



# Seabrook Station

License Renewal Application  
Consideration of ASR

May 9, 2017

**NextEra Energy (NYSE: NEE) is comprised of two strong businesses supported by a common platform**



**\$16.2B Consolidated Revenues <sup>(1)</sup>**  
**45,900 MW in operation <sup>(1, 2)</sup>**  
**14,700 employees**



**FPL**

**One of the largest U.S. electric utilities**  
**4.9 MM customer accounts**  
**26,000 MW in operation**



**U.S. leader in renewable generation**  
**Assets primarily in 30 states and Canada**  
**19,900 MW in operation**

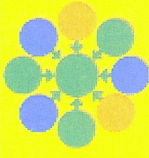
**World's largest generator of renewable energy from the wind and sun**

**Ranked Number 1 overall among electric and gas utilities on Fortune's 2017 list of "World's Most Admired Companies" for the 10<sup>th</sup> time in 11 years, and ranked in the top 10 companies in the world in Innovation, Social Responsibility, and Wise use of corporate assets**

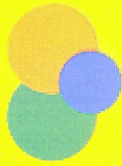


(1) As of Dec. 31, 2016 from Annual Report  
(2) Includes NEE's ownership share of NextEra Energy Partners' portfolio

# The foundation for everything we do are the Values and Core Principles of our Nuclear Excellence Model



## Nuclear Excellence Model



## Seabrook Attendees

- **Ken Browne**  
NEE Seabrook Licensing Manager  
NEE Seabrook ASR Project Manager
- **Ed Carley**  
NEE Seabrook License Renewal Supervisor
- **Mike Collins**  
NEE Seabrook Engineering Director
- **Brian Brown**  
NEE Seabrook Principal Engineer
- **Larry Nicholson**  
NEE Fleet Licensing Director
- **William Blair**  
NEE Managing Attorney – Nuclear
- **Steve Hamrick**  
NEE Senior Attorney
- **Dr. Said Bolourchi**  
SGH Senior Principal
- **Ryan Mones**  
SGH Staff
- **Jim Moroney**  
MPR ASR Test Program PM
- **John Simons**  
MPR Gen Manager Power Projects



**SIMPSON GUMPERTZ & HEGER**

Engineering of Structures  
and Building Enclosures

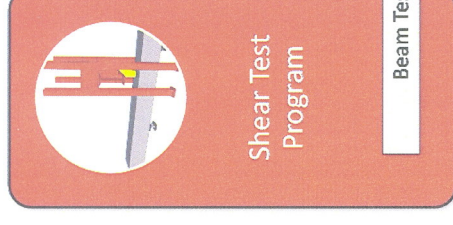
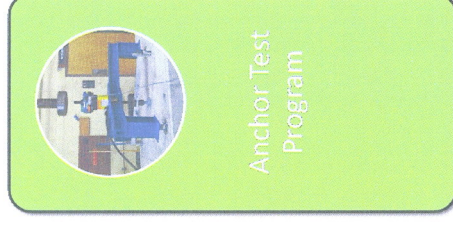


## Agenda

- **Update on CLB activities**
  - MPR/FSEL test programs
  - Building deformation analyses
  - ASR monitoring
  - License Amendment Request
- **Discussion of Reconciliation of AMPs with Current Licensing Basis (CLB)**
- **March 2017 NRC RAIs on License Renewal**
- **Closing remarks**

