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# **BWRX-300 Source Term Methodology Licensing Topical Report**

**Dec. 11, 2024**



# — Open Session

# Agenda



- Open Session
  - Purpose and Scope
- Closed Session
  - BWRX-300 Enhanced Safety Overview
  - Event Selection Approach
  - Summary
- Q&A

## Purpose & Scope



- GEH Licensing Topical Report (LTR) NEDC-33913P, BWRX-300 Source Term Methodology, is being developed to describe the approach for determining the source terms to be used for performing the radiological analyses for establishing various dose-related scope:
  - Emergency Planning Zone (EPZ)
  - Exclusion Area Boundary (EAB) & Low Population Zone (LPZ)
- The proposed approach utilizes a Risk Informed, Performance Based (RIPB) method for selecting limiting accident event sequences and then utilizes a mechanistic approach for determining radiological release source terms and timing
- Additional pre-application meeting(s) are expected to provide NRC staff more information about the LTR.
- The purpose of this presentation is to describe the proposed event sequence selection approach that will be provided in the LTR for NRC approval
- No full power, internal event sequences that result in core-melt are identified for the BWRX-300 within the event sequence selection approach, and therefore, the mechanistic radiological analyses use reduced source terms



# — Closed Session

## BWRX-300 Enhanced Safety Overview



- The BWRX-300 passive plant design and safety analyses establish a level of safety assurance exceeding what is required by existing USNRC Light Water Reactor (LWR) guidance. In particular, the BWRX-300 is:
  - Focused on Defense-in-Depth (D-in-D) of the facility as a whole
  - Features low core damage frequency
  - Features low frequency for large release
- BWRX-300 Implementation of D-in-D through:
  - Systematic and robust identification and analyses of Postulated Initiating Events (PIEs) and event sequences
    - Fault evaluations
    - Deterministic Safety Analysis (DSA)
    - Probabilistic Safety Analysis (PSA)
  - Maintaining Fundamental Safety Functions (FSFs)
    - Control of reactivity
    - Removal of heat from the fuel
    - Confinement of radioactive material

# BWRX-300 Enhanced Safety Overview



- BWRX-300 design features include:
  - A relatively large Reactor Pressure Vessel (RPV) volume, along with a relatively tall chimney region, provides a substantial reservoir of water above the core
  - No RPV penetrations below 4 meters above top of active fuel, including no bottom drain line
  - RPV Isolation Valve (RIV) forged integrated valve bodies and flanges attached to RPV forged integrated nozzles and flanges
  - No large recirculation line which has been a potential break location for traditional BWRs
  - No safety relief valves which have been a potential risk to loss of coolant for traditional BWRs
- The combination of the robust, systematic process required by the BWRX-300 Safety Strategy (NEDC-33934P), along with the inherent safety features of the BWRX-300 design makes the likelihood of significant nuclear fuel failure including core melt not credible

## Event Selection Approach



- Event sequence selection includes PIEs and event sequences from the Anticipated Operational Occurrence (AOO), Design Basis Accident (DBA), and Design Extension Condition (DEC) categories
- Event sequences with a mean frequency of [[ ]] are included in the event selection process
  - To support cliff-edge evaluation of events with significant release that may be screened out, [[ ]]
  - This approach credits the significant improvements in the safety of the design compared to previous light water reactors
- **Accidents with a fission product release from the core into the containment are included only if they meet the preceding criteria**
  - BWRX-300 currently does not have any **full power, internal events** that meet this criteria that result in core-melt, so no core-melt accidents would be included in the spectrum of events
- Approach is consistent with selection of “major accident” as described in RG 1.183, Rev. 1
  - *“...accident whose consequences, as measured by the radiation exposure of the surrounding public, would not be exceeded by any other accident whose occurrence during the lifetime of the facility would appear to be credible.”*



## Summary



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- The BWRX-300 currently has no full power, internal events within the evaluation’s proposed cut-off frequency that have subsequent release into containment of appreciable quantities of fission products
  - The design of the BWRX-300 is such that events are successfully mitigated to prevent an accident resulting in core meltdown “whose occurrence during the lifetime of the facility would appear to be credible” per RG 1.183
  - Therefore, the BWRX-300 [[

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**Q&A**