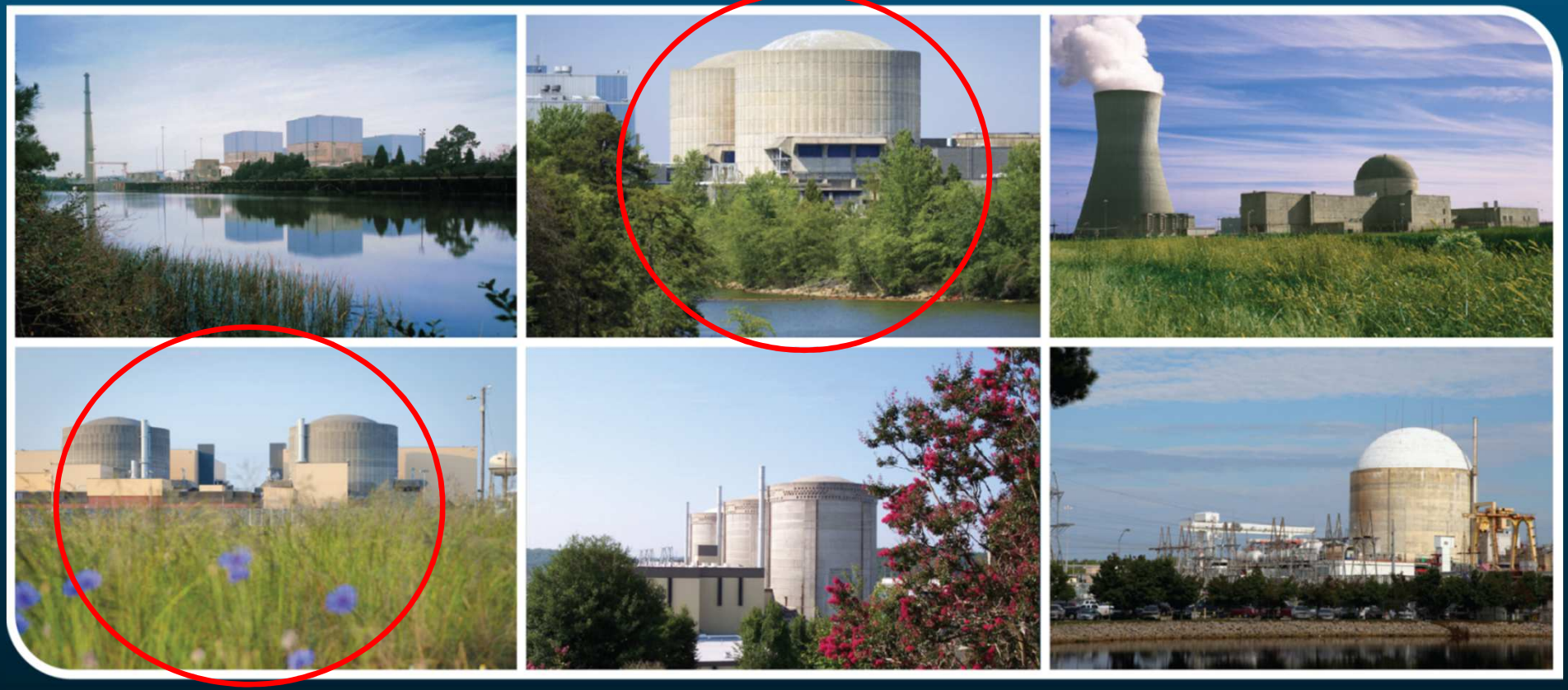


SPRA Relief for McGuire and Catawba

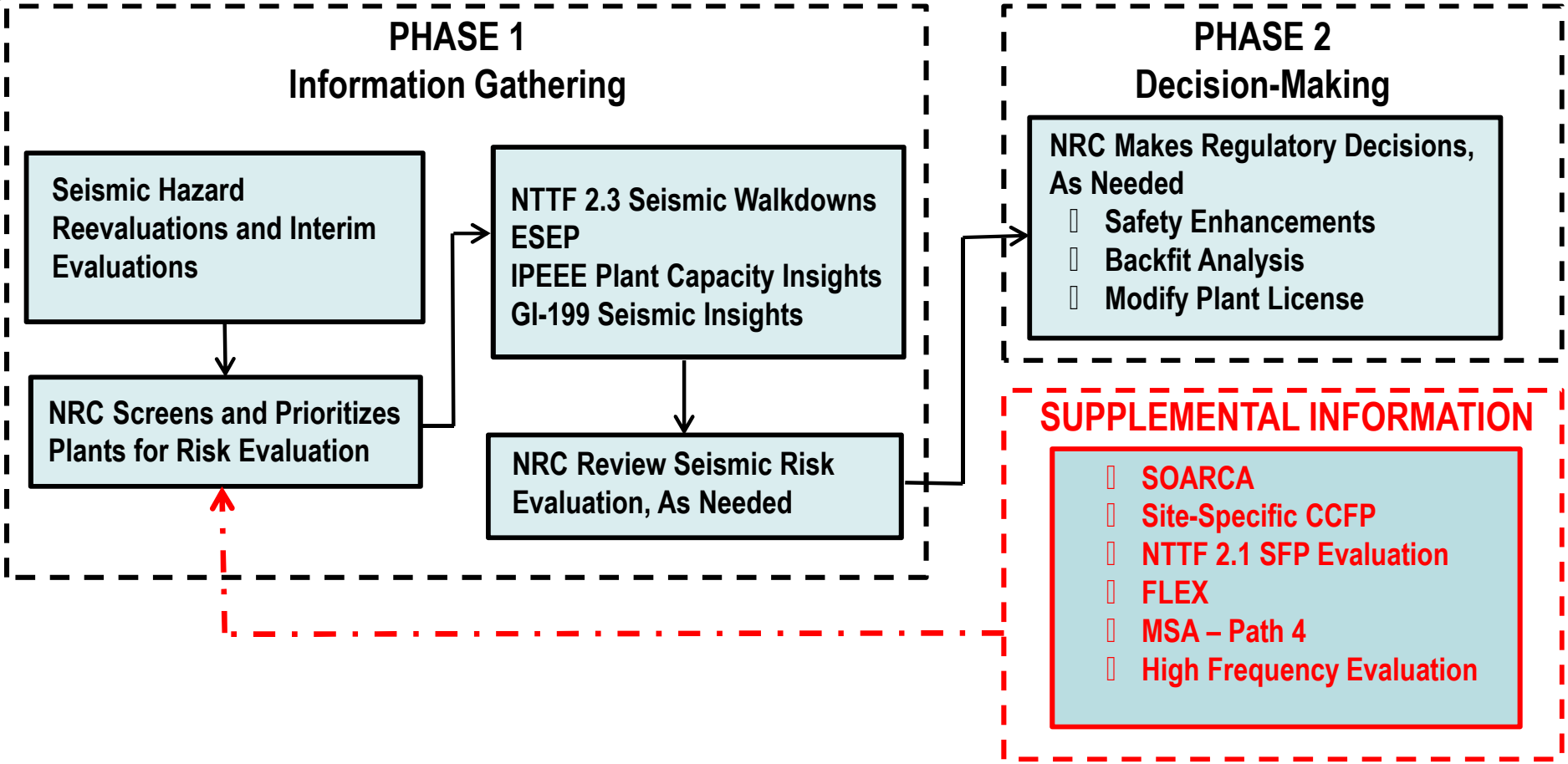
September 14, 2016

DUKE ENERGY®

Agenda

- Opening Remarks
- Introduction
- NRC's Initial Screening and Additional Assessment
- Supplemental Information
- Proposed Path Forward
- Closing Remarks

- Understanding of NRC Information Requests is to gain knowledge toward the goal of appropriately enhancing safety
- Currently, Duke Energy is on the path to develop seismic probabilistic risk assessments (SPRA) for McGuire and Catawba
- Duke Energy has identified supplemental information that supports SPRA Relief at McGuire and Catawba
- Purpose of today's meeting is to share supplemental information, obtain NRC Feedback, and discuss next steps


