



Quad Cities Nuclear Power Station

RICT and 50.69 LARs

NRC Pre-Submittal Meeting

March 2, 2023

Agenda Topics

- Meeting Objectives
- QCNPS Design Features of Note
- Overview of License Amendment Requests (LARs)
- Probabilistic Risk Assessment (PRA) Models
- FLEX Equipment Use
- External Hazards
- Submittal Timeline
- Key Takeaways

Meeting Objectives

- Provide NRC a clear understanding of the planned site-specific LARs
- Obtain NRC feedback on the proposed LARs to aid the acceptance review and minimize the need for RAIs
- Discuss proposed submittal schedule and corresponding need by date in order to allow NRC resource planning

QCNPS Design Features of Note

- Pre-General Design Criteria (GDC) plant
- Safe-Shutdown Makeup Pump (SSMP) is a common unit system designed to supply makeup water to the reactor core at the same capacity as the Reactor Core Isolation Cooling (RCIC) system
- Three emergency diesel-driven generators (EDGs) - one dedicated per unit plus one that can be utilized by either unit
- Two station blackout diesel-driven generator sets, each having a continuous rating of 4350 kW
- FLEX equipment, including the Hardened Containment Vent System (HCVS) and use of BlackStarTech™ carts, for Extended Loss of AC Power (ELAP) conditions

Overview of License Amendment Requests

- 50.69 LAR based on NEI 00-04, Rev. 0
 - No deviation from LAR template (except seismic)
 - QCNPS meets the EPRI 3002017583 Tier 1 criteria for a "Low Seismic Hazard/High Seismic Margin" site
 - RICT LAR based on TSTF-505-A, Rev. 2
 - BWR/3 reactor design with a Mark 1 containment
 - TS markups follow TSTF for BWR/4 (NUREG-1433 basis)
 - No clean page revisions included in the LAR
 - Submittal intended to allow use of the model Safety Evaluation (SE)
- * Considering including content of TSTF-591, which alters the RICT Program description wording and adopts RG 1.200 Rev. 3 (impacted by timing of final approval of the Traveler)

Variances from TSTF-505 (identified in Attachment 1 and Enclosure 4)

- Mostly nomenclature, section numbering or title wording differences, or driven by plant design
- TSTF-505 LCOs/Conditions not in QCNPS TS
 - 3.3.4.1 "End of Cycle Recirculation Pump Trip (EOC-RPT) Instrumentation"
 - 3.3.6.3 "Low-Low-Set (LLS) Instrumentation"
 - 3.6.3.1 "Drywell Cooling System Fans"
 - 3.7.2 "Plant Service Water (PSW) System and Ultimate Heat Sink (UHS)"
 - 3.8.7 "Inverters - Operating"
- RICT added to plant-specific LCOs not included in TSTF-505
 - 3.3.6.3 "Relief Valve Instrumentation"
 - 3.6.2.6 "Residual Heat Removal (RHR) Drywell Spray"
 - 3.7.9 "Safe Shutdown Makeup Pump (SSMP) System"
- RICT not added to LCOs included in TSTF-505
 - 3.6.2.4 "Residual Heat Removal (RHR) Suppression Pool Spray"

PRA Models' Technical Acceptability

- Full Power Internal Events (FPIE) PRA – Peer Reviewed to RG 1.200 Rev. 2
 - Fact & Observation (F&O) Closure review performed
 - No Open Finding F&Os

- Fire PRA – Peer Reviewed to RG 1.200 Rev. 2
 - F&O Closure review performed
 - No Open Finding F&Os

Evaluation of PRA Uncertainties and Assumptions

QCNPS RICT and 50.69 LAR submittals will follow the process defined in NUREG-1855 Rev. 1, and the guidance in EPRI 1016737 and EPRI 1026511, including:

- Identification of internal events/internal flooding PRA model plant-specific and generic sources of uncertainties per EPRI 1016737
- Identification of internal fire PRA model plant-specific and generic sources of uncertainty per Appendix B of EPRI 1026511
- Consideration of generic Level 2 model sources of uncertainty per Appendix E of EPRI 1026511, as applicable to large early release frequency (LERF)
- Assessment of potential sources of uncertainties that are key to the respective applications, and associated disposition or treatment
- Consideration of parameter and completeness uncertainties

FLEX Equipment Use

- FLEX equipment included in the PRA model:
 - Three portable diesel-driven pumps
 - One deep well motor-driven FLEX pump and associated diesel generator
 - Four separate portable generators and associated piping, valves, and instrumentation
 - Hardened Containment Vent System (HCVS)

- Only used during ELAP conditions per QCNPS plant procedures
 - Thus, only credited in PRA for ELAP

