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

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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

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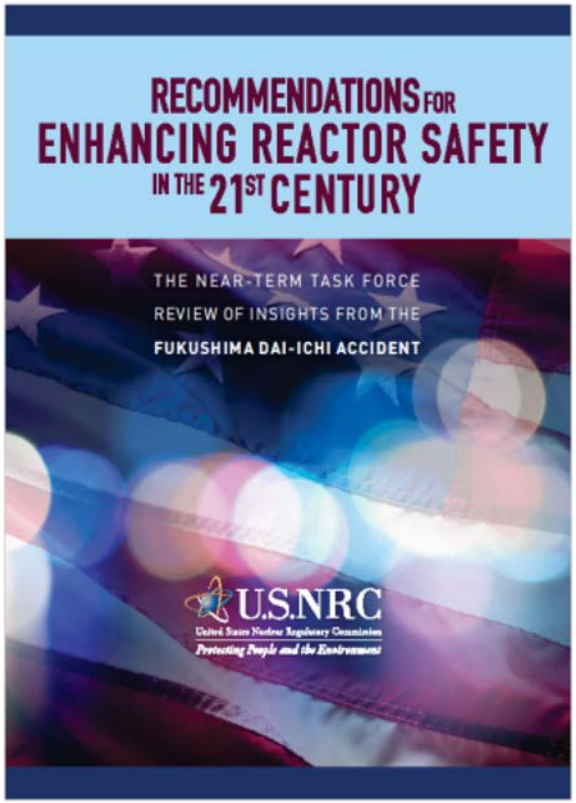
Lessons Learned: Near-Term Task Force

- 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



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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

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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

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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

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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

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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)

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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