PHASE 1
Information Gathering
Seismic Hazard Reevaluations and Interim Evaluations
NRC Screens and Prioritizes Plants for Risk Evaluation
NTTF 2.3 Seismic Walkdowns
ESEP
IPEEE Plant Capacity Insights
GI-199 Seismic Insights
NRC Review Seismic Risk Evaluation, As Needed
PHASE 2
Decision-Making
NRC Makes Regulatory Decisions, As Needed
Safety Enhancements
Backfit Analysis
Modify Plant License
SUPPLEMENTAL INFORMATION
SOARCA
Site-Specific CCFP
NTTF 2.1 SFP Evaluation
FLEX
MSA – Path 4
High Frequency Evaluation

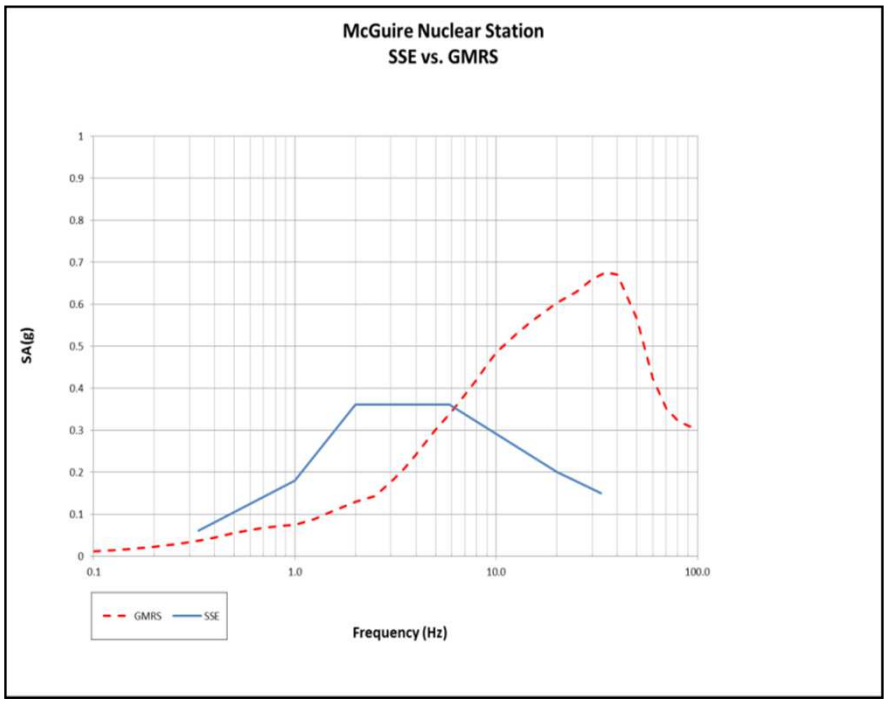
- Background on Current Path:
  - May 9, 2014, NRC screening and prioritization letter discussed that SPRAs for some Group 3 plants with limited exceedances may not be needed for Phase 2 Decision-Making
  - October 27, 2015, NRC assessment letter evaluated additional information and granted SPRA relief for some Group 3 and a limited number of Group 2 plants
  - McGuire (Group 3) and Catawba (Group 2) are currently required to perform an SPRA

