SCHEDULING NOTE

Title: **BRIEFING ON THE STATUS OF LESSONS LEARNED FROM THE FUKUSHIMA DAI-ICHI ACCIDENT (Public Meeting)**

Purpose: To provide the Commission with a discussion of the status of actions taken in response to lessons learned from the Fukushima Dai-ichi accident.

Scheduled: April 30, 2015
9:00 am

Duration: 3 hours

Location: Commissioners' Conference Room, 1st fl OWFN

Participants: **Presentation**

External Panel **32 mins.***

Maria Korsnick, Executive Director, U.S. Industry Fukushima Response Chief Nuclear Officer and Chief Operating Officer, Constellation Energy Nuclear Group, LLC — 8 mins.*
Topic:
- Industry progress on Fukushima lessons learned

Anthony Pietrangelo, Senior Vice President and Chief Nuclear Officer, Nuclear Energy Institute — 8 mins.*
Topic:
- Improvements and challenges related to implementation of Fukushima lessons learned activities, specifically addressing seismic and flooding

Jon Franke, PPL Susquehanna, Susquehanna Steam Electric Station — 8 mins.*
Topic:
- Licensee perspective on the implementation of Fukushima lessons learned initiatives

Edwin Lyman, Senior Staff Scientist, Union of Concerned Scientists — 8 mins.*
Topic:
- Perspectives on NRC and industry activities in response to the Fukushima accident

Commission Q & A **40 mins.**

Break **5 mins.**

NRC Staff Panel **50 mins.***

Mike Johnson, Deputy Executive Director for Reactor and Preparedness Programs and Fukushima Steering Committee Chairman
Bill Dean, Director, Office of Nuclear Reactor Regulation
Jack Davis, Director, Japan Lessons Learned Division
Scott Flanders, Director, Division of Site Safety and Environmental Analysis
Raymond Lorson, Director, Division of Reactor Safety, Region I

Topics:

- Progress on implementing lessons learned recommendations, including timelines and next steps for bringing all items to closure.
    - Tier 1 recommendations:
        - Progress and challenges related to mitigating strategies and station blackout
        - Status of implementing safety improvements at plants
        - Rulemakings related to Japan lessons learned
        - Status of seismic and flooding reevaluations
        - Staff actions in response to Commission direction on "Integration of Mitigating Strategies for Beyond-Design-Bases External Events and the Reevaluation of Flooding Hazards (COMSECY-14-0037)
        - Activities associated with oversight of post-Fukushima actions
    - Tiers 2 & 3 recommendations:
        - Previous plans and current status
        - Insights based on work completed to-date (e.g., Tier 1)
        - Next steps

