# NRC PERSPECTIVES ON POST FUKUSHIMA SEISMIC SAFETY

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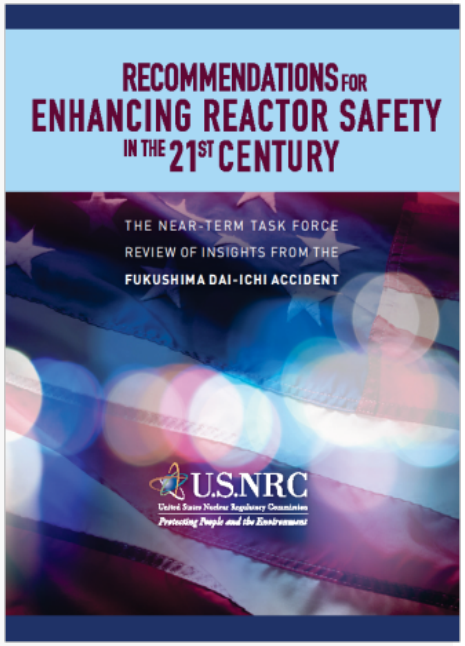
United States Nuclear Regulatory Commission
*Protecting People and the Environment*

# SUMMARY OF TIER 1 REGULATORY ACTIONS

- **Orders (issued March 2012)**
  - Mitigation strategies for external events
  - Containment venting system for Mark I and II containments
  - Spent fuel pool water level instrumentation

- **Request for Information (issued March 2012)**
  - Seismic and flooding walkdowns
  - Seismic and flooding hazard reevaluations
  - Emergency Preparedness staffing and communications

- **Rulemakings (ongoing)**
  - Station Blackout Mitigation Strategies (SBOMS)



# KEY ELEMENTS OF DIVERSE AND FLEXIBLE COPING STRATEGIES (FLEX)

**Added capacity to deal with the station blackout and loss of access to ultimate heat sink for extended period of time for extreme external events – three Phases**

# NTTF RECOMMENDATION 2

***Recommendation 2***

***The Task Force recommends that the NRC require licensees to reevaluate and upgrade as necessary the design-basis seismic and flooding protection of SSCs for each operating reactor.***

The Task Force recommends that the Commission direct the following actions to ensure adequate protection from natural phenomena, consistent with the current state of knowledge and analytical methods. These should be undertaken to prevent fuel damage and to ensure containment and spent fuel pool integrity:

*2.1 Order licensees to reevaluate the seismic and flooding hazards at their sites against current NRC requirements and guidance, and if necessary, update the design basis and SSCs important to safety to protect against the updated hazards.*

*2.2 Initiate rulemaking to require licensees to confirm seismic hazards and flooding hazards every 10 years and address any new and significant information. If necessary, update the design basis for SSCs important to safety to protect against the updated hazards.*

*2.3 Order licensees to perform seismic and flood protection walkdowns to identify and address plant-specific vulnerabilities and verify the adequacy of monitoring and maintenance for protection features such as watertight barriers and seals in the interim period until longer term actions are completed to update the design basis for external events.*

# OVERALL APPROACH

R2.3 – Walkdowns

R2.1 Seismic Hazard Reevaluations

R2.1 Risk Evaluation

Regulatory Actions (if needed)

R2.2 – Periodic Reevaluations of new and significant information

# OVERALL APPROACH

R2.3 – Walkdowns

R2.1 Seismic Hazard Reevaluations

R2.1 Risk Evaluation

Regulatory Actions (if needed)

R2.2 – Periodic Reevaluations of new and significant information

# INSIGHTS FROM SEISMIC WALKDOWNS

- Licensee plant walkdowns complete (November 2012)
- Issues are being addressed through licensee Corrective Action Programs and the NRC's Reactor Oversight Process. Potential issues identified include:
    - Minor anchorage issues
    - Spatial interaction issues
    - Housekeeping issues
- NRC staff assessments have been issued for all plants