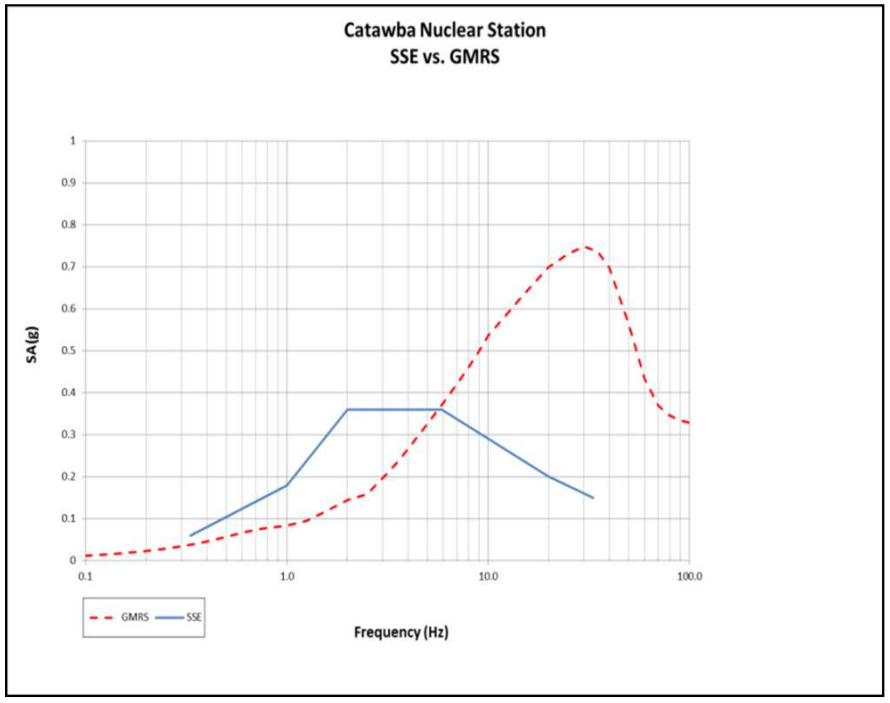
NRC's Initial Screening and Additional Assessment

- NRC's initial screening and additional assessment examined available information to determine the need for an SPRA, including:
  - NTTF 2.3 Seismic Walkdown
  - NTTF 2.1 Seismic Hazard Reevaluation
  - Expedited Seismic Evaluation Process (ESEP)
  - Individual Plant Examination of External Events (IPEEE) Seismic Plant Capacity Insights
  - GI-199 Seismic Risk Insights
  - EPRI 2014 Seismic Core Damage Frequency (SCDF) Estimates

- NTTF 2.3 Seismic Walkdown
  - Purpose: Verify plant configuration conforms to the current seismic licensing basis
  - McGuire and Catawba verified capability to successfully respond to design basis seismic events, which is a foundation for FLEX
    - Verified plant configuration conforms to the current seismic licensing basis
    - Substantiated adequacy of monitoring and maintenance programs for protective features
    - Addressed degraded and nonconforming seismic conditions
  - No safety concerns were identified

- NTTF 2.1 Seismic Hazard Reevaluation
  - Purpose: Reevaluate plant for new seismic hazard (i.e., GMRS)





- Expedited Seismic Evaluation Process (ESEP)
  - Purpose: Confirm seismic margin and expedite plant safety enhancements and modifications of selected core and containment cooling equipment, as necessary, while more comprehensive seismic evaluations are underway
  - Validated seismic margin by reviewing seismic capacity of certain key installed mitigating strategies equipment
  - Installed plant equipment was evaluated to GMRS-to-SSE ratios:
    - McGuire = 1.74
    - Catawba = 1.91
  - Minor enhancements were identified and completed

NRC's Initial Screening and Additional Assessment

- Individual Plant Examination of External Events (IPEEE) Seismic Plant Capacity Insights
  - In 1984 Duke developed detailed SPRAs for McGuire and Catawba
  - IPE submittal (MNS – 1991; CNS – 1992)
  - 1994 IPEEEs examined external events for severe accident vulnerabilities
  - Existing SPRAs were utilized to assess seismic risk, including containment performance, using the best data and analysis tools available at the time

- Individual Plant Examination of External Events (IPEEE) Seismic Plant Capacity Insights
  - McGuire IPEEE Results: SCDF = 1.1E-05 / yr.
    - Several of the dominant accident sequences involve an SBO
    - Reactor Building, Containment Vessel, Ice condenser, hydrogen igniters and Containment Internal Structure all had median fragilities > 2.5g
    - Containment structure and penetrations are seismically rugged
    - No bad actors were identified in the containment isolation circuits
    - No fundamental plant weaknesses or vulnerabilities were identified
    - Plant walkdowns were conducted and several enhancements were recommended and implemented