## MPR/FSEL Test Programs

- **Status**
  - All test programs completed in 2015

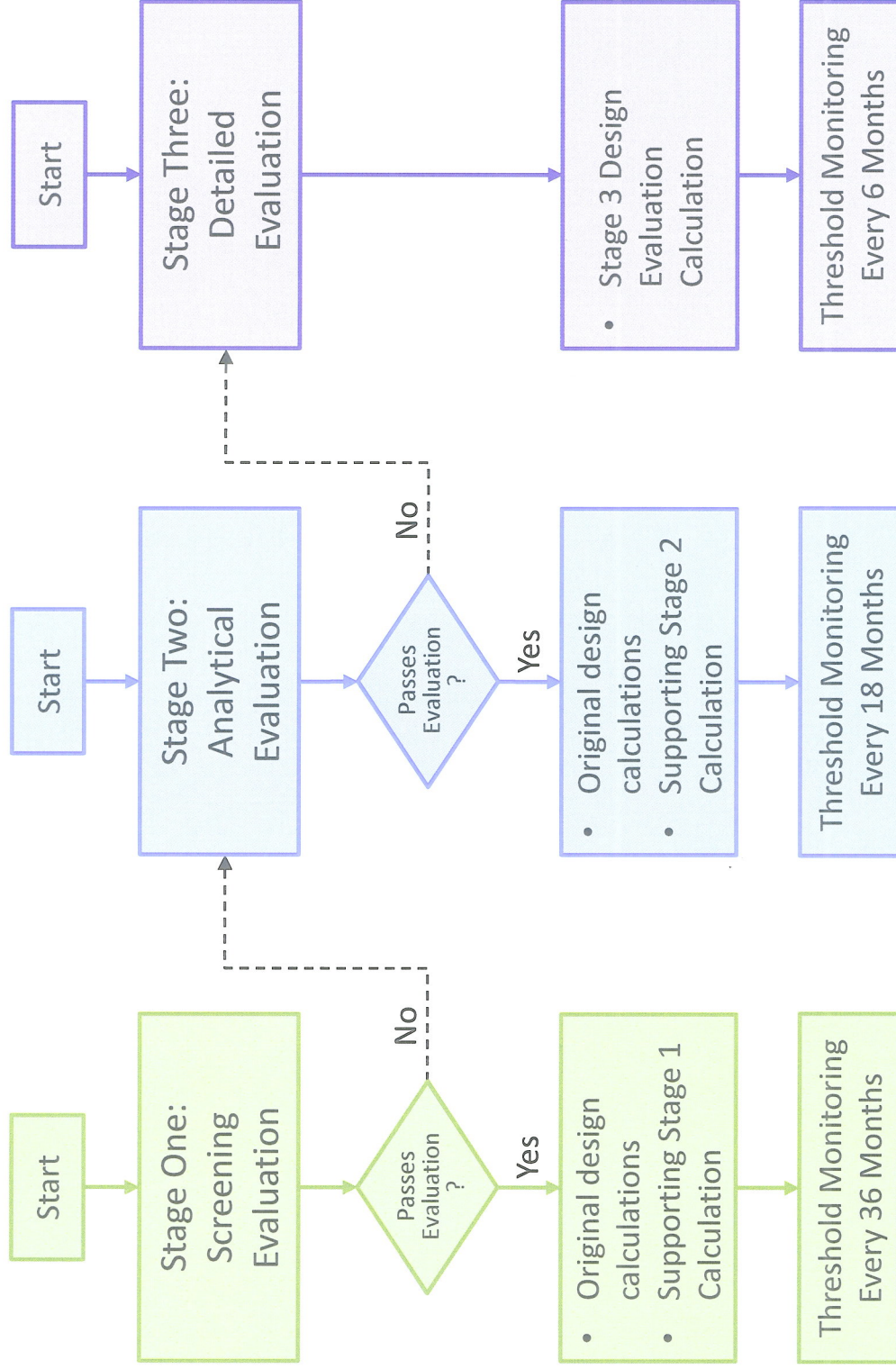


- **Accomplishments since April 2016**
  - Completed summary reports on test programs
    - MPR-4273 – Summary report of test programs
    - MPR-4288 – Structural impacts of ASR
  - Updated methodology for determining  $\epsilon_z$  to-date
    - MPR-4153 – Correlation between expansion and elastic modulus; revised in 2016 to capture all data from test programs
  - Results from the test programs incorporated into the SMP

## Building Deformation Analyses

- **Purpose**
  - Confirm compliance with original design codes considering
    - Impact of ASR on structural capacity and demand
    - Building deformation from ASR expansion
- **Scope**
  - All seismic Cat I and selected non-Cat I structures
- **Approach**
  - ASR demands are amplified with load factors to be consistent with safety margins in codes of record
  - Analyses determine monitoring parameters and associated threshold limits for monitoring to ensure structure remains bounded by the analysis

# Building Deformation Analyses



Note: For more complex structures, the evaluation may start at Stage Two or Stage Three.