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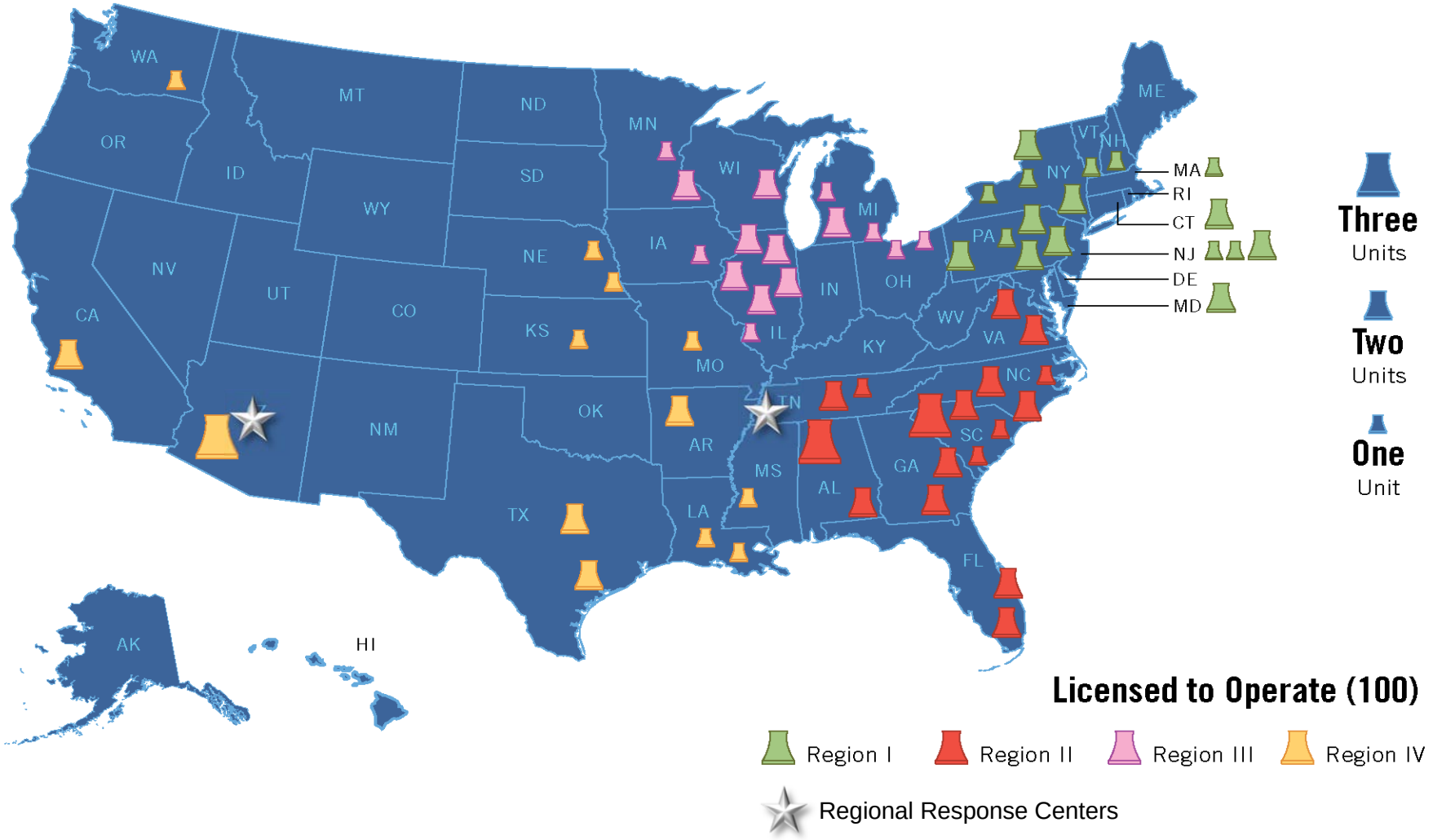
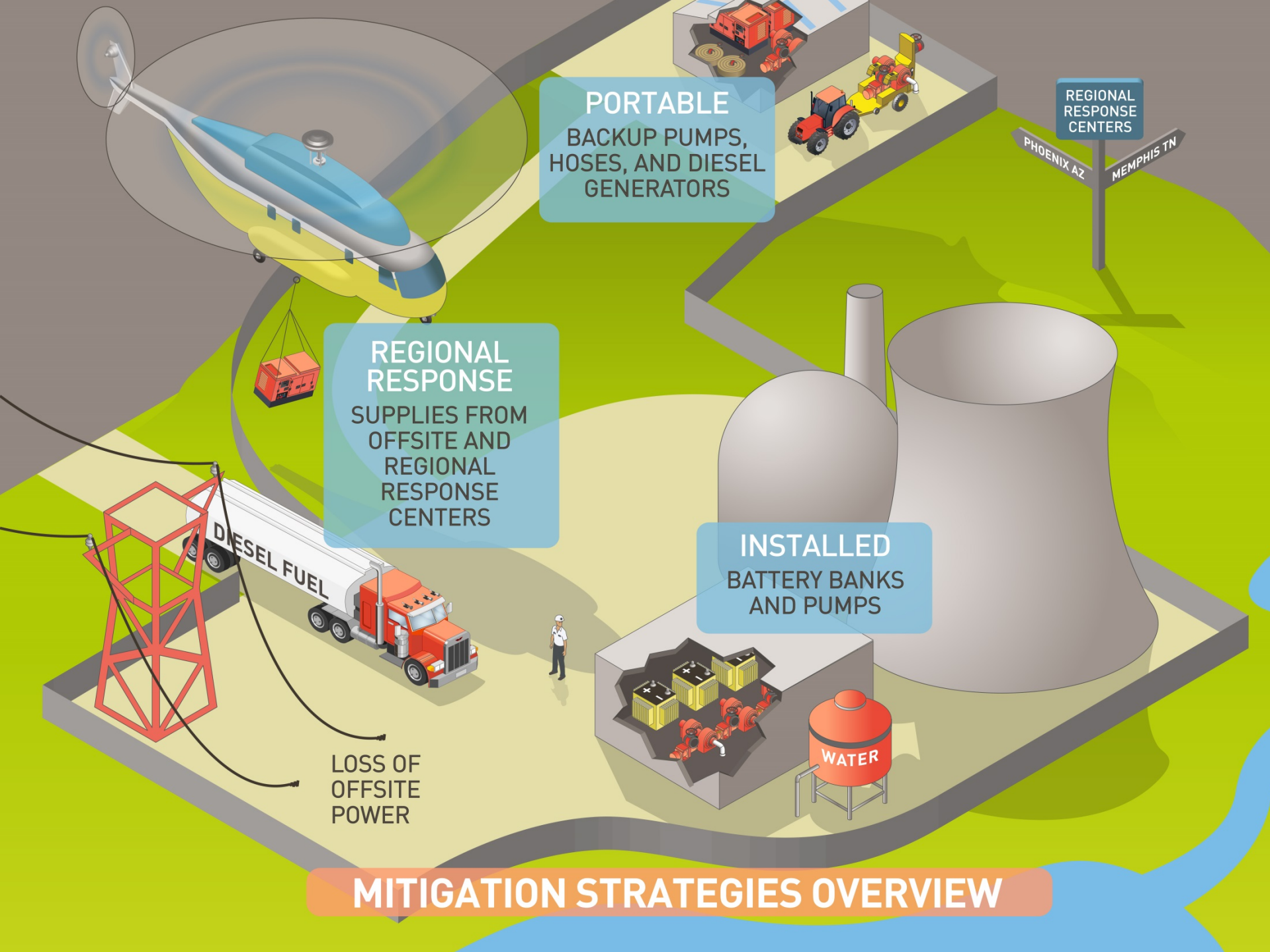
Nuclear Plant & NSRC Locations