- Individual Plant Examination of External Events (IPEEE) Seismic Plant Capacity Insights
  - Catawba IPEEE Results: SCDF = 1.6E-05 / yr.
    - Several of the dominant accident sequences involve an SBO
    - Reactor Building, Containment Vessel, Ice condenser, hydrogen igniters and Containment Internal Structure all had median fragilities ≥ 2g
    - Containment structure and penetrations are seismically rugged
    - No bad actors were identified in the containment isolation circuits
    - No fundamental plant weaknesses or vulnerabilities were identified
    - Plant walkdowns were conducted and several enhancements were recommended and implemented

- GI-199 Seismic Risk Insights
  - Purpose: Determine, on a generic basis, if the risk associated with increased seismic hazard warrants additional actions
  - GI-199 utilized 3 different seismic demand sources with 3 different methods to calculate 9 different SCDF estimates
  - Specifically for the simple average method using PGA (PGA controlled), the range of SCDF estimates were:
    - Catawba: 1.7E-05 / yr to 2.8E-05 / yr
    - McGuire: 1.5E-05 / yr to 2.8E-05 / yr

- GI-199 Seismic Risk Insights
  - NRC concluded that seismic hazard increases are small
  - No concerns with adequate protection
  - Current seismic designs provide a safety margin to withstand earthquakes exceeding the design basis
  - McGuire and Catawba were not identified as one of the plants that would be utilized in the Regulatory Assessment Phase for GI-199
  - GI-199 was subsumed by NTTF 2.1 seismic

- EPRI 2014 Seismic Core Damage Frequency (SCDF) Estimates
  - SCDF point estimates were recalculated as a result of the new CEUS seismic hazards
    - Used plant level fragilities developed under GI-199 safety assessment
    - Combined existing plant level fragilities with the new EPRI hazards
    - New SCDF estimates, based on simple average method, were:
      - Catawba: 2.8E-05 / yr
      - McGuire: 2.7E-05 / yr
  - New estimates for McGuire and Catawba are within the range of SCDF estimates previously computed under GI-199

- Duke Energy has identified supplemental information that supports SPRA relief for McGuire and Catawba
  - State-of-the-Art Reactor Consequence Analyses (SOARCA) Insights
  - Site-Specific Conditional Containment Failure Probability (CCFP)
  - NTTF 2.1 Spent Fuel Pool (SFP) evaluation
  - FLEX
  - Mitigating Strategies Assessment (MSA) – Path 4
  - NTTF 2.1 High Frequency Limited-Scope Evaluation