# OVERALL APPROACH

R2.3 – Walkdowns

R2.1 Seismic Hazard Reevaluations

R2.1 Risk Evaluation

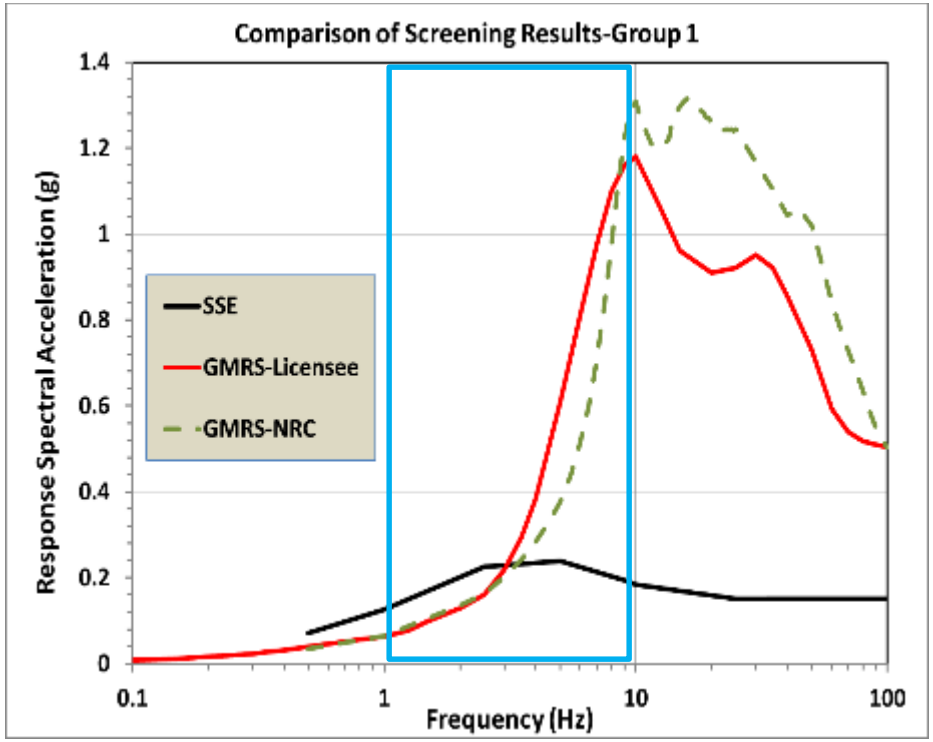
Regulatory Actions (if needed)

R2.2 – Periodic Reevaluations of new and significant information

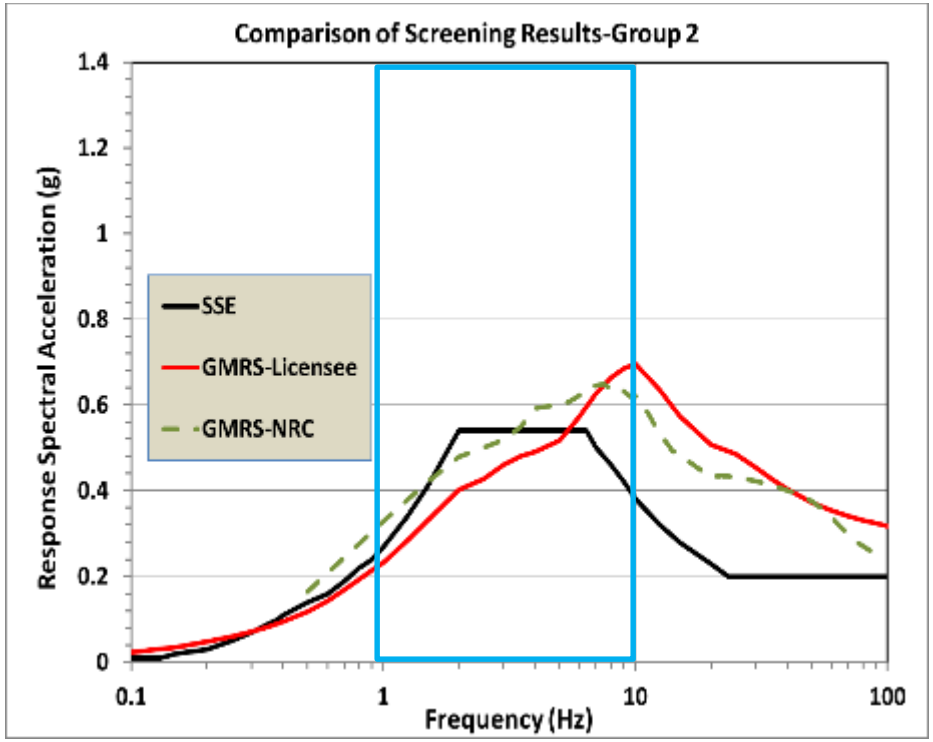
# OVERALL APPROACH FOR 2.1 REEVALUATIONS