FLEX Equipment Use– BlackStarTech™

- BlackStarTech™ was incorporated into the QCNPS PRA models and is used in sample RICT calculations
 - Multiple portable carts with equipment capable of providing backup power to specific equipment
 - Located near equipment intended to be served
 - RCIC flow controller
 - Automatic Depressurization System (ADS) valves and logic instrumentation
 - HCVS



External Hazards

- IPEEE Initial Screening
- Reviewed current hazard information
- Updated analysis using Part 6 screening criteria of ASME/ANS PRA Standard RA-Sa-2009
- Performed conservative or bounding analyses where appropriate

RICT – Incorporates NEI 06-09 guidance

- Justify exclusion of external risk sources from the PRA models based on their insignificance to the calculation of configuration risk

50.69 – Incorporates NEI 00-04 guidance

- Figure 5-6, “Other External Hazards”
- Seismic will use EPRI alternative approach (TR 3002017583) for Tier 1 plants

QCNPS External Hazards – External Flooding

Two flood causing mechanisms to be screened

Local Intense Precipitation

- Intense rainfall is monitored by the station in accordance with LIP Procedures
- Following a consequential rainfall event, the procedure directs the installation of six flood barriers
- In combination with permanently installed features (such as exterior doors), the station does not lose any key SSCs or safety functions during the event
- Time Validation performed to ensure all actions can be accomplished in the time window
- Operators are trained on the installation of the temporary barriers

QCNPS External Hazards – External Flooding

Two flood causing mechanisms to be screened

Local Intense Precipitation

- Station response to LIP was presented in Integrated Assessment letter RS-18-045 (ML18180A033)
- NRC assessment issued August 29, 2019 (ML19168A196)

- Initial Preliminary Screening Criterion C1, "Event damage potential is less than events for which the plant is designed"

QCNPS External Hazards – External Flooding

Two flood causing mechanisms to be screened

PMF (River Flood with Hydrologic Dam Failure)

Current Strategy:

- Station strategy includes shutting down reactors well in advance of flood, cooling down, disassembling, flooding up and refilling with river water over the long duration event
- Building doors are opened to allow water pressure to equalize on both sides of the walls
- This strategy will remain in place for the most extreme floods

QCNPS External Hazards – External Flooding

PMF (River Flood with Hydrologic Dam Failure)

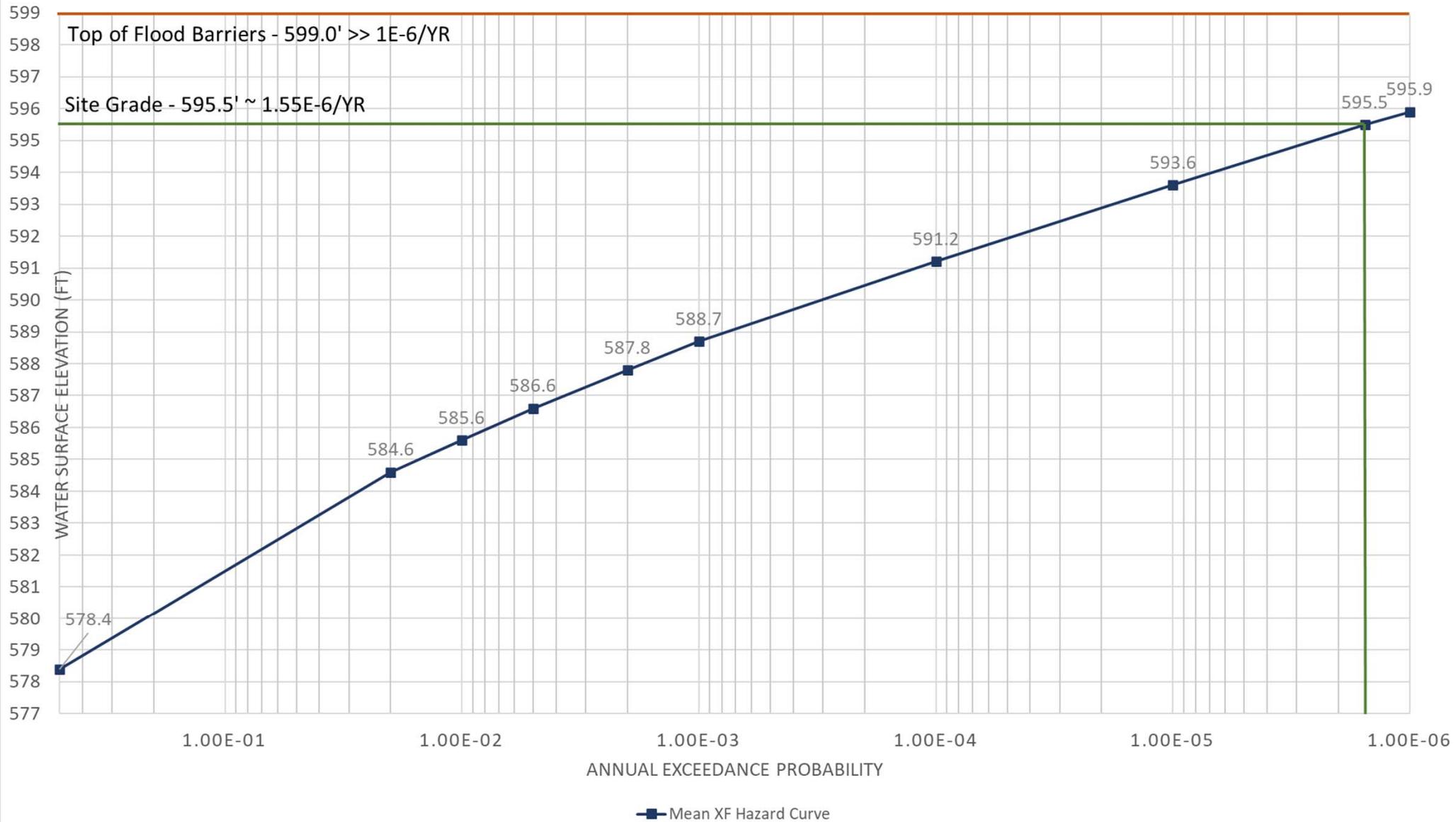
- Station performed a Probabilistic Flood Hazard Assessment for the river flood mechanism
 - Utilized stochastic weather modeling and continuous simulation hydrologic model accounting for uncertainties