PORTABLE
BACKUP PUMPS, HOSES, AND DIESEL GENERATORS
REGIONAL RESPONSE CENTERS
PHOENIX AZ
MEMPHIS TN
REGIONAL RESPONSE
SUPPLIES FROM OFFSITE AND REGIONAL RESPONSE CENTERS
DIESEL FUEL
INSTALLED
BATTERY BANKS AND PUMPS
WATER
LOSS OF OFFSITE POWER
MITIGATION STRATEGIES OVERVIEW

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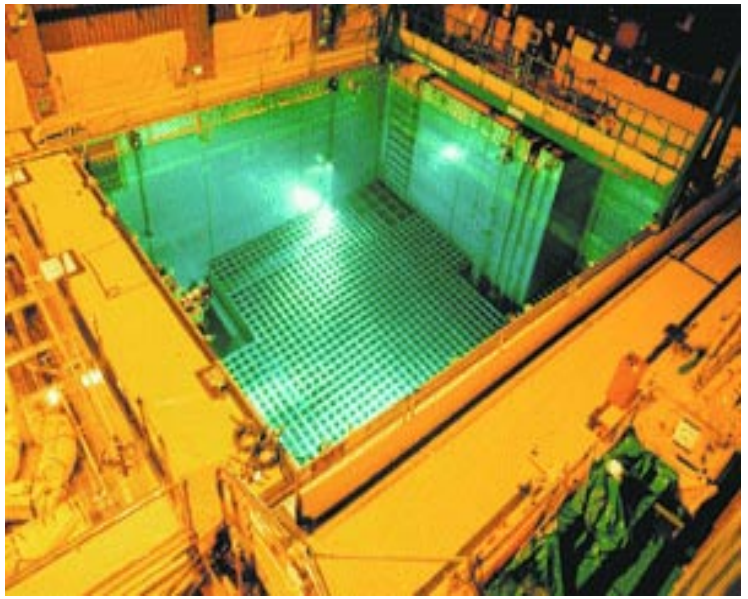
Spent Fuel Pool Instrumentation

- 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



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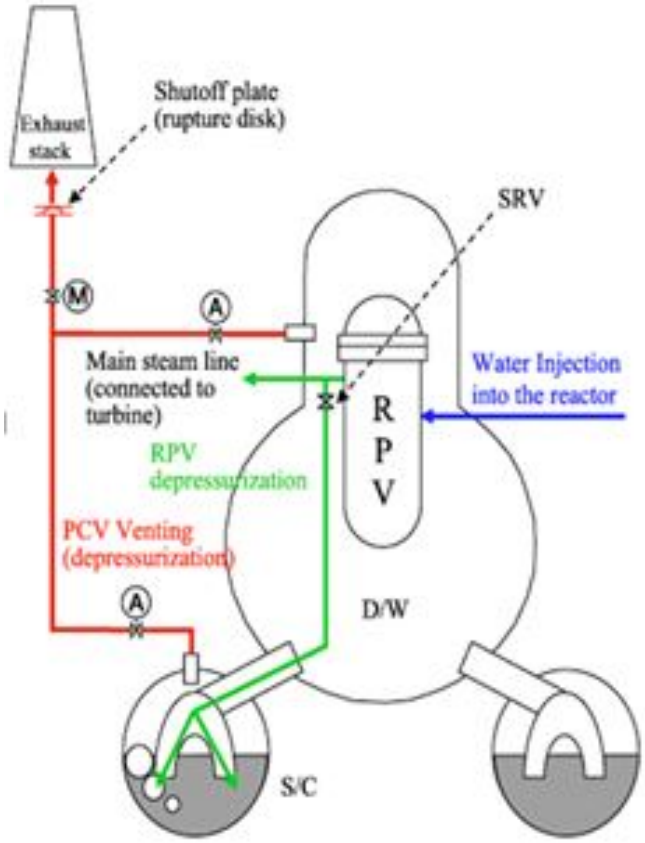
Containment Vents

- 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



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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

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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

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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

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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

