Point Beach GL 2004-02 Resolution Update

NextEra Energy Point Beach, LLC (NextEra)

December 9, 2021

Meeting Agenda

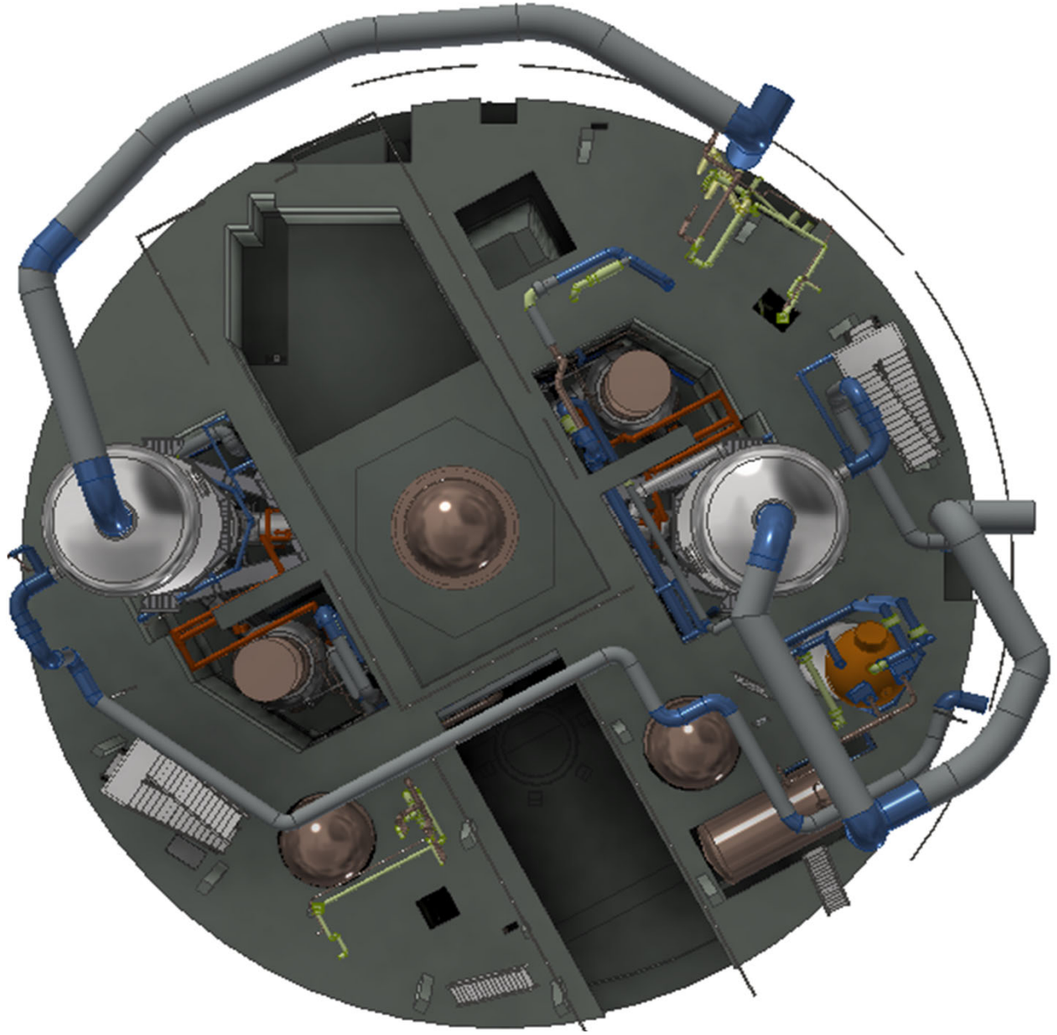
- Overview of Plant Layout and Strainer Configuration
- Overview of Risk-Informed Resolution Approach
- Risk and Uncertainty Quantification
- Content of Submittal
- Current Status and Submittal Schedule

