

Implementing Lessons-Learned from Fukushima

ENSREG's Second National Action Plan Peer Review Workshop
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Agenda

- Background
- Overall Tier 1 Progress
 - Orders
 - Requests for Information
 - Rulemaking Activities
- Tier 2 and 3 Recommendations
- Summary

Initial USNRC Actions

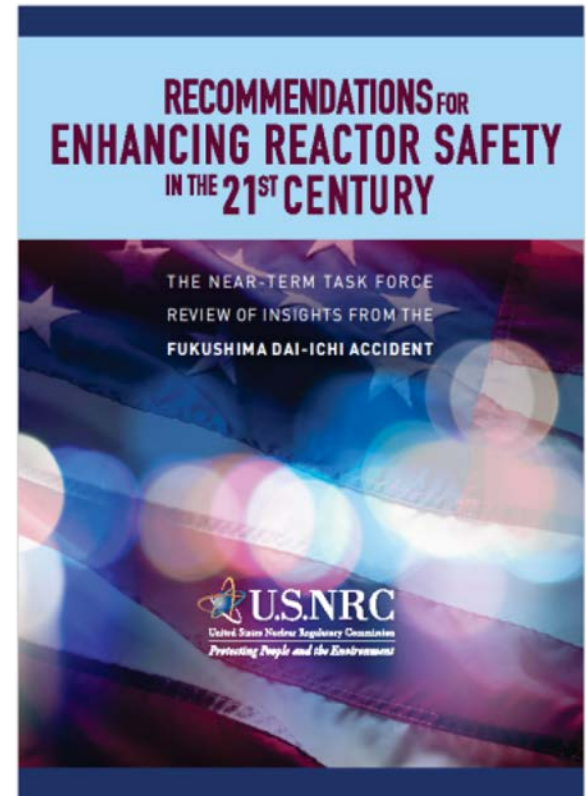
- All U.S. plants confirmed adequately prepared for design basis seismic and flooding events
- Reconfirmed safety improvements implemented after the September 11, 2001 attacks on the U.S.
- USNRC performed inspections and where discrepancies were identified, licensees took necessary action.



USNRC inspected licensees preparedness for similar events

Lessons Learned: Near-Term Task Force

- Within weeks of the accident, USNRC created a task force to review the events and provide recommendations to enhance safety at U.S. plants
 - Report issued July 2011
 - Concluded that a similar sequence of events in the U.S. was unlikely and there were no imminent risks of continued operation and licensing activity
 - Identified 12 overarching potential safety enhancements



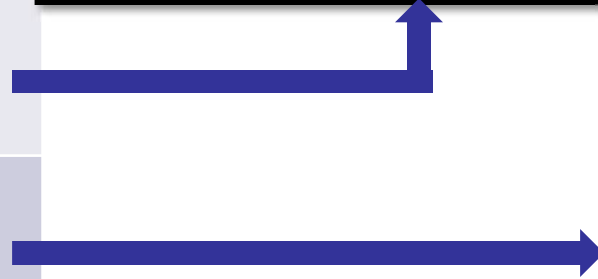
Prioritization of Lessons-Learned

- Prioritization of NTTF recommendations and other actions:
 - Tier 1 – To be implemented without delay
 - Tier 2 – Could not be initiated in the near term due to resource or critical skill set limitations
 - Tier 3 – Require further staff study to determine if regulatory action is necessary
- Regulatory tools to implement recommendations include Orders, Requests for Information, and Rulemaking
- March 2012 – Three Orders and one Request for Information were issued

Mitigating Strategies



Requires a three-phase approach for maintaining or restoring core cooling, containment, and spent fuel cooling



Phase	Licensee may use
Initial	Installed equipment
Transition	+ Portable, onsite equipment
Final	+ Resources obtained from offsite

Fundamental cornerstone of USNRC approach

Mitigating Strategies –

What is FLEX?



