to jet impingement
  - Test articles remained restrained in the test fixture
- Post test inspections will be performed to assess the integrity of the encapsulation and to characterize any damage that may have occurred
- To qualify as suitable insulation the individual results from the jet impingement tests and other testing activities must be integrated to show that fibrous, particulate, and chemical debris are not generated



# Jet Impingement Testing Concerns – Calculation of Test Pressure

- Concern
  - Do the methods and calculations described in the test plan conform to the approved design basis for the resolution of GSI-191 for AP1000
- Response
  - No ZOI has been defined for encapsulated [ ]<sup>a,c</sup> insulation or the other non-metal material used in the neutron shielding panels
    - The most relevant defined ZOI is for (un-encapsulated), micro-porous insulation
      - 29 pipe inner diameters, per AP1000 DCD
    - The encapsulated non-metal material is therefore within the ZOI and must shown to be a suitable equivalent insulation

# Jet Impingement Testing Concerns – Calculation of Test Pressure

- Response
  - DCD Words
    - “In order to qualify as a suitable equivalent insulation, testing must be performed that subjects the insulation to conditions that bound the AP1000 conditions”
  - Testing will subject the non-metal material encapsulation to jet impingement from a conservative nozzle break in the Reactor Cavity nozzle gallery
    - LBB piping is not credited
    - Test conditions scaled to plant conditions with NRC approved ANS 58.2 two phase jet model

# Jet Impingement Testing Concerns – Shield Block Manufacturing Tolerances

- Concern
  - How were the test specimens configured to bound the expected manufactured condition?
- Response
  - The test specimens were procured to the design specification and drawings that they will procure and manufacture for US AP1000's
  - The test article Quality Data Package and the Certificate of Conformation verify that the Samples were constructed using the identical fabrication techniques used on panels shown on the design drawings

# Submergence Testing Concerns – Acceptance Criteria

- **Concern**
  - Lack of GSI-191 acceptance criteria
    - No acceptance criteria in the test plan related to chemical concentrations or fiber amounts measured in the test
    - Not clear submergence test acceptance criteria
- **Response**
  - Test plan acceptance criteria ensure that the test subjected the test samples to bounding post LOCA submergence conditions
  - Acceptance criteria for a suitable equivalent insulation are stated in the DCD
    - No debris generated
    - Results of testing must be integrated with current chemical effects analysis (APP-PXS-M3C-052)
- To qualify as suitable insulation the individual test results must be integrated to show that fibrous, particulate, and chemical debris are not generated

## NRC General Concerns – Aging Effects

- **Concern**

- Have the test programs fully addressed how material subjected to aging would perform since only fresh material will be tested?
  - [ ]<sup>a,c</sup> could generate gas causing the foil encapsulation to fail (leak and lose seal)
  - Aged [ ]<sup>a,c</sup> could fall to pieces (crumble)
  - Heating and cooling would cause the sealed foil encapsulation to bloat and shrink possibly resulting a loss of integrity
- There may be other aging effects that may not have been identified yet

## Addressing Aging Concerns

- To address concerns about unidentified aging effects
  - Perform a FMEA (Failure Mode and Effects Analysis) to support our initial justification
    - Outside subject matter experts are being brought in for support
    - EQ experts assessing feasibility and ramifications of aging
  - Investigating addition of a breather vent to remove the uncertainty of [ ]<sup>a.c</sup> off gassing
    - Allows for gases generated by the aging boron silicone to escape
    - Allows air to enter and leave during heat up and cool down
  - FMEA to assess benefit of breather vent addition