ENCLOSURE 2

M220141

2022 Technology Update Presentation

Non-Proprietary Information

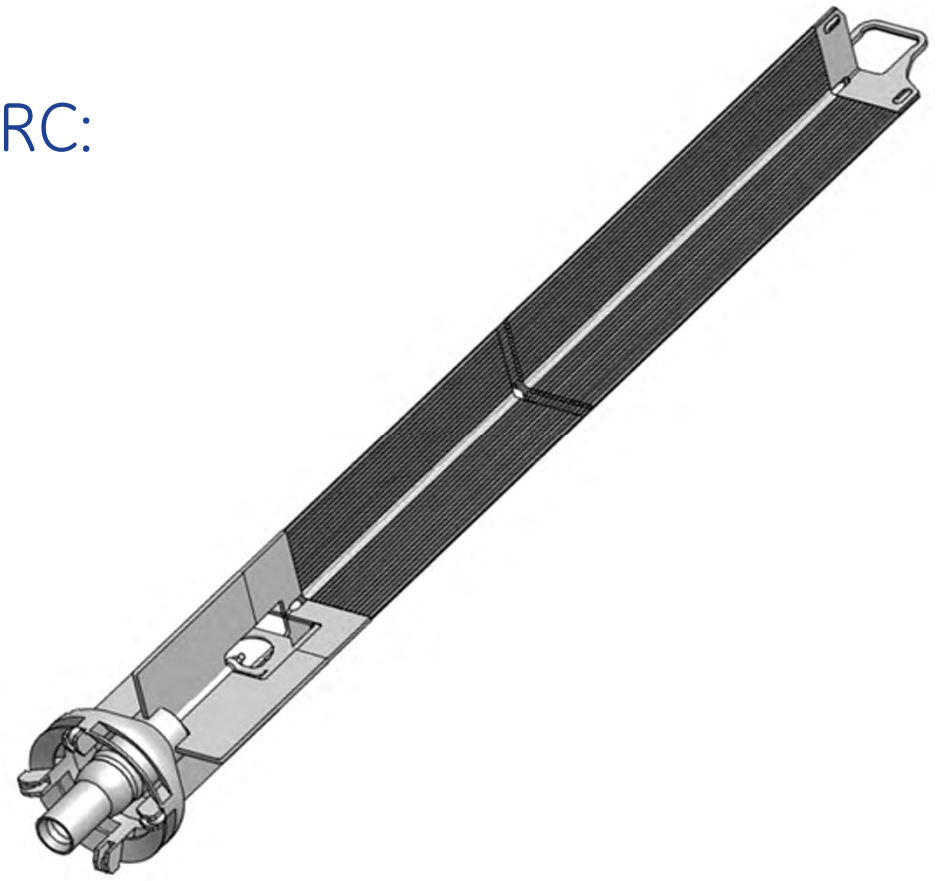
INFORMATION NOTICE

Enclosure 2 is a non-proprietary version of the 2022 Technology Update Presentations from Enclosure 1, which has the proprietary information removed. Portions that have been removed are indicated by open and closed double brackets as shown here [[ ]].

Technology Update for the US NRC August 2022

2022 Annual Report to NRC:
M220102

August 10, 2022



Control Rods

Scott Nelson

DBR-0067060

HITACHI

Product Line Overview

Marathon (1991 – 2014)

- NEDE-31758P-A, 1991
- Lifetime reductions in 2011 ([[ ]]) and 2022 ([[ ]])due to observed cracks.
- Continue to perform visual inspections to confirm lifetime limits.

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Ultra MD (2009 – present)

- NEDE-33284P-A Rev. 2, 2009
- Perform visual inspections of lead depletion control rods.
- **Zero** cracks observed to date.

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Ultra HD (2012 – present)

- NEDE-33284 Suppl. 1P-A Rev. 1, 2012
- Perform visual inspections of lead depletion control rods.
- **Zero** cracks observed to date.

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Marathon-C+ Inspection

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PRC 22-02 Summary

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SC 22-02 – Timeline

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Marathon and Ultra Control Rod Design Comparison

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Ultra Surveillance Requirements

Ultra MD: NEDE-33284P-A Rev. 2 Safety Evaluation

- Inspect 2 lead depletion control rods.
- Inspect 2 lead depletion control rods of opposite lattice, once they have exceeded 75% of NEOL.
- Inspect 12 control rods of each lattice type upon end of life discharge.