- **NEI 12-06 (Diverse and Flexible coping strategies (FLEX) Implementation Guide)**
 - Endorsed by the USNRC August 2012 to support implementation of Mitigating Strategies Order
 - FLEX provides a means to prevent fuel damage while maintaining containment function and spent fuel pool cooling in beyond design basis external event conditions resulting in an:
 - Extended Loss of AC Power, and
 - Loss of Normal Access to the Ultimate Heat Sink

Establishes an essentially indefinite coping capability by relying upon installed equipment, onsite portable equipment, and pre-staged offsite resources

Mitigating Strategies – Phase 1



- Following the event and prior to the time when portable equipment can be deployed, the plant must be able to maintain key safety functions using installed equipment
- Operators use installed equipment and resources to maintain or restore core cooling, containment, and spent fuel pool cooling
 - Station batteries
 - Water supplies
 - Steam driven pumps

Mitigating Strategies – Phase 2



- Operators will use portable onsite equipment
- Stored onsite in robust storage buildings
- Industry-wide standardized connections



Disaster-resistant dome (Source: ABC Domes)

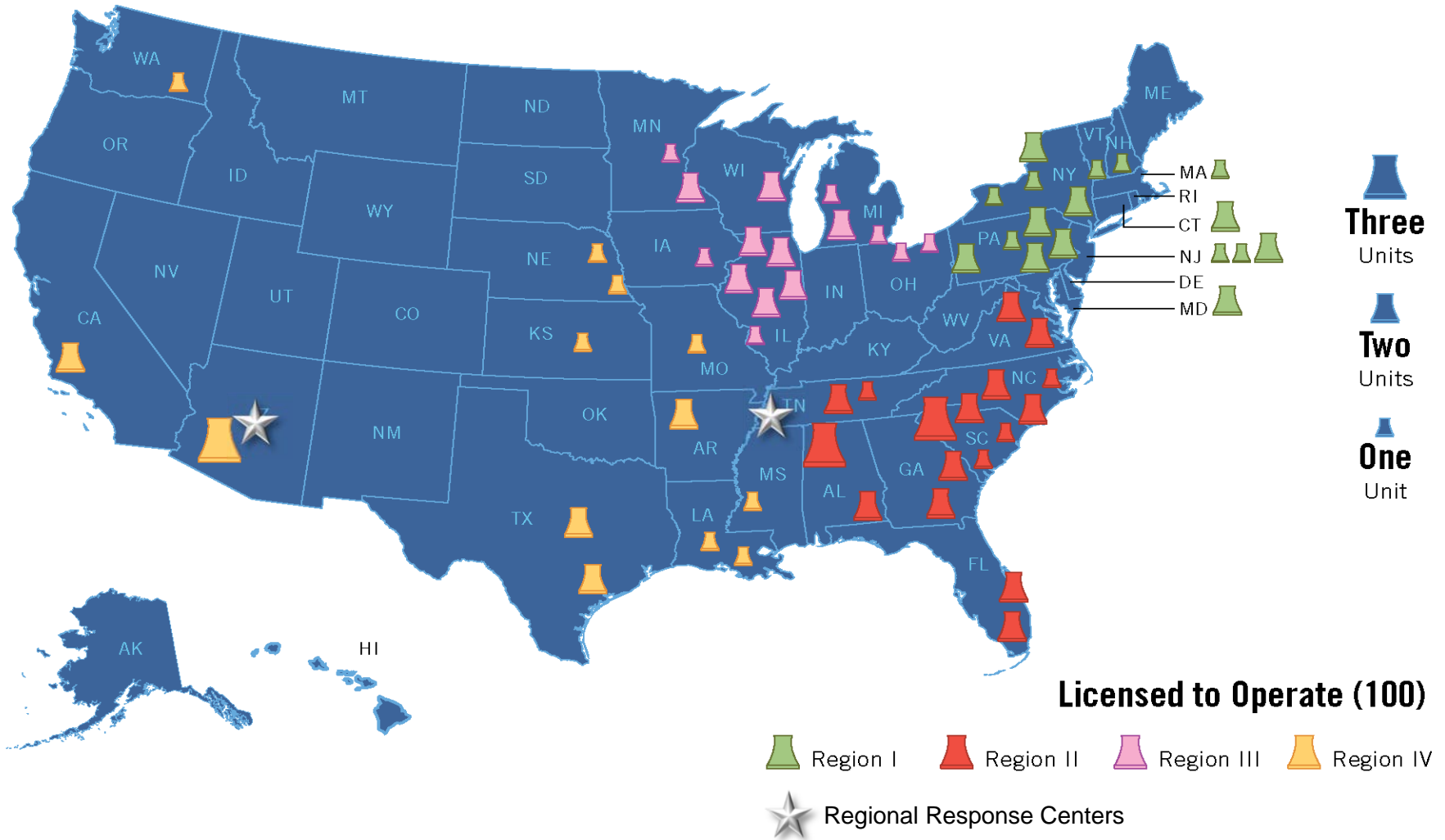
Mitigating Strategies – Phase 3



- Licensees will receive portable equipment from an offsite facility
- Two redundant response centers:
 - Phoenix, Arizona, and Memphis, Tennessee
 - Two redundant command and control centers



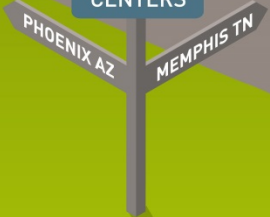
Nuclear Plant & NSRC Locations



**PORTABLE
BACKUP PUMPS,
HOSES, AND DIESEL
GENERATORS**



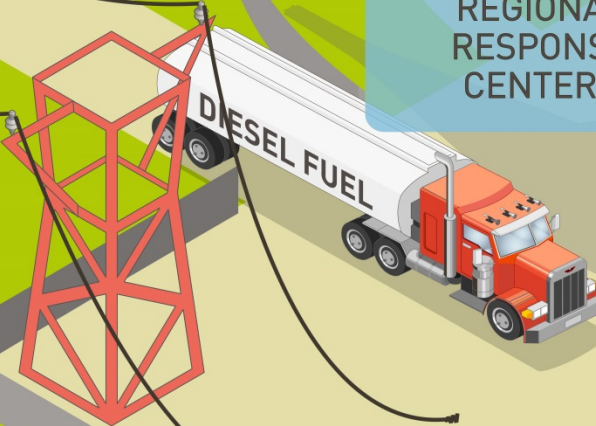
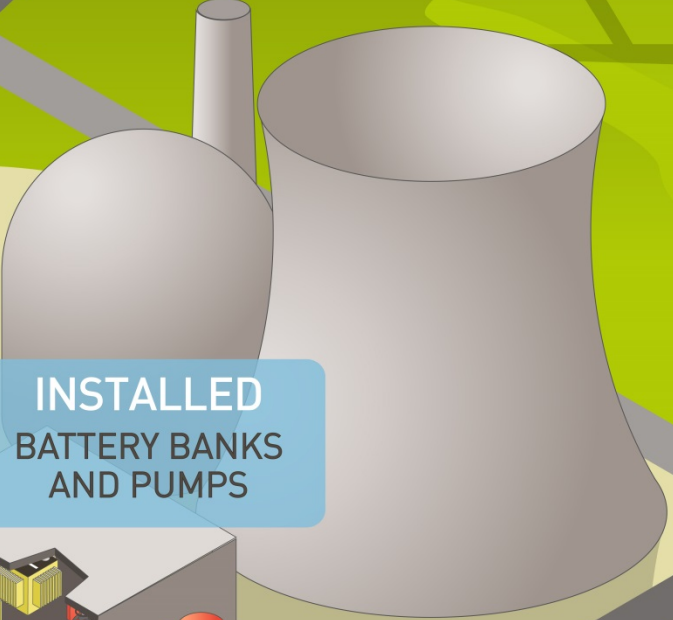
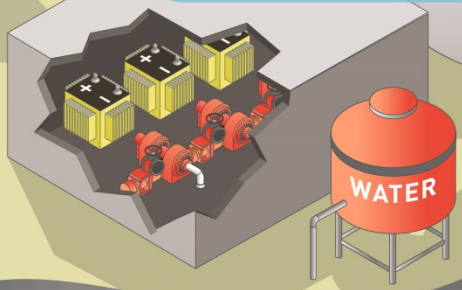
**REGIONAL
RESPONSE
CENTERS**