Meeting Objectives

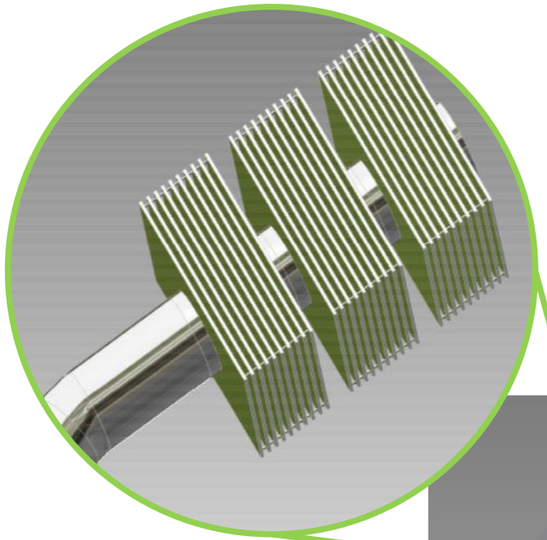
- Communicate current status of PBN response to GL 2004-02
- Obtain staff feedback on the overall risk-informed resolution path

PBN Plant Layout

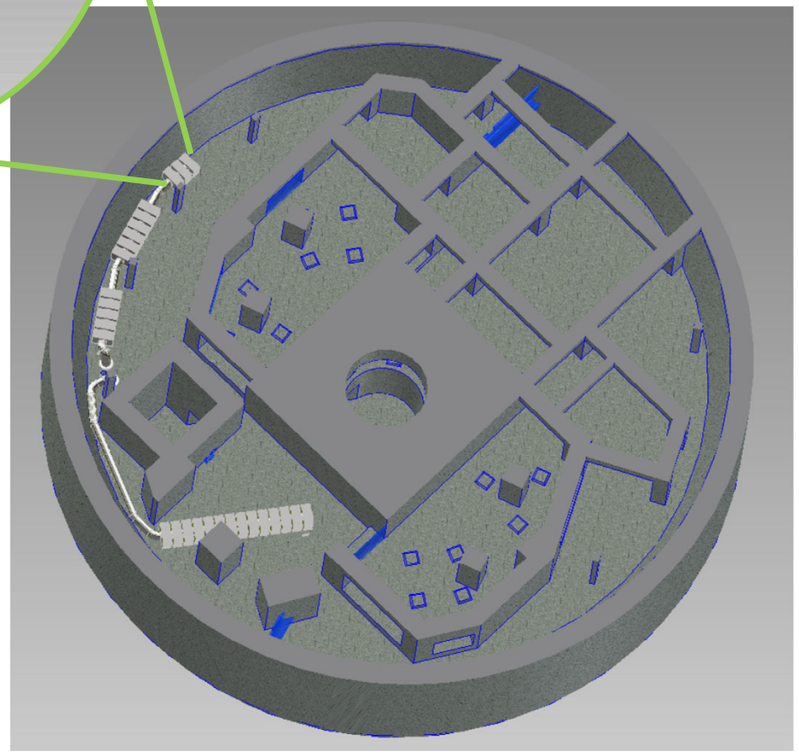
- Westinghouse 2-loop pressurized water reactor (PWR) with large dry containment
- Two redundant emergency core cooling system (ECCS) and containment spray (CS) trains
  - Each train has a high-head safety injection (SI) pump, residual heat removal (RHR) pump, and CS pump
  - During recirculation, the CS and SI pumps take suction from the RHR pump discharge