- Use current day NRC methods to develop probabilistic seismic hazard and a Ground Motion Response Spectrum (GMRS) at each nuclear power plant
- Plants with GMRS > SSE "**Screen In**" for
  - Interim Evaluation
  - Expedited Seismic Evaluation Program
  - Seismic Risk Evaluations
- Screening approach specified in Industry Screening, Prioritization, and Implementation (**SPID**) Guidance
- SPID provides detailed guidance for
  - Development of GMRS
  - Seismic Risk Evaluations & Limited Scope Evaluations (high frequency, spent fuel pool)

# Examples of Priority Groups 1 & 2



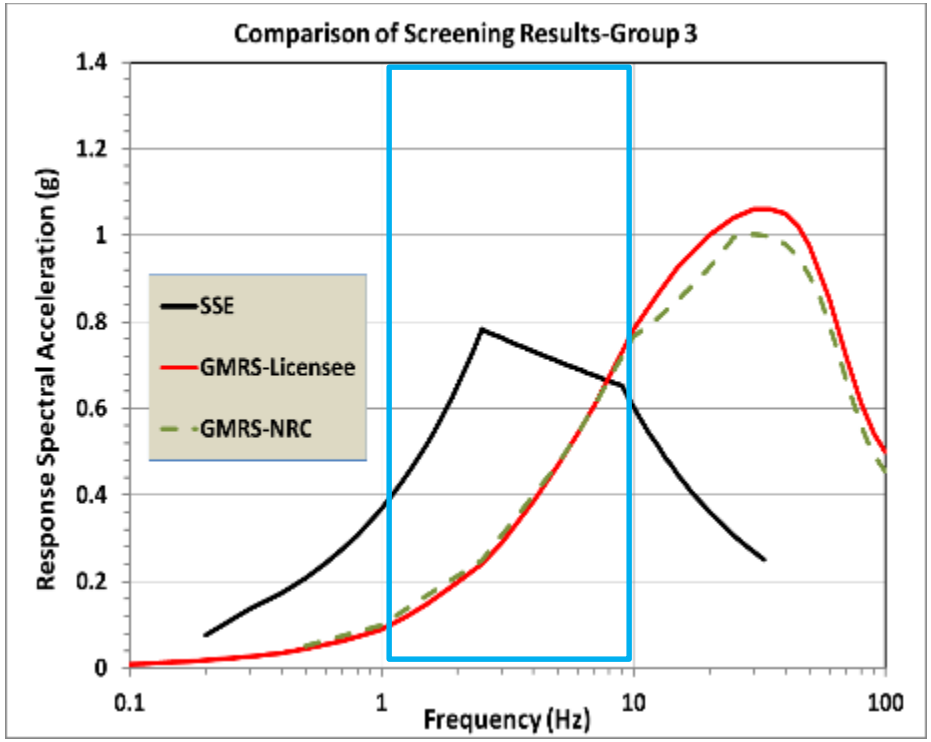

**10 Group 1 Plants**

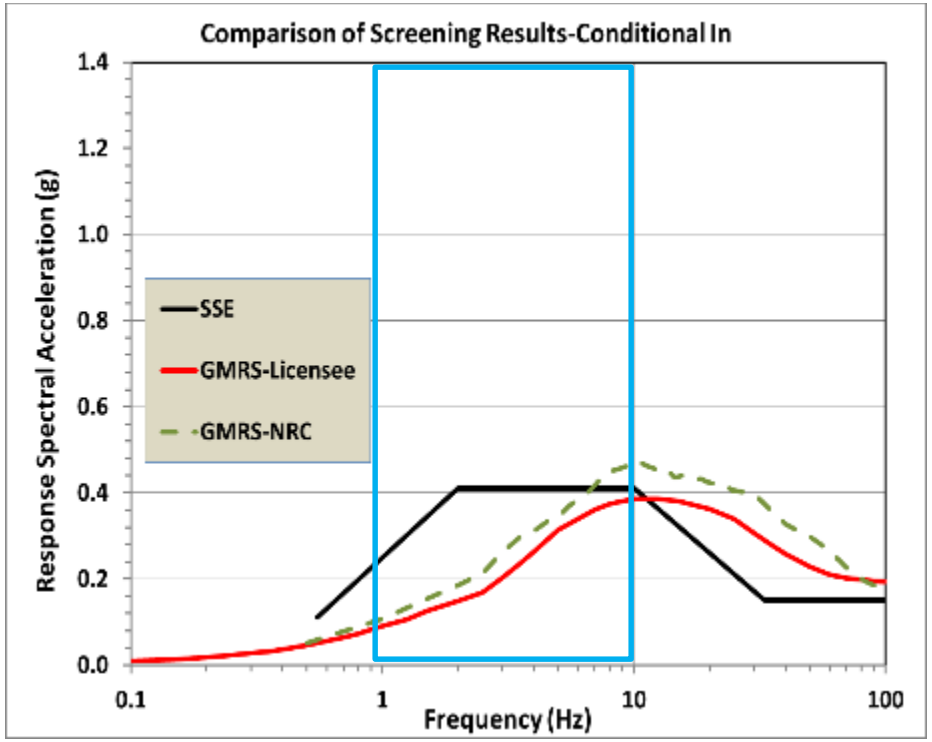



**10 Group 2 Plants**

Currently, 16 CEUS plants and 2 Western plants are performing SPRAs

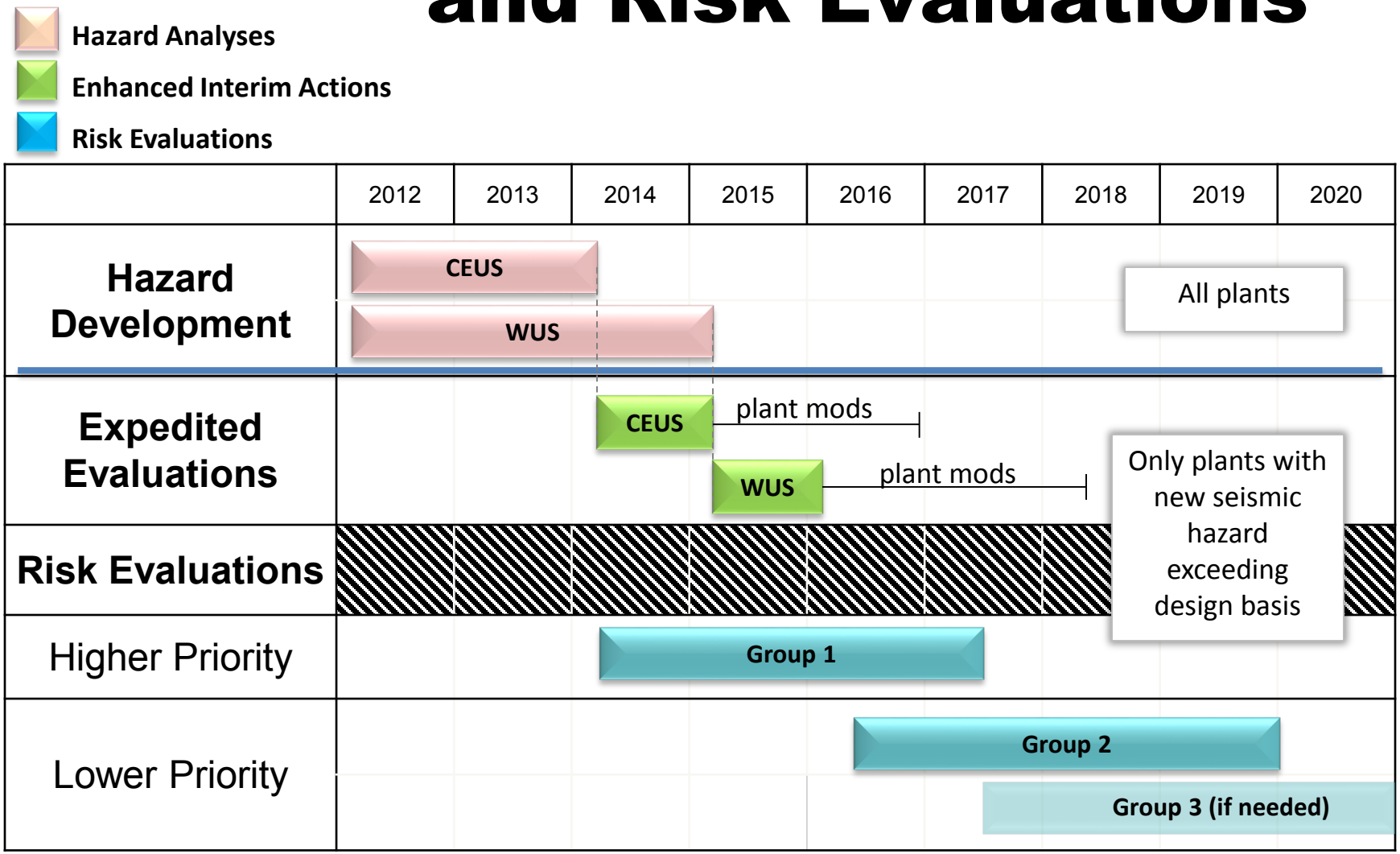
# Examples of Priority Group 3 and Conditional-In