**REGIONAL
RESPONSE
SUPPLIES FROM
OFFSITE AND
REGIONAL
RESPONSE
CENTERS**



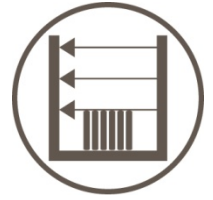
**INSTALLED
BATTERY BANKS
AND PUMPS**



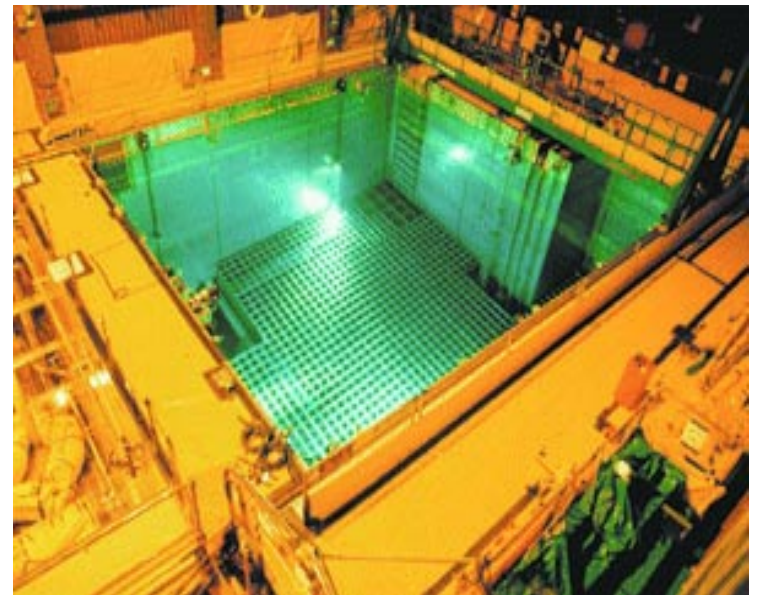
**LOSS OF
OFFSITE
POWER**

MITIGATION STRATEGIES OVERVIEW

Spent Fuel Pool Instrumentation



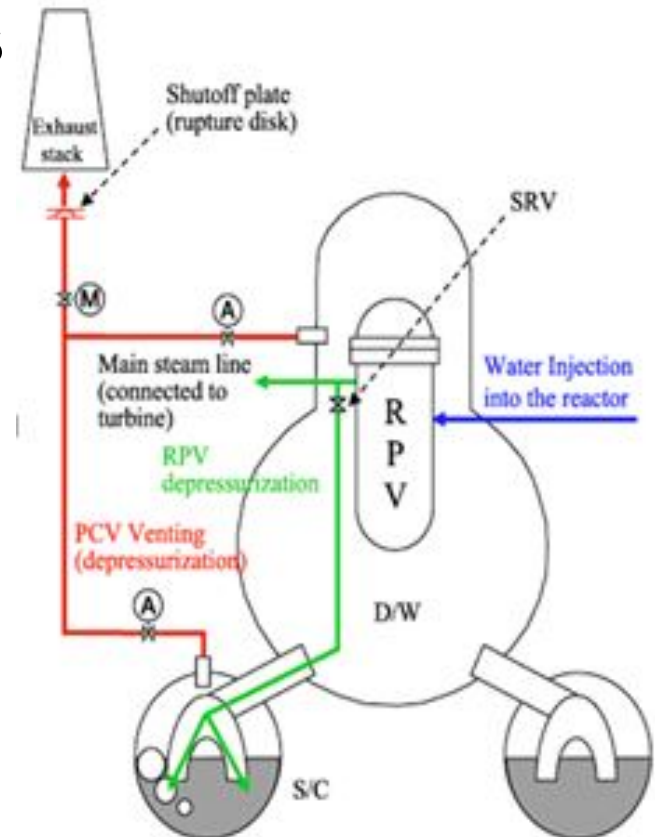
- Requires installation of water level instrumentation to indicate the following levels:
 - Normal fuel pool level
 - Below-normal level that still provides radiation shielding
 - Very low level, near top of fuel, where immediate action to add make-up water should be taken