Sump Strainer Arrangement



Unit 1



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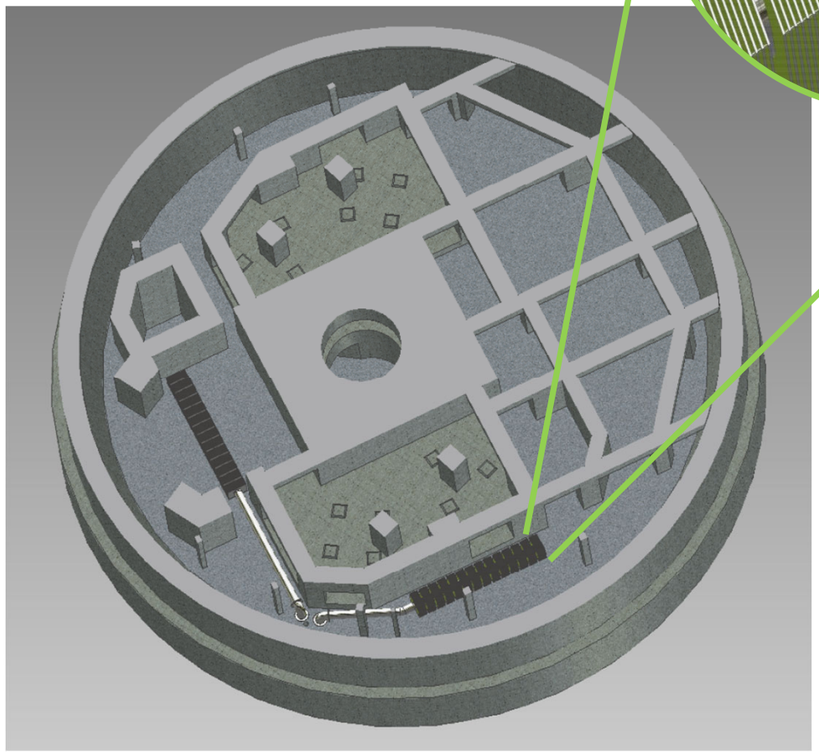
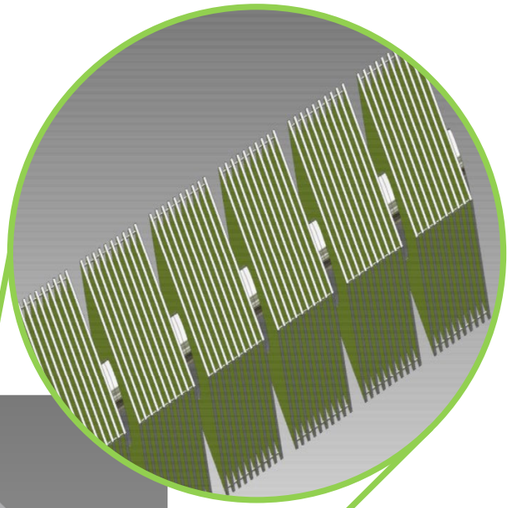




- PCI Sure-Flow strainers
- Vertical disk modules around a core tube
- Surface area of 1904.6 ft^2 per train

Background

- Previous GL Response submitted to the NRC in 2017 (ML17363A253)
- NRC performed an audit of the submittal in January 2019 and issued an audit report in December 2019 with several questions
- PBN was able to address all questions from the audit report except for Mineral Wool cassettes having a lower destruction pressure than assumed
- NextEra conducted an alternative analysis for PBN to determine the best path for closeout of GL 2004-02
- The selected option was the use of a risk-informed resolution approach