## **Building Deformation Analyses – Status Summary**

- **Methodology Documents**
  - Criteria Document for deformation analyses—complete
  - Load factors for ASR expansion—complete
- **Analyses**
  - Criteria Document (and LAR) procedure has been implemented for all of three analyses stages for multiple structures
  - 14 out of 26 structures are complete or in-progress
  - 4 of the 6 structures that are expected to have complex ASR deformation are complete or in-progress

## Building Deformation Analyses (1 of 2)

Structure	Schedule	Percent Complete
Condensate water storage tank	Complete	100%
Containment enclosure building	Complete	100%
Containment enclosure ventilation area	Complete	100%
Containment structure	Complete	100%
Equipment hatch missile shield	Complete	100%
Steam generator recovery blowdown bldg.	Complete	100%
Control room make-up air intake	2Q2017	90%
Electrical cable tunnels	2Q2017	10%
Pre-action valve building	2Q2017	70%
RHR equipment vault	2Q2017	90%
Containment internal structures	3Q2017	20%
Main steam and feed water east pipe chase	3Q2017	10%
Hydrogen recombiner structure	3Q2017	30%
Safety-related electrical duct banks and manholes	3Q2017	
Emergency feedwater pump building	3Q2017	
Fuel storage building	3Q2017	50%

Structures that are/expected to be Stage 3

## Building Deformation Analyses (2 of 2)

Structure	Schedule
Control Building	4Q2017
Diesel Generator Building	
Mechanical Penetration	
Personnel hatch area	4Q2017
Main steam and feed water west pipe chase	
Primary auxiliary building	4Q2017
Intake transition structure (Non-Category I)	4Q2017
Service water cooling tower including switchgear rooms	1Q2018
Service water access (inspection) vault	1Q2018
Discharge transition structure (Non-Category I)	1Q2018
Circulating water pumphouse (below el. 21')	
Service water pumphouse	2Q2018
Piping (RCA) Tunnels	2Q2018
Tank farm area	2Q2018
Waste processing building	2Q2018

Structures that are/expected to be Stage 3

## Conclusions from Building Deformation Analyses

- **For all completed structural evaluations:**
  - Used consistent and repeatable methods of analysis
    - Criteria Document required no update
  - Structures shown to maintain structural integrity.
  - Monitoring locations and associated threshold limits identified and incorporated into SMP
- **Completed structures are now being monitored against threshold limits**

## ASR Monitoring

- **Pre-2016**
  - In-plane expansion monitored by CCI and pins
- **Changes to Monitoring Program in 2016 and 2017**
  - Initiated monitoring through-thickness expansion
    - Installed 48 extensometers (38 ASR-affected; 10 control)
    - Removed cores at extensometer locations to determine expansion to-date using MPR-4153 methodology
      - Material property testing of 117 specimens from cores
  - Initiated monitoring of structural deformation
    - Cracking, concrete distress
    - Expansion (in-plane and through-thickness expansion)
    - Seismic isolation joint widths
    - Deformations from structural dimensions (e.g., CEB annulus)
  - Crack gages, Invar rod, temperature and humidity probes in RHR vaults

## ASR Monitoring Results

- **Trending of In-Plane Expansion**
  - Minimal increase over 4+ years
- **Limits from Test Programs**
  - All locations well within expansion limits
  - All locations well within volumetric expansion criterion
- **Thresholds from Structural Deformation Evaluations**
  - All parameters well within thresholds (for structures with completed evaluations)

**ASR expansion levels do not challenge plant structures now or for the foreseeable future.**

## License Amendment Request Under Part 50

- **Need for LAR**
  - Current plant licensing basis and Seabrook structural design codes do not specify methods to evaluate the effects of ASR
- **Timeline**
  - August 2016 – Submitted LAR to supplement code of record with a methodology to address ASR
  - September 2016 – Submitted supplement to address NRC questions
  - October 2016 – NRC accepted LAR for review
- **NRC Review**
  - First audit scheduled for early June

## **Discussion of Reconciliation of AMPs with CLB**

- **Changes to CLB from the LAR and SER apply to PEO**
  - Changes to the UFSAR
  - Methods used to analyze building deformation
  - Deformation analyses provide limits for each affected structure
  - Limits for ASR concrete expansion
- **NRC approval of ASR evaluation methodology is provided by its review of the LAR under Part 50**
- **NextEra will update ASR AMPs to account for changes that arise from the License Amendment**
  - Program to monitor ASR expansion
  - Program to monitor building deformation



# Relationship between Part 50 and Part 54

## Maintenance Rule SMP Part 50

SMP  
CLB\*

- ASR Expansion Monitoring
- ASR Deformation Monitoring
- Equipment Affected by Deformation Monitoring