Containment Vents



- Applies to boiling water reactors with certain designs (Mark I/II)
- Vents help control pressure by removing heat
- May help prevent core damage
- Required to work when normal power is lost
- Must continue to function if core damage/melting occurs



Severe Accident Capable Hardened Vents

- Phase 1 (Wetwell Vent)
 - Licensee plans submitted
 - Interim staff evaluations of plans issued
- Phase 2 (Drywell Vent or Strategy)
 - Draft guidance endorsing revision to NEI 13-02
 - Final endorsement by April 30, 2015
 - Finalizing details of water management strategies
- NRC to issue safety evaluations and perform inspections after Phases 1 & 2 are complete

Requests for Information

- NRC asked licensees to:
 - Walk down currently installed earthquake and flooding protection features, and correct degraded conditions
 - Use present-day information to reevaluate the potential effects of an earthquake or flooding event (Hazard Reevaluation)
 - Evaluate emergency plans to ensure sufficient staffing and communication capabilities if multiple reactors at a single site are affected by the same event

Hazard Reevaluations

- **Seismic Hazard Reevaluations**
 - Use of updated U.S. Geological Survey Seismic Hazards Information (central and eastern United States)
 - Prioritization and screening letter in May 2014
 - Determines need for Seismic Probabilistic Risk Assessment
 - Interim evaluation (Expedited Seismic Evaluation Process) for any planned interim actions
- **Flooding Hazard Reevaluations**
 - Three groups based on prioritization process
 - Licensees implementing any necessary interim actions

Rulemaking

- **Mitigation of Beyond Design Basis Events**
 - Will make generically applicable mitigating strategies for beyond design basis external events imposed by Mitigating Strategies Order. Intended to put in place requirements for an integrated accident response capability
- **Containment Protection and Release Reduction**
 - For boiling water reactors with Mark I and II Containments
 - Will consider additional performance-based requirements to address the potential release of radioactive materials during a severe accident

MITIGATION OF BEYOND DESIGN BASIS EVENTS RULEMAKING

NTTF Orders

- 4.2: Mitigation Strategies, EA-12-049
- 7.1: Spent Fuel Pool Instrumentation, EA-12-051
- 7: Spent Fuel Pool Requirements (partial)*
- 8 Onsite Emergency Response Capabilities (partial)*

*Part of EA-12-049

Supporting Guidance

- DG-1301: NEI 12-06 Mitigation Strategies Guidance
- DG: 1317: NEI 12-02 SFP Level Guidance
- DG-1319: NEI 12-01 Staffing and Communications Assessment; NEI 13-06 Emergency Response Capabilities; NEI 14-01 Emergency Response Procedures and Guidelines

Petitions for Rulemaking

- 50-97: EP Enhancements for Prolonged Station Blackout
- 50-98: EP Enhancements for Multiunit Events
- 50-100: Improve Spent Fuel Safety
- 50-101: Revise 10 CFR 50.63
- 50-102: Require More Realistic Training on SAMGs

Existing Requirements

- 10 CFR 50.63
- 10 CFR Part 50,
- Appendix E
- 10 CFR 50.54(hh)(2)

NTTF Misc.