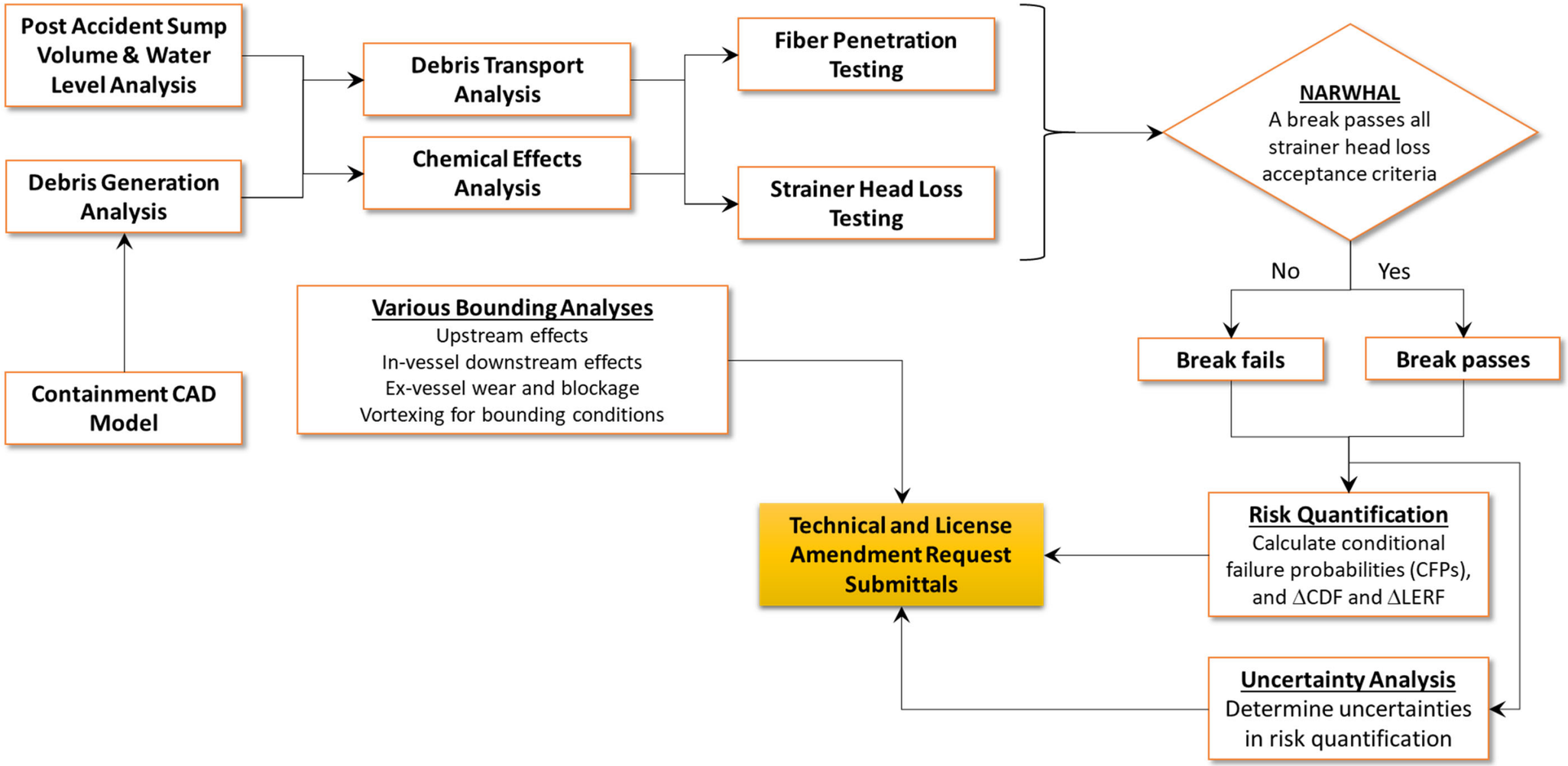
Overview of Risk-Informed Approach

- PBN's risk-informed approach is similar to Vogtle
- Overall evaluation based on models that have been used in the past and accepted by the NRC for GSI-191 resolution
- Screening of break scenarios and high likelihood equipment configurations
- Multiple breaks postulated at each Class 1 weld within first isolation valve on primary loop
- NARWHAL software evaluated each primary side break to determine if it would result in strainer failures due to effects of debris
- In-vessel downstream effects analyzed in a bounding evaluation outside of NARWHAL

Overview of Risk-Informed Approach

- Conditional failure probabilities (CFPs) calculated for each equipment lineup and PRA break size category
- Change in core damage frequency (ΔCDF) calculated outside PRA model using LOCA frequencies and equipment failure probabilities
- Change in large early release frequency (ΔLERF) calculated from conditional large early release probability for a large LOCA given core damage
- Risk contribution of secondary side breaks evaluated conservatively assuming all breaks fail the strainers due to effects of debris
- The total CDF and LERF values are obtained from the PBN PRA model
- Risk quantification results compared with RG 1.174 acceptance guidelines

PBN Risk-Informed Approach



Revision to Debris Generation Calculations

- ZOI size for mineral wool increased to 5.4D
- Mineral wool insulation is similar to K-Wool, which is classified as unjacketed mineral wool with wire mesh reinforcement in NEI 04-07
- K-Wool went through air jet impact testing and was assigned a ZOI size of 5.4D per NEI 04-07 SE
  - Tested K-Wool had wire mesh lining and fabric cover
- Mineral wool insulation at PBN is encapsulated in stainless steel cassettes
- All mineral wool within the 5.4D ZOI is assumed to be fines
  - Shown to be more conservative than using 17D ZOI and LDFG size distribution
- This assumption is similar to that used by Surry and North Anna