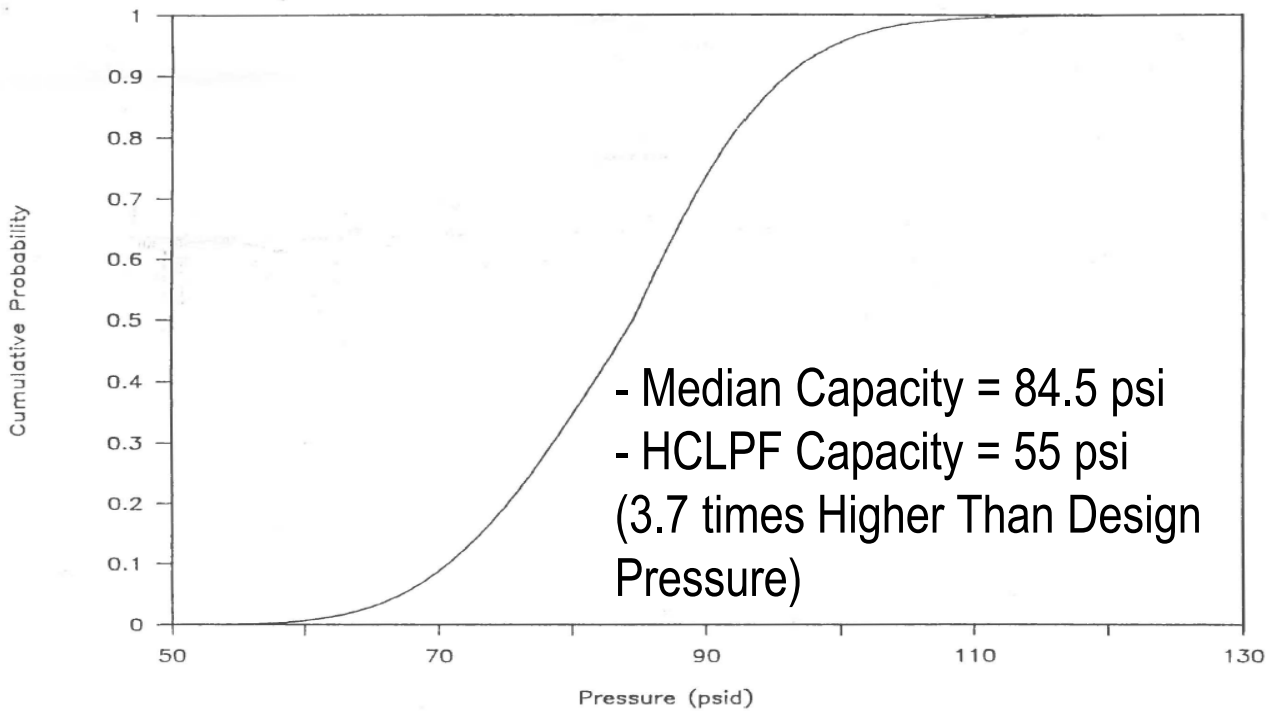
- State-of-the-Art Reactor Consequence Analyses (SOARCA) Insights
  - SOARCA Purpose: Initiated by NRC to develop a body of knowledge on the realistic outcomes of potential severe reactor accidents
  - Pilot plants examined in study: Peach Bottom, Surry, and Sequoyah
  - Accident scenarios progress more slowly and release smaller amounts of radioactive material than previously thought
  - FLEX was not considered in the study
  - Duke Energy concludes that NRC Insights from SOARCA are applicable to McGuire and Catawba

- State-of-the-Art Reactor Consequence Analyses (SOARCA) Insights
  - The Turbine-Driven Auxiliary Feedwater (TDAFW) system is important in extending core cooling, allowing more time for implementation of additional mitigation
    - McGuire and Catawba ESEP assessed TDAFW system to the GMRS-to-SSE ratio
  - Successful use of hydrogen igniters in an ice condenser containment averts potential early containment failure
    - McGuire and Catawba have Phase 2 FLEX strategies that can repower the igniters when needed as required by Order EA-12-049
    - ESEP assessed the hydrogen igniters to the GMRS-to-SSE ratio