\*To Be Revised by the LAR

## SMP AMP Part 54

SMP  
GALL Rev. 2

- ASR Expansion AMP\*
- ASR Building Deformation and Equipment Functionality AMP\*

\*To Reflect Changes Imposed by the LAR

## Discussion of Reconciliation of AMPs with CLB

- **Seabrook ASR Aging Management Programs, Element 10**
  - *“NextEra Seabrook has submitted a License Amendment Request to the Commission in accordance with 10CFR50.90 to incorporate a revised methodology related to ASR material properties and building deformation analysis for review and approval. NextEra will incorporate changes related to this LAR submittal as necessary to maintain alignment of the aging management program to the current license basis.”*
  - Similar language can be added to the UFSAR supplement or made a formal commitment

## Existing Commitments regarding MPR/FSEL Test Programs

- **Current LRA Commitments to Support ASR Methodology Include:**
  - #45: Corroborate methodology in MPR-4153 for determining expansion-to-date – At least 2 years prior to PEO
  - #66: Perform an integrated review of expansion trends to ensure large scale test programs remain applicable - At least 5 years prior to PEO and every 10 years thereafter

## **March 2017 NRC RAIs on License Renewal**

- **“Parameters Monitored or Inspected” for Building Deformation Monitoring Program**
- **AMR**
- **Consideration of In-plane and Through-Thickness Expansion in Acceptance Criteria for Effect on Structural Limit States**
- **Corroboration of Modulus – Expansion Correlation from MPR/FSEL Testing**

## March 2017 NRC RAIs on License Renewal

### Topic:

- Provide threshold parameters for ASR Deformation program and provide basis

### Response:

- AMP incorporates procedures and methodology for development of building-specific parameters and associated acceptance criteria
- Repeatable and auditable design standard is complete and available for review
  - This aspect of License Renewal Commitment #91 is complete
- Criteria Document to be submitted on docket
- Proposed commitment
  - Provide monitoring parameters and acceptance criteria for structures as part of annual update process until initial evaluations have been completed

## March 2017 NRC RAIs on License Renewal

### Topic:

- Provide Aging Management Review (AMR) results that identify structures and components, materials and environments that will be affected by building deformation and indicate the appropriate AMP

### Response:

- AMR Tables will be revised to include a plant specific note for the applicable line entries that states the SMP is augmented by the ASR and Building Deformation programs. Additional line entries may be required for certain items and annotated accordingly.

## March 2017 NRC RAIs on License Renewal

### Topic:

- Use of in-plane expansion as an acceptance criterion for shear and reinforcement anchorage

### Response:

- **Volumetric expansion proposed in August 2016 will be added as an acceptance criterion in AMP**
  - Purpose of this monitoring parameter is comparable expansion behavior to MPR/FSEL test specimens
  - Relocate discussion on volumetric expansion from Element 10 (Operating Experience) to Elements 3, 4, 5, and 6.
- **Through-thickness expansion criterion will be retained**
  - Purpose of this criterion is structural performance, based on results from MPR/FSEL test program

## March 2017 NRC RAIs on License Renewal

### Topic:

- **Technical basis for approach for corroborating methodology for determining pre-instrument expansion**

### Response:

- **Approach**
  - Compare change in measured  $\Delta\varepsilon_z$  from extensometer with that determined using correlation (i.e., reduction in modulus of cores)
  - Performed  $\leq 2$  years prior to PEO
- **Selection of extensometer locations**
  - Cover range over which correlation is being applied
  - Appreciable  $\Delta\varepsilon_z$  from extensometer measurements
- **Number of extensometer locations for corroboration**
  - 3 locations, increase scope if necessary based on results
  - Assess need to extend range for new extensometers



## Closing Remarks

- **MPR/FSEL testing**
  - Complete and all reports have been issued
- **SGH deformation analyses are underway**
  - Criteria Document for performing analyses and establishing parameters and acceptance criteria is complete
  - Evaluations for 14 of 26 structures are complete or in-progress
  - All are expected to be complete by 2Q 2018
- **Ongoing expansion monitoring at Seabrook Station**
  - Expansion levels at all locations well within limits from testing
  - Monitoring parameters well within thresholds from structural evaluations (for structures with completed evaluations)
- **Reconciliation of AMPs with CLB**
  - ASR AMPs are consistent with proposed changes to CLB
  - ASR AMPs will incorporate relevant changes to the licensing basis that result from NRC's review of LAR