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

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

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

Existing Requirements

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

NTTF 50.54(f) Requests

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

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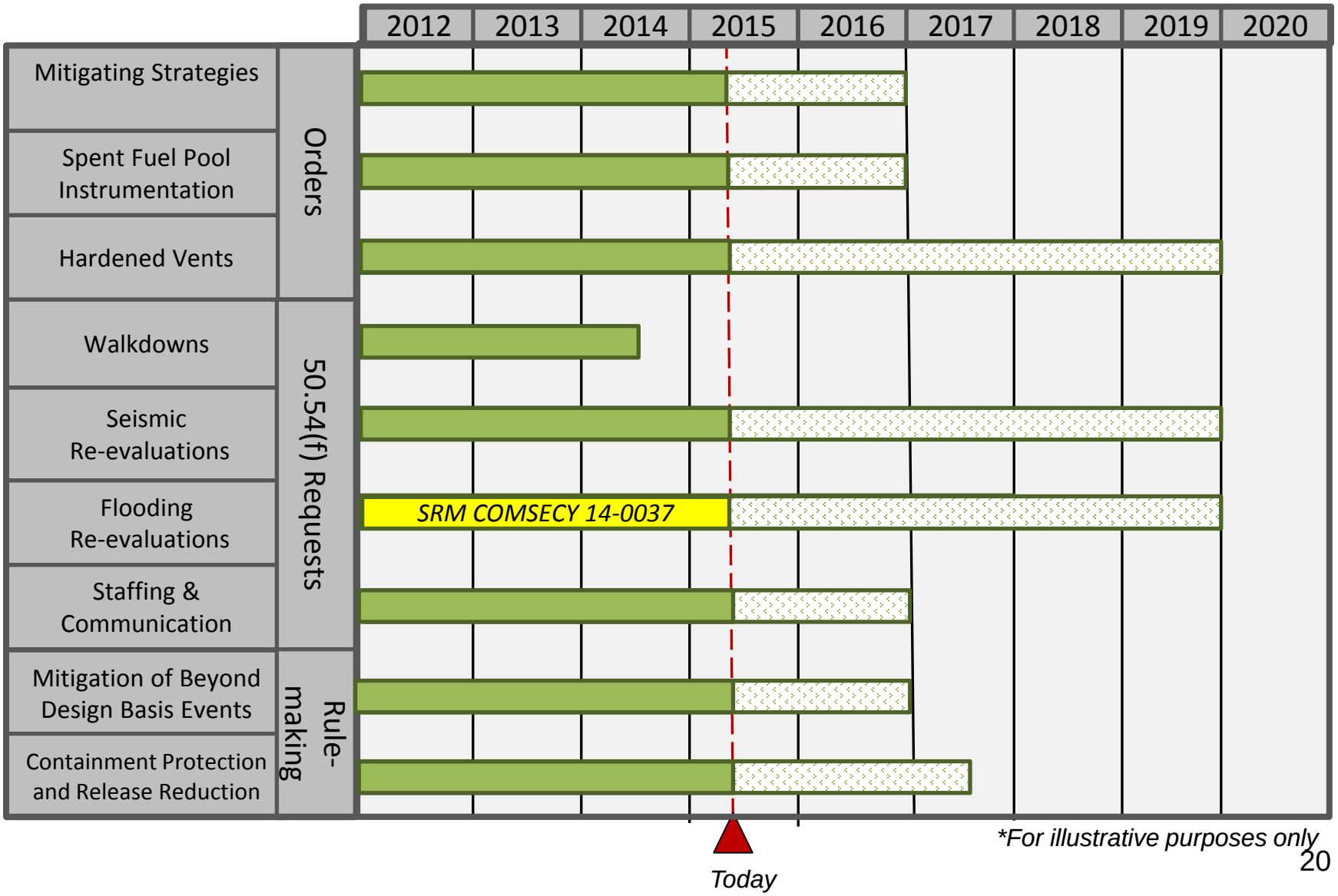
Tier 1 Implementation*

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



*For illustrative purposes only

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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

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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

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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)

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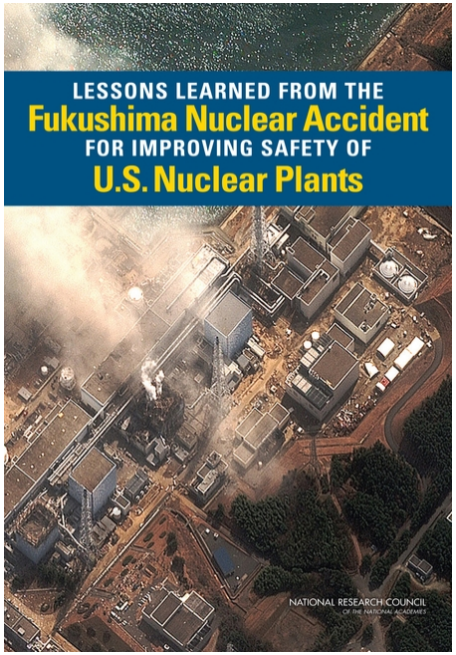
Independent Reviews

- 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



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Summary

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