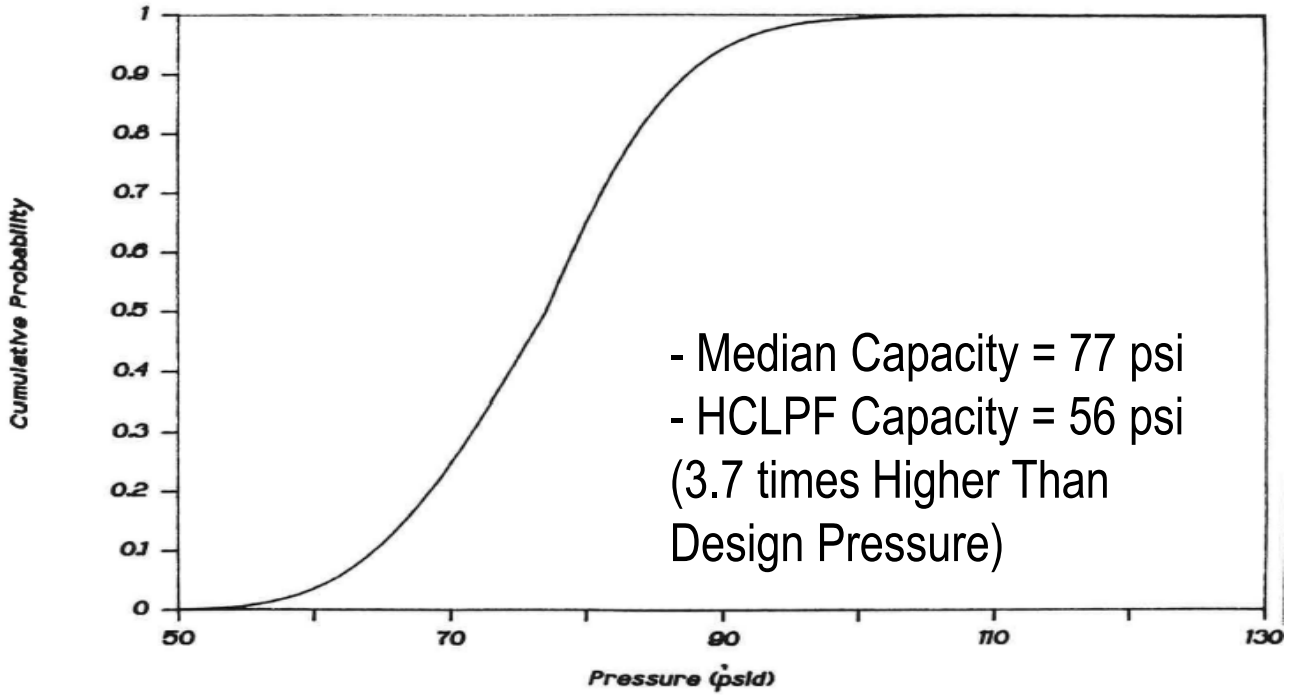
- State-of-the-Art Reactor Consequence Analyses (SOARCA) Insights
  - Knowledge gained from SOARCA was a key factor in closure of NTTF 5.2 and NTTF 6
  - NTTF 5.2, Reliable Hardened Vents for Other Containment Designs
    - Reliable hardened vents are not warranted for ice condensers such as McGuire and Catawba
  - NTTF 6, Hydrogen Control and Mitigation
    - Overall safety will not be substantially enhanced by hydrogen control measures beyond those already taken in plants like McGuire and Catawba

- Site-Specific Conditional Containment Failure Probability (CCFP)
  - The IPE analyses address the failure of the containment vessel shell and all related structures
  - CCFP curves were developed from the more realistic ultimate containment capacity study for the individual plant examination (IPE)
  - Once all identified failure modes were investigated, a containment failure distribution was developed in a manner similar to that presented in NUREG/CR-1891, "Reliability Analysis of Containment Strength"

- Site-Specific Conditional Containment Failure Probability (CCFP)
  - Catawba Containment failure probability curve from IPE



- Site-Specific Conditional Containment Failure Probability (CCFP)
  - Containment failure probability curve from IPE used for McGuire



- Site-Specific Conditional Containment Failure Probability (CCFP)
  - NUREG/CR-6595 assumes failure of ice condenser containments if no hydrogen igniters
  - McGuire and Catawba MAAP analyses were performed to determine peak containment pressure
    - The sequences selected for the evaluation are common sequences for SBO and other conditions
    - Most cases without igniters resulted in pressure demands below or slightly higher than the containment HCLPF capacity
    - LERF contributions will be further reduced considering availability of the seismically robust hydrogen igniters

- Site-Specific Conditional Containment Failure Probability (CCFP)
  - Based on information from McGuire and Catawba SPRAs, SOARCA study and site-specific CCFP, new insights from another SPRA are unlikely
  - Unlikely to identify enhancements that would significantly reduce risk