- Study showed that flood waters exceeding:
 - Site Grade (@595.5') ~ 2E-6/yr
 - LIP Barriers (@599.0') ~ 5E-8/yr

QCNPS External Hazards – External Flooding

PMF XF MEAN HAZARD CURVE

WATER SURFACE ELEVATION VS. ANNUAL EXCEEDANCE PROBABILITY



QCNPS External Hazards – External Flooding

PMF (River Flood with Hydrologic Dam Failure)

Proposed Strategy:

- Upon receipt of river flood warning, operators close LIP Barriers in accordance with the station LIP Procedures
- Follow normal procedures to shutdown, cooldown, and disassemble for long term make up in extreme flood situations

Revised Analysis:

- Structural capability of LIP Barriers and Building walls to sustain hydrologic forces to an elevation of 599'
- Modifications of some LIP barriers to protect to 599'
- Revision to procedures to include step of closing six LIP barriers prior to the flood waters arriving

QCNPS External Hazards – External Flooding

PMF (River Flood with Hydrologic Dam Failure)

Bounding mean CDF evaluation – conservative assumptions, inputs and methods

Anticipated CDF will be estimated an order of magnitude lower than the threshold

No credit for mitigation capabilities once water tops barriers

Screen utilizing Progressive Screening Criterion PS4 where the bounding mean CDF is less than $1E-6/yr$

External Hazards – Extreme Winds / TORNADOS

- Wind pressure effects from high winds and tornados screen
- Although the Tornado Missile design and licensing bases are met, tornado risk is evaluated due to risk-significant SSCs vulnerable to missiles

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- Although average CDF is expected to be $< 1E-6/yr$, a penalty factor will be needed to account for configuration risk

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- Expect to screen with CDF $< 1E-6/yr$ (PS4)