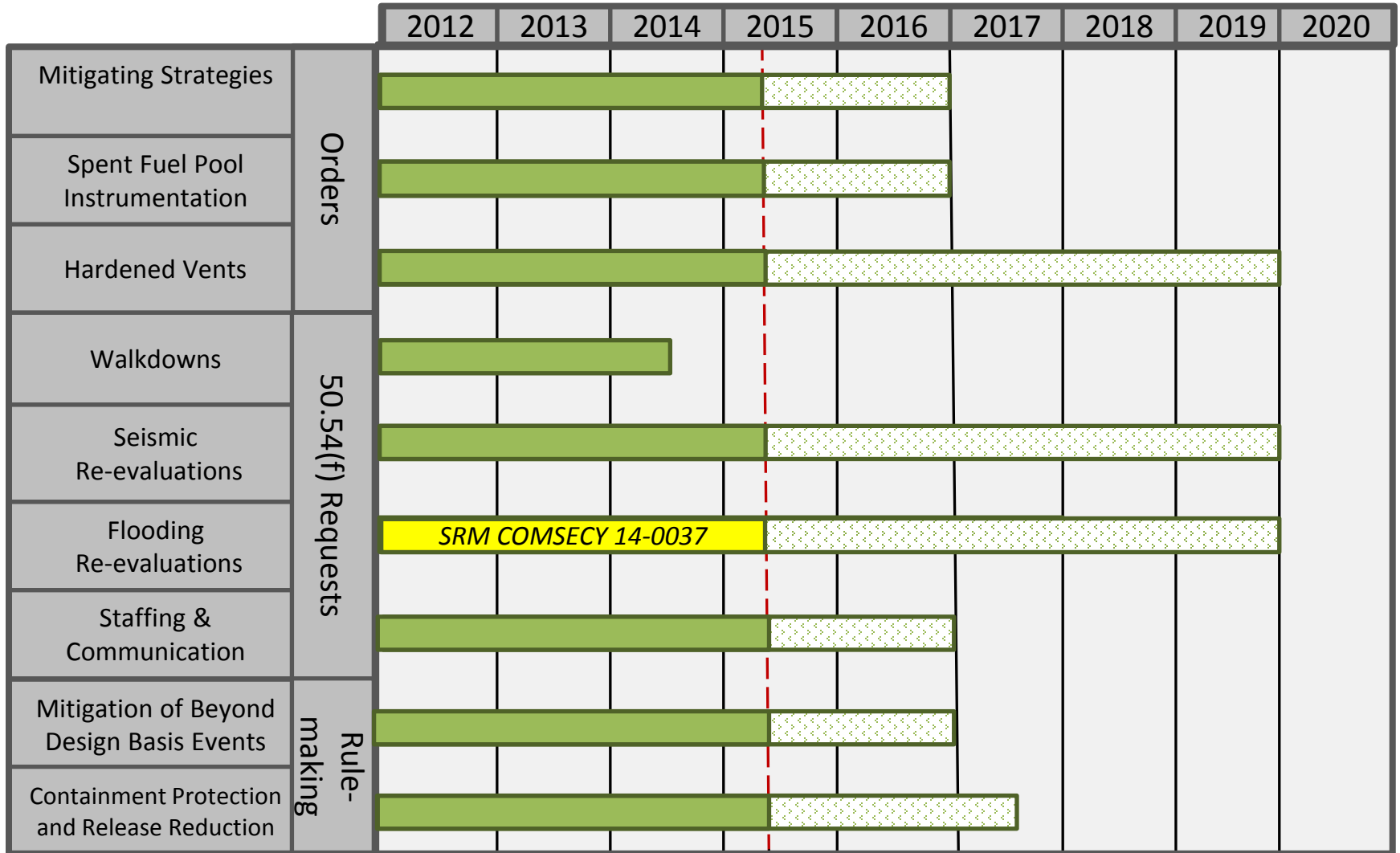
- 4.1: Station Blackout Rulemaking
- 7: Spent Fuel Pool Requirements (partial)
- 8: Onsite Emergency Response Capabilities (partial)
- 9.1: EP for Multiunit Events Rulemaking
- 9.2: EP for Prolonged Station Blackout
- 9.3: EP Orders (except long term ERDS)
- 9.4: ERDS Modernization
- 10.2: Command and Control Structure and Qualifications
- 11.1 Enhanced Onsite Emergency Response Resources