**12-13 Group 3 Plants**

# Status of Seismic Hazard and Risk Evaluations



# OVERALL APPROACH

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# OVERALL APPROACH

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Regulatory Actions (if needed)

R2.2 – Periodic Reevaluations of new and significant information

# RECOMMENDATION 2.2

- *"Initiate rulemaking to require licensees to confirm seismic hazards and flooding hazards every 10 years and address any new and significant information. If necessary, update the design basis for SSCs important to safety to protect against the updated hazards."*

- NRC Staff approach to address this recommendation described in SECY–15-0137 and SECY-16-0144

# ONGOING ASSESSMENT OF NATURAL HAZARDS PROPOSED FRAMEWORK

- Complements existing processes for evaluating new information
  - Proactive
  - Systematic
  - Timely/efficient
  - Predictable
- Seeks, aggregates, and interprets new information related to external hazards
- Leverages existing agency capabilities
- Assesses the potential effect of new information on plants and refers issues to appropriate regulatory program

# Ongoing Assessment of Natural Hazards Key Elements

## Knowledge Base Activities

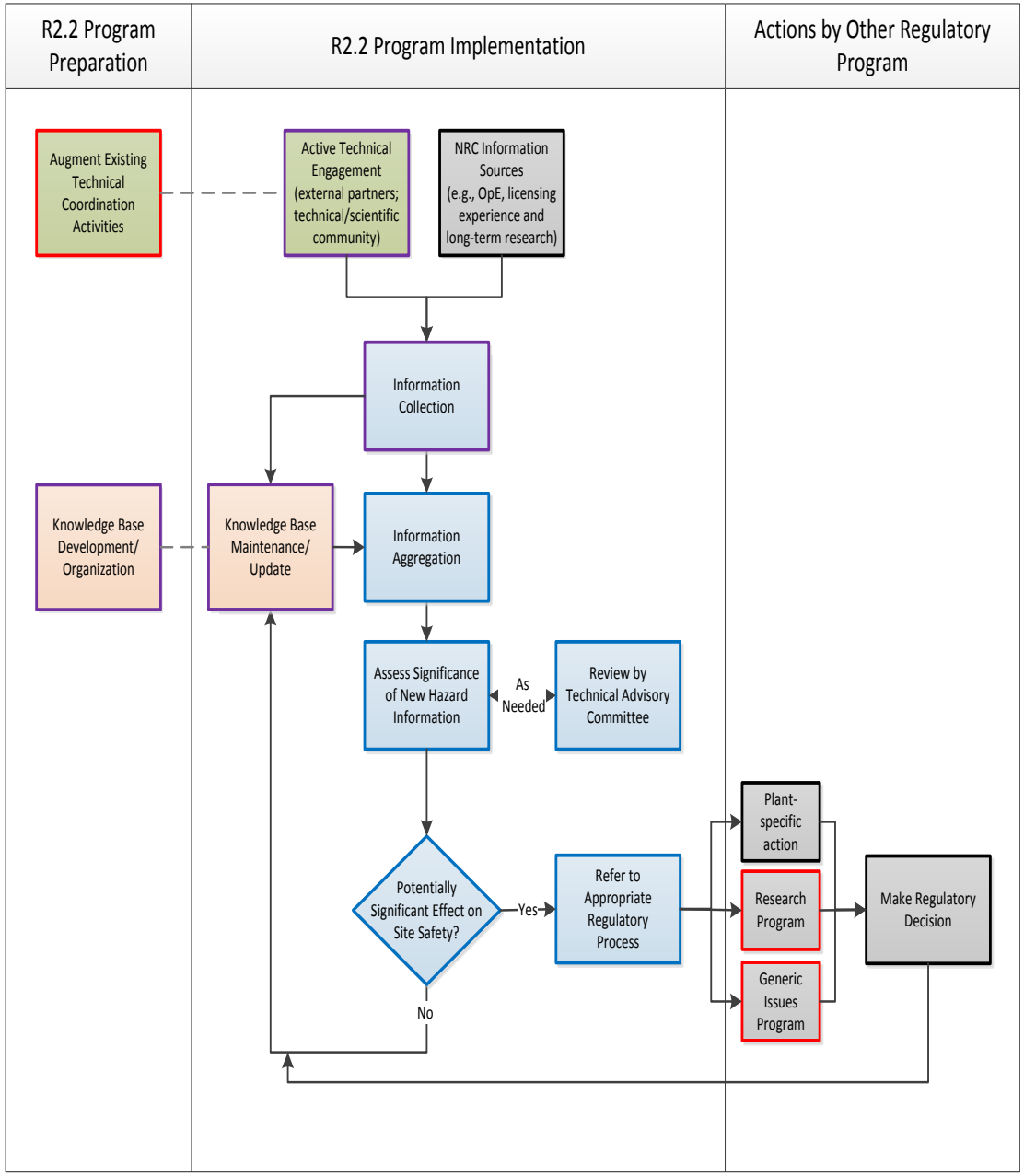
- Compiles and organizes existing info/tools
- Incorporates new info/tools

## Active Technical Engagement and Coordination

- Periodic engagement with external organizations as well as scientific and technical communities

## Assessment Activities

- Collects and integrates new information
- Assesses whether new/aggregated information has a significant effect on site hazard