External Hazards - Seismic

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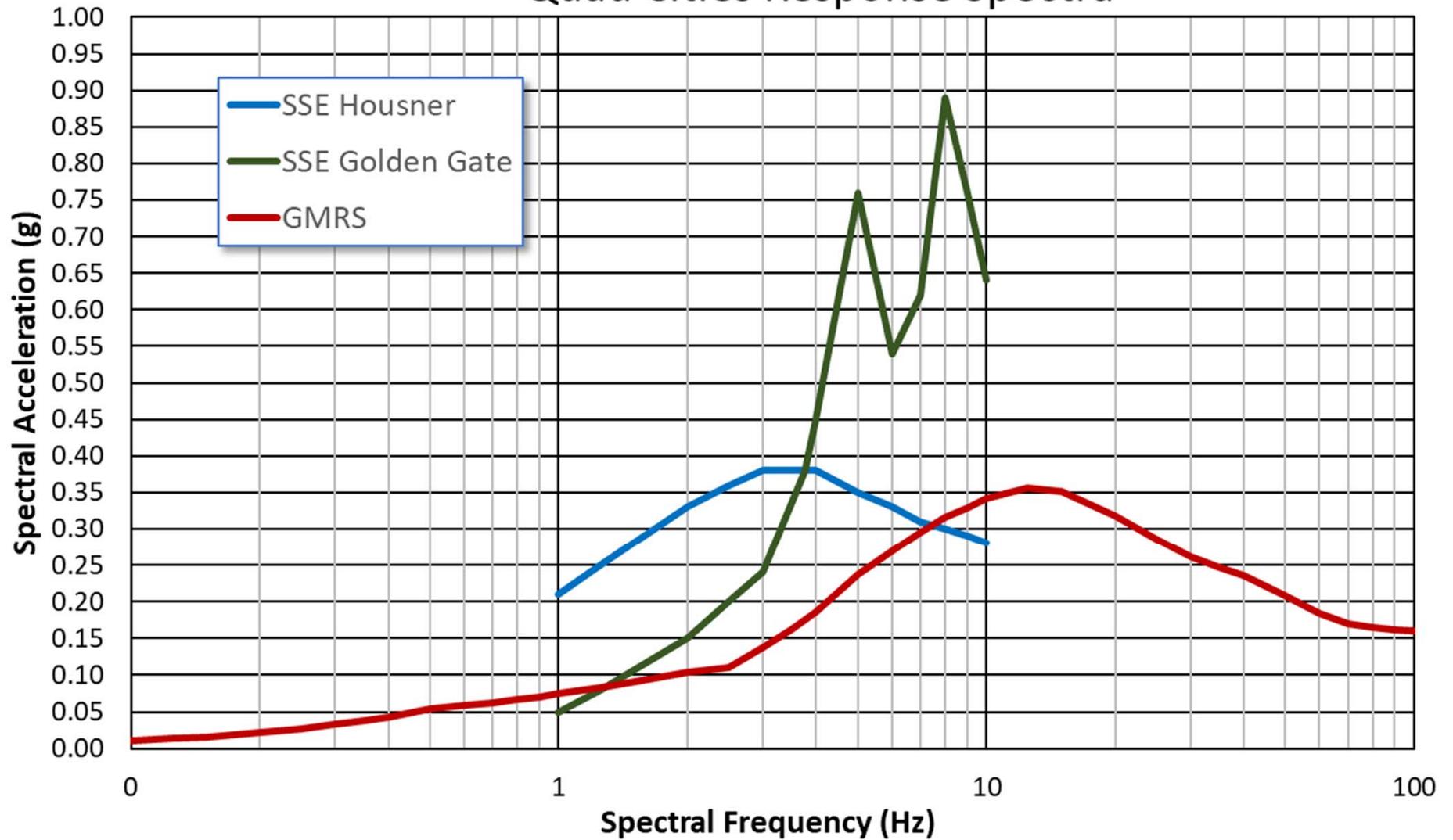
- Seismic penalty value
- QCNPS seismic risk contribution was included in overall risk

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- EPRI Seismic Alternative Tier 1 Methodology
 - Tier 1 definition: (1) GMRS peak acceleration derived from the seismic hazard is at or below $\approx 0.2g$ or (2) where the GMRS is below or \approx equal to the SSE between 1.0 Hz and 10 Hz
 - QCNPS meets second criterion since GMRS is bounded by a combination of 2 SSE curves (next slide) (ML15309A493)

External Hazards – 50.69 Seismic

Quad Cities Response Spectra



External Hazards - Other

- All external hazards, except for seismic and tornado missiles, screened for applicability to QCNPS in accordance with GL 88-20
- Screening criteria in ASME PRA Standard RA-Sa-2009 used for both the TSTF-505 and 50.69 applications

Lessons Learned

- A primary goal of presubmittal meetings is to understand what site-specific issues the NRC may be interested in prior to docketing the submittal
- QCNPS submittal will address common themes in past NRC Requests for Additional Information (RAIs), including the NEI published generic set of TSTF-505 RAIs
- Proactively incorporating RAI insights reduces burden on both the NRC and CEG during the review

Submittal Timeline

QCNPS 50.69 and RICT LARs

- Submitted as two separate requests on same day (or close to same day)
 - Common assessment approach of PRA technical adequacy and sources of uncertainty
 - Common screening approach of external hazards
 - Same technical teams reviewing PRA risk information



Key Takeaways

- QCNPS submittals similar to prior CEG BWR submittals
 - Template variations administrative in nature or to accommodate plant-specific design
 - Primary plant-specific differences are SSMP and available alternative power sources
- FLEX/HCVS only credited in PRA for ELAP
- Seismic & tornado missile use penalty factor
- External flood strategy capitalizes on current licensing basis by providing physical barriers to increase time to flood plant equipment, but otherwise generally same strategy



Feedback