NTTF 50.54(f) Requests

- 2.1: Seismic and Flooding Reevaluation (for reasonable protection)
- 9.3: EP Staffing and Communication*

Tier 1 Implementation*

The USNRC is on or ahead of schedule in almost every area of Tier 1.



Today

*For illustrative purposes only

Tier 2 Recommendations

- **Spent Fuel Pool Cooling Capability**
 - Addressed under mitigation strategies
- **Emergency Preparedness**
 - Addressed under mitigation strategies
 - Multiunit dose assessment capability fully in place by mid-2015 (only one site incomplete)
- **Reevaluation of Other External Hazards**
 - Dependent on insights from seismic/flooding reevaluations and staff resources
 - Request for Information planned after the seismic and flooding hazards are resolved

Tier 3 Activities

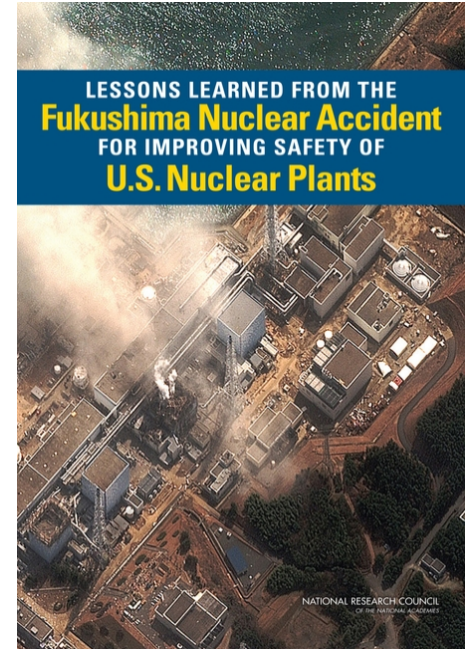
- Some issues require additional information/evaluation
- Some issues are dependent on insights from Tier 1 activities
- Progress being made on Tier 3 activities as information, resources, and insights become available

Tier 3 Recommendations

- 2.2 Perform periodic confirmation of seismic and flooding hazards
- 3 Enhanced capability to prevent/mitigate seismically induced fires and floods
- 5.2 Consider reliable hardened vents for other containment designs
- 6 Hydrogen control and mitigation inside containment or in other buildings
- 9.1/9.2 EP enhancements for prolonged SBO/multiunit events
- 9.3 Improve emergency response data system capability
- 10 Additional EP topics for prolonged SBO and multiunit events
- 11 EP topics for decision-making, radiation monitoring, and public education
- 12.1 Reactor Oversight Process enhancements
- 12.2 Staff training on severe accidents and resident inspector training on SAMGs
- Revisit Emergency Planning Zone size
- Pre-stage potassium iodide beyond 10 miles
- Reactor and containment instrumentation
- Expedited transfer of spent fuel to dry cask storage (complete)

Independent Reviews

- U.S. National Academy of Sciences
 - Congressionally mandated study
 - Phase 1 Fukushima accident complete
 - Phase 2 Spent fuel pool safety and security in progress
- Advisory Committee on Reactor Safeguards
 - Ongoing review of USNRC staff actions



Summary

- Considerable progress has been made
- Activities have already resulted in safety improvements
- Expect further substantial safety enhancements in place by 2016