Ultra HD: NEDE-33284 Suppl. 1P-A Rev. 1 Safety Evaluation

- Inspect 2 lead depletion control rods once they have exceeded 75% of NEOL.
- Inspect 2 lead depletion control rods of opposite lattice, once they have exceeded 90% of NEOL.
- Inspect 12 control rods of each lattice type upon end of life discharge.

NEOL = Nuclear End of Life

Ultra MD Visual Inspection Data

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Plant M-B Ultra MD Inspection

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Ultra MD Surveillance Summary

Ref: NEDE-33284P-A Rev. 2 Safety Evaluation

- Inspect 2 lead depletion control rods.
  - ✓ Plant M-B has the lead depletion Ultra MDs, inspected in fall 2019 and planned for fall 2021.
- Inspect 2 lead depletion control rods of opposite lattice, once they have exceeded 75% of NEOL.
  - ✓ Performed opposite lattice inspection at [[ ]] of NEOL, ahead of 75% NEOL requirement.
- Inspect 12 control rods of each lattice type upon end-of-life discharge.
  - ✓ Total 6 D/S lattice Ultra MDs permanently discharged and inspected to date (3 at Plant M-A, 3 at Plant M-B).

No observed cracks to date on Ultra MD control rods.

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Ultra HD Visual Inspection Data

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Ultra HD Surveillance Summary

Ref: NEDE-33284 Suppl. 1P-A Rev. 1 Safety Evaluation

- Inspect 2 lead depletion control rods once they have exceeded 75% of NEOL.
  - ✓ Lead depletion control rods are being inspected at multiple plants, far earlier than 75% NEOL requirement.
- Inspect 2 lead depletion control rods of opposite lattice, once they have exceeded 90% of NEOL.
  - ✓ Inspections to date are D/S lattice. C lattice Ultra HD at Plant V will become the lead depletion units, and be inspected in spring 2022.
- Inspect 12 control rods of each lattice type upon end-of-life discharge.
  - ✓ 7 D/S Lattice Ultra HD control rods have been permanently discharged and inspected (4 Plant O, 3 Plant U).

No observed cracks to date on Ultra HD control rods.

HITACHI

Global Nuclear Fuel

August 2022

Proposed Approach to FFRD

HBU Technical Risks for LOCA/ECCS Performance

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Addressing the Important Phenomena of FFRD

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Fine Fragmentation Threshold

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Transient Fission Gas Release

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- Transient FGR in the RIL figures is based on terminal temperature of ~1200°C, well above HBU BWR fuel temperatures

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Transient Fission Gas Release Model

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GNF is developing a tFGR model to account for [[

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Proposed Approach to FFRD – High Level

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Proposed FFRD Evaluation Steps

Global Nuclear Fuel

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INT Break, Fuel temperatures, Nominal 55 GWD/MTU

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INT Break, Fuel temperatures, Nominal 63.5 GWD/MTU

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INT Break, Fuel temperatures, Nominal 77 GWD/MTU

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TRACG Results – Large Break

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TRACG Results – Intermediate Break (0.3154 ft^2)

Global Nuclear Fuel

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TRACG Results – Small Break (0.1067 ft^2)

Global Nuclear Fuel

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Rim region fuel temperatures, Nominal 57.5 GWD/MTU

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SAFER Results

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tFGR LOCA Sensitivity Studies Summary

SAFER and TRACG analyses performed studying the effects of tFGR on susceptibility of burst at higher exposures.

Key conclusions:

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Conclusions

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Acknowledgement

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Non-Proprietary Information

2022 Technology Update
August 10

BWRX300

Chimney Characteristics and Analyses

Charles Heck, Consulting Engineer, Nuclear Applications Technology
Zhe Zhang, Senior Engineer, Advanced Methods Technology
Core & Fuel Engineering

GNF Global Nuclear Fuel

BWRX Natural Circulation Phenomena

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Relative Pressure Distribution in BWRX RPV

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Steady State Flows & CU vs Power

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Approach to Validate TRACG Chimney Void Fraction Calculation(s) for BWRX

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TRACG Qualification – Void Fraction

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TRACG Qualification – Void Fraction in the BWRX Chimney vs [[ ]]

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ESBWR [[ ]]

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[[ ]] for 100% BWRX Power

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Impact of Calculated Chimney Conditions on Steam Separators

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[[ ]] and TRACG Transient ATWS Simulation with Isolation Condenser Condensate Flow into Chimney

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Transient Mass Flow Rate and Temperature for [[ ]]

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Chimney Volume-Averaged Void Fraction for the Transient ATWS Simulation

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Chimney Regional Void Fraction Comparisons for the Transient ATWS Simulation

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Concluding Remarks

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BWRX300