- [If needed] Refers the issue and associated analyses to appropriate regulatory process



# SAFETY ENHANCEMENTS FROM TIER 1 ACTIONS

- Substantial safety enhancements already achieved
  - Mitigation Strategies fully in place. Added capacity to deal with the station blackout and loss of access to ultimate heat sink
  - Addressing vulnerabilities found during walkdowns
  - Implementation of interim actions for external hazards
  - Implementation of other recommendations and through other measures (e.g., SFP instrumentation)
- Some enhancements will extend beyond 2016
  - SPRAs will provide additional insights into safety enhancements through understanding of integrated plant response to seismic events
  - Implementation of Proposed Mitigation of Beyond-Design-Basis Events (MBDBE) Rulemaking
- Potential implementation of the proposed approach for ongoing assessment of natural hazards

# SUMMARY

- Substantial safety enhancement has been achieved through FLEX, hazard specific activities, enhanced emergency response capabilities, and through other measures
- Effective and proactive process to deal with changing knowledge in natural hazards and large uncertainties
- Safety is combination of hazard and plant capability – tools to timely assessment of impact while preserving stability
- Integrated evaluation tools, such as PRA, provide insights into total plant response to an initiator and identify most beneficial safety enhancements
- Defense-in-depth is a key cornerstone of safety - Incompleteness in our knowledge and assessments
- FLEX has significantly increased the capability for all initiators
- Going forward - incorporation of lessons in siting and design