- NTTF 2.1 Spent Fuel Pool (SFP) Evaluation
  - NRC endorsed guidance specified in EPRI 3002007148 provides criteria for evaluating SFP seismic integrity to the reevaluated GMRS hazard level
  - SFP integrity evaluation for McGuire and Catawba were submitted on August 18, 2016 and July 20, 2016, respectively
  - NRC issued staff reviews for McGuire (August 31, 2016) and Catawba (August 11, 2016) concluding the SFP integrity evaluations met NRC criteria and Duke responded appropriately
  - Conclusion: Spent fuel stored in McGuire and Catawba pools are adequately protected from the reevaluated seismic hazards

- FLEX
  - McGuire and Catawba are in full compliance with NRC Order EA-12-049
  - Provides a diverse and flexible means to prevent fuel damage in the core and spent fuel pool while maintaining containment function
  - Designed to mitigate the consequences of an unbounded range of initiating events impacting all units onsite and resulting in an extended loss of AC power and loss of normal access to the Ultimate Heat Sink
  - Establishes an indefinite coping capability by relying upon installed equipment, onsite portable equipment, and offsite resources
  - FLEX has achieved significant safety benefit

- Mitigating Strategies Assessment (MSA) – Path 4
  - McGuire and Catawba will perform a Path 4 Seismic MSA
  - Path 4 is applicable to sites with GMRS-to-SSE ration of 2 or less in the 1 to 10 Hz frequency range
  - Seismic MSAs will verify implementation of FLEX against the site GMRS providing additional defense in depth in preventing core damage
  - Primary FLEX path was evaluated as part of the ESEP effort
  - Submittals for McGuire and Catawba to be provided by end of August 2017

- NTTF 2.1 High Frequency Limited-Scope Evaluation
  - Purpose: Where GMRS spectral accelerations are higher than SSE accelerations above 10 Hz, plants must evaluate a selected set of equipment for the impact of high frequency accelerations
  - Evaluation will be performed in accordance with EPRI 3002004396, “High Frequency Program, Application guidance for Functional Confirmation and Fragility Evaluation”
  - Plants not performing an SPRA must submit the evaluation by August 2017

PROPOSED PATH FORWARD

- Submit Request for SPRA relief by October 2016
- NRC decision on SPRA relief needed by December 2016
- Submit Seismic MSA (Path 4) by August 2017
- If SPRA relief granted
  - Accelerate High Frequency Evaluation – Submit by August 2017
- If SPRA relief not granted
  - Submit Catawba SPRA & High Frequency Evaluation by September 2019
  - Submit McGuire SPRA & High Frequency Evaluation by December 2019

Comments and Feedback

ACRONYMS

CCFP	Conditional Containment Failure Probability
CEUS	Central and Eastern United States
DG	Diesel Generator
ESEP	Expedited Seismic Evaluation Process
EPRI	Electric Power Research Institute
FSG	FLEX Support Guideline
GI	Generic Issue
GMRS	Ground Motion Response Spectrum
HCLPF	High Confidence of Low Probability of Failure
HF	High Frequency
IPE	Individual Plant Examination
IPEEE	Individual Plant Examination of External Events
LERF	Large Early Release Frequency
LUHS	Loss of Normal Access to the Ultimate Heat Sink
IPE	Individual Plant Examination
MAAP	Modular Accident Analysis Program
MSA	Mitigating Strategies Assessment
MSSHI	Mitigating Strategies Seismic Hazard Information
NTTF	Near Term Task Force
PGA	Peak Ground Acceleration
RCS	Reactor Coolant System
RV	Reactor Vessel
SBO	Station Blackout
SCDF	Seismic Core Damage Frequency
SFP	Spent Fuel Pool
SHSR	Seismic Hazard and Screening Report
SLERF	Seismic Large Early Release Frequency
SMA	Seismic Margin Assessment
SOARCA	State-of-the-Art Reactor Consequence Analysis
SPRA	Seismic Probabilistic Risk Assessment
SSE	Safe Shutdown Earthquake
SSF	Safe Shutdown Facility
TDAFW	Turbine Driven Auxiliary Feedwater