Acceptance Criteria for Risk Quantification

- NARWHAL software used to evaluate strainer performance
  - Strainer head loss vs. pump NPSH margin and strainer structural margin
    - -- NPSHr adjusted for degasification using RG 1.82 methodology
  - Gas voids from degasification or flashing compared with acceptance limits
  - Debris loads of a break compared with debris limits
  - Head loss compared with acceptance criterion for partially submerged strainer
- Bounding analyses were performed for the following acceptance criteria
  - Upstream blockage does not prevent water from reaching sump
  - Pump performance not affected by air intrusion from vortexing
  - Penetrated debris within ex-vessel wear and blockage limits
  - In-vessel fiber load within WCAP-17788 limit for Westinghouse two-loop plant

Evaluation of In-Vessel Downstream Effects

- In-vessel downstream effects was analyzed outside of NARWHAL following latest NRC review guidance
- Determined total in-vessel fiber load for the bounding hot leg break using WCAP-17788 methodology
- Maximum total in-vessel fiber load is ~85 g/FA, which is less than the limit in WCAP-17788 for Westinghouse 2-loop plants
- Boric acid precipitation is mitigated by starting an SI pump ~3-5 hours after the accident to supply flow to the cold legs and reactor core inlet
- PBN meets the requirements in the NRC review guide on in-vessel effects
  - In-vessel effects have no contribution to the risk quantification

Risk Quantification Results

- Risk quantification results for base case:
  - ΔCDF on the order of 1E-08 /yr
  - ΔLERF less than 1E-10 /yr
- Total CDF and LERF were based on PBN PRA model of record for internal and external events
  - Total CDF less than 1E-04 /yr
  - Total LERF on the order of 1E-6 /yr
- Risk increase due to strainer and reactor failures caused by LOCA-generated debris is within Region III of RG 1.174 guideline

Uncertainty Evaluation

- Following the guidance in NUREG-1855, uncertainty evaluation addresses parametric uncertainty, model uncertainty and completeness uncertainty
- Parametric uncertainty analyzed by rerunning base case model and shifting all input parameters that are not bounding to the more conservative direction
  - Parametric uncertainty cases showed increase in ΔCDF but the result is well within Region III of RG 1.174 guideline
- Model uncertainty quantified by replacing each non-consensus model with an alternative model
  - Four model uncertainty scenarios were analyzed
  - All model uncertainty cases showed results within RG 1.174 Region III
- Completeness uncertainty qualitatively determined to be low, given over four decades of industry and NRC research and analysis in this area

PBN PRA Model Status

- Internal events and fire PRA models developed and maintained in accordance with RG 1.200, Revision 2
- Recent NRC approved applications
  - TS Initiative 5.b – Surveillance Frequency Control Program
  - 10 CFR 50.69
  - NFPA-805
- The open peer review facts and observations (F&Os) were determined to have no significant impact on the risk-informed resolution of GL 2004-02
- The relevant PRA model assumptions were reviewed and none of the assumptions are key sources of uncertainty for the risk-informed resolution of GL 2004-02

Submittal Content and Schedule

- Submittal will address the five principles from RG 1.174
- Submittal will include the following enclosures
  - Enclosure 1: Request for exemption from the requirement of using deterministic methodology in 10 CFR 50.46(a)(1)
  - Enclosure 2: License amendment request (LAR) for implementation of risk-informed approach to address debris effects
  - Enclosure 3: Updated GL 2004-02 responses following the NRC content guide (revision bars will be shown for technical changes from the 2017 GL submittal)
  - Enclosure 4: Risk quantification and uncertainty analyses
  - Enclosure 5: Defense in depth measures and safety margin
- NextEra is currently working on the submittal
- Projected date for submittal to the NRC: Spring 2022

Questions?