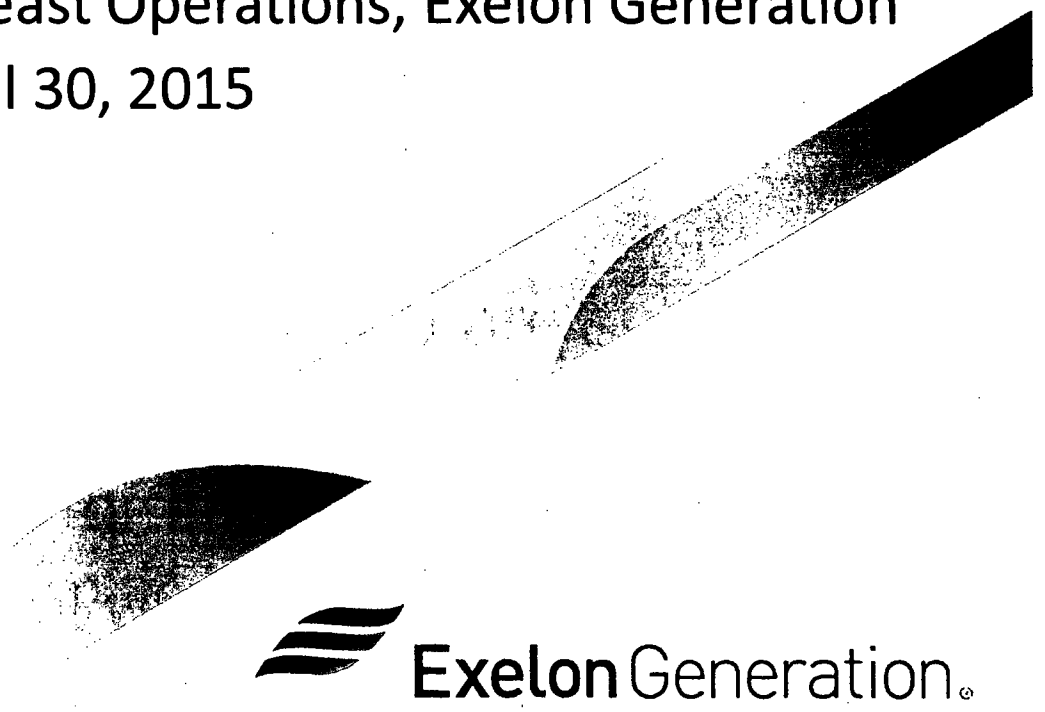
Commission Q & A **40 mins.**

Discussion – Wrap-Up **5 mins.**

*For presentation only and does not include time for Commission Q & A's

Fukushima Lessons Learned

Maria Korsnick
Chief Nuclear Officer, Constellation Energy Nuclear Group, LLC and
Senior Vice President, Northeast Operations, Exelon Generation
April 30, 2015

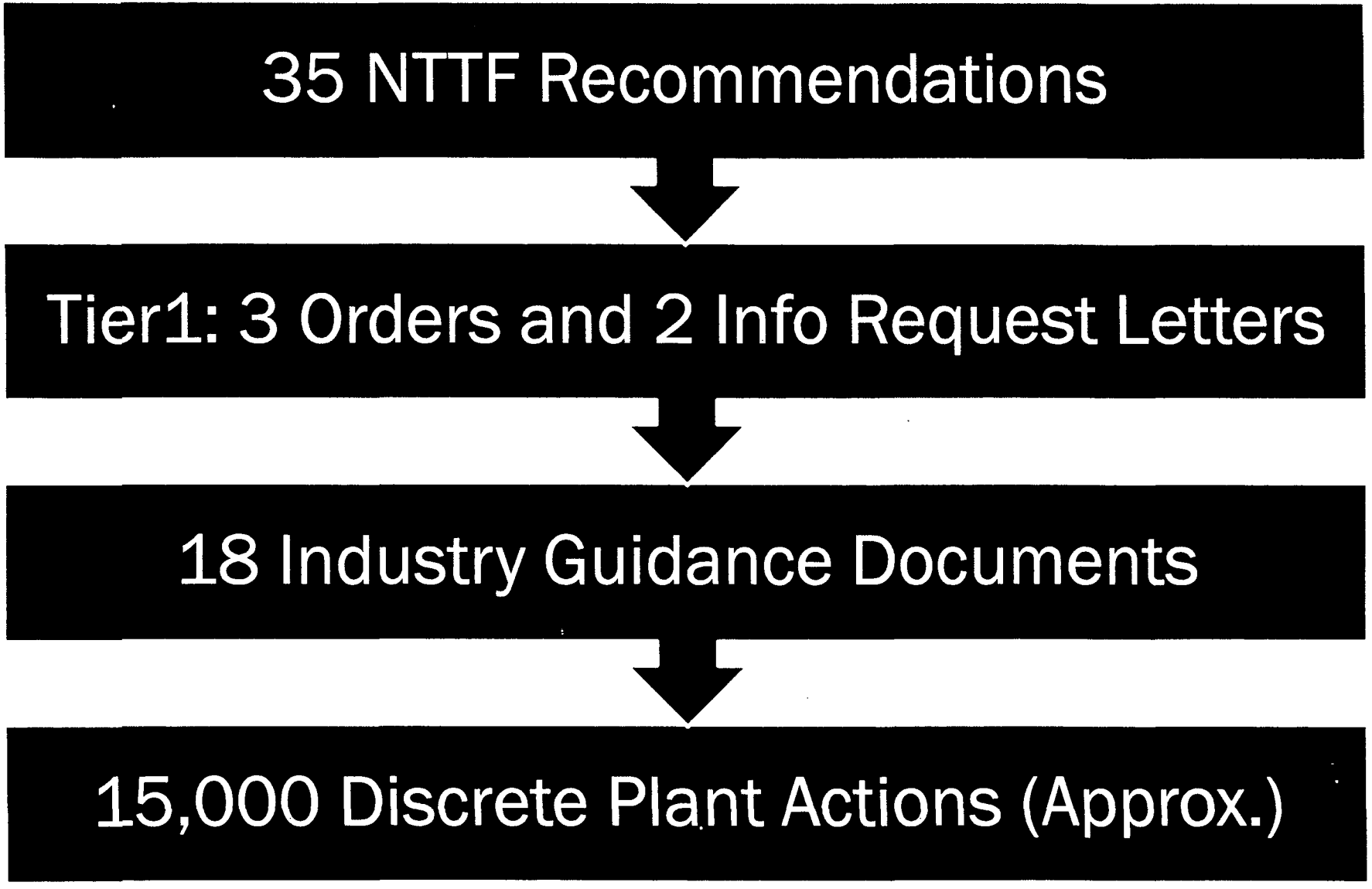


Exelon Generation®

Overarching Lessons

- Provide cooling water and power under extreme conditions when station and off-site power are unavailable
- Retain or regain access to the ultimate heat sink
- Be prepared to handle multiple units affected by the same natural hazard
- As demonstrated at Fukushima Daini, portable equipment, high-quality site leadership, and dedicated personnel are the keys to success

70% Complete on Tier 1 Requirements



Exelon Generation

NRC Orders

- Mitigating Strategies – FLEX
  - Required by end 2016
- Spent Fuel Pool level instrumentation
  - Required by end 2016
- BWR Mark I & II hardened, severe accident capable vents
  - Phase 1 required by June 2018
  - Phase 2 required by June 2019

Bias for Action

- Positioned for indefinite coping during an extended loss of AC power
- Compliance with NRC orders (as of end 2014)
  - Mitigating Strategies: 6 units completed
    - 57 more during 2015; substantially complete by end 2016
  - Spent Fuel Pool Instrumentation
    - 18 units completed; full completion by end 2016
  - BWR hardened vent order
    - On track to complete both phases by June 30, 2019
- Two national support centers in operation
  - Additional portable equipment within 24 hours
- Able to handle natural hazards affecting multiple reactors at same site

Flood and Seismic Hazards

- Seismic
  - Walkdowns and hazard re-evaluations completed
- Flooding:
  - Walkdowns and hazard re-evaluations substantially complete
- Additional discussion regarding flood and seismic hazards in following presentation

BWR Containment Filtering Strategy

- Protecting containment is the primary focus
- FLEX protects containment by core cooling
- If core damaged, vent protects containment
  - Severe accident water addition will control damaged core
- Extensive evaluations show no safety benefit from an external filter
  - Severe accident water addition will filter releases

Going Forward

- Our lessons learned from Fukushima are substantial and on-going
- 2015/16 are significant for implementation
- We have been successful when there are both industry and NRC alignment and accountability for execution
- We will achieve significant safety benefit by those actions completed by the end of 2016

Fukushima Response: Integration of Flood and Seismic Hazards with Mitigation Strategies

Tony Pietrangelo
Senior Vice President and Chief Nuclear Officer
April 30, 2015

Flood Reevaluations

- More than adequate for Mitigation Strategies Assessment (MSA)
- Need NRC endorsement of MSA guidance
- Need to expedite NRC staff review letters so that MSAs can be completed in 2016
- Need to factor in NRC review of MSA results so that any resulting actions can move forward

Seismic Reevaluations

- Expedited Seismic Evaluation Process (ESEP) for sites where the reevaluated hazard exceeds the design basis between 1 and 10 Hertz
- ESEP focuses on Phase 1 of Mitigation Strategy
  - Permanent plant equipment with key functions
- 32 stations submitted ESEPs in December 2014
  - Confirmed robustness of seismic design

Seismic Challenges

- Discussion underway on scope and methods to assess plants/strategies where the reevaluated hazard exceeds the design basis
- Guidance development, endorsement and execution by 2016 will require focused effort
- Goal is to provide additional confidence that mitigation strategy would remain viable

Conclusions

- A substantial amount of analysis and review work remains for licensees and NRC
- All plants will have mitigating strategies substantially complete by the end of 2016
- Goal is to have all plants assess their mitigating strategies against reevaluated hazards in 2016
- Need to retain focus on integration of efforts
  - Rulemaking should help provide this focus

Licensee Perspectives on the Implementation of Fukushima Lessons Learned

Jon Franke
Site Vice President
Susquehanna Steam Electric Station
April 2015

Nuclear Safety Perspective

Prepared for the unknown

- Greatly enhanced ability of plant and staff to protect public safety
- National Support Centers
  - Simple, standard, compatible implementation
- Station specifics addressed
  - Seismic and flooding hazards
  - Individual site technical requirements met

TEAM SUSQUEHANNA
Generating Excellence

Nuclear Safety Perspective

Temporary power and cooling water staged

- Matched to site requirements

TEAM SUSQUEHANNA
Generating Excellence

Site Implementation

- Commitment delivered has matched the importance of the issue
  - Plant modifications
  - Staffing
  - Training
  - Emergency response programs

Industry Collaboration Response

- Strategic Alliance for Flexible Emergency Response (SAFER)
  - Response centers
  - Logistics
  - Equipment and personnel
- Industry support through Institute of Nuclear Power Operations (INPO), Nuclear Energy Institute (NEI), and the Electric Power Research Institute (EPRI)
- Open, public, collaborative approach has led to stronger, more effective solutions

Going Forward Considerations

- Regulatory certainty of Tier 2 and 3
- Focus time and resources on safe and efficient plant operations
  - Future actions need to be commensurate with technical merit

UCS Perspectives on NRC and Industry Actions in Response to Fukushima

April 30, 2015

Dr. Edwin S. Lyman
Senior Scientist
Union of Concerned Scientists

General comment

- UCS acknowledges the enormous effort on the part of the NRC and the industry to address safety vulnerabilities post-Fukushima
- However, the lack of a unifying framework (e.g. NTTF Recommendation 1) has led to an overly complex and confusing set of activities
- Consequently, it is hard to assess to what degree safety is being improved
- The NRC should keep a tight rein on "schedule relaxations" (e.g. Indian Point 3) to prevent a repeat of the decade-long time to fully implement post-9/11 modifications

UCS view of mitigating strategies/FLEX

- **FLEX does not fulfill the original intent of the Near Term Task Force**
  - **Stakeholder input influenced the NRC staff to pursue a more performance-based approach [e.g. FLEX] to improve the safety of operating power reactors than envisioned in NTTF Recommendation 4.2 ..." – boilerplate language in NRC Safety Evaluation Reports**
- **"Diverse and flexible" response is necessary, but perhaps not sufficient**
  - **French "hardened safety core" may also be needed**
- **FLEX boundary conditions are too narrow and represent an artificial, stylized event**
  - **Contributes to the confusion surrounding the flooding hazard reevaluations**

Industry position has shifted

"... the mitigation of Beyond-Design-Basis Event capabilities needs to address a spectrum of plant conditions that may be caused by the different initiating events and the resulting damage states ... it basically requires that you assume the ELAP condition and the loss of the heat sink even when you're assessing the revised hazard response. We think that in many of those cases you should be able to use a alternate or targeted hazard mitigation strategy that takes into account the actual state of the plant."

– Bryan Ford, Entergy, ACRS Fukushima Subcommittee meeting, March 20, 2015.

FLEX inspections

- **Performance-based requirements need performance testing-based inspections**
- **UCS proposes that the effectiveness of mitigating strategies be inspected through a series of stress test scenarios, supplemented by performance testing where appropriate**
  - **To be modeled on force-on-force security inspections**
- **Goal: to assure that FLEX can provide plausible success paths for a sufficiently broad spectrum of beyond-design-basis events**

Westinghouse RCP seal problem

- **NSAL-15-2 released publicly on April 23**
- **UCS is still evaluating its significance but it appears that it could have an impact on FLEX timelines and cause further delays in compliance with EA-12-049**
- **This is in addition to the previously revealed problems in RCP seal leakage modeling (NSAL-14-1):**
  - **"At the present time, the NRC staff is unable to conclude that Westinghouse's analytical modeling of RCP seal leakage is acceptable on its own merits." – Watts Bar mitigating strategies SER, March 27, 2015.**

Flooding

- **NRC seems to be "at sea" at the moment regarding its response to flooding hazards**
- **UCS strongly supports SRM-COMSECY-14-0037, but is concerned that directing the staff to be "risk-informed" may only increase confusion, given the absence of credible flooding PRA methods**
- **In our view, reevaluated hazards (based on more accurate information and improved methods) constitute the *true* design basis; the original design basis was *wrong***

Defense-in-depth

- DID should not be lumped in with other "qualitative" factors: it has a unique regulatory role
- DID is a crucial consideration in evaluating the benefits of regulatory requirements for post-core damage measures (e.g. SAMGs and CPRR)
  - Effectiveness of mitigating strategies for preventing core damage cannot be well-quantified (depends on uncertain operator actions)

BDBE mitigation and CPRR rulemakings

- **UCS strongly supports the incorporation of SAMGs into the BDBE mitigation rulemaking as a regulatory requirement**
  - **SAMGs cannot otherwise be effectively integrated with other emergency procedures/guidelines**
  - **Severe accident water management is being proposed as a measure for compliance with EA-13-109 and as such would be a regulatory requirement**
  - **NRC should approve such a rule in its entirety on the basis of adequate protection**
- **UCS strongly recommends that the NRC follow through with its commitment to develop a CPRR draft rule for public comment (including a filter alternative)**

Benefits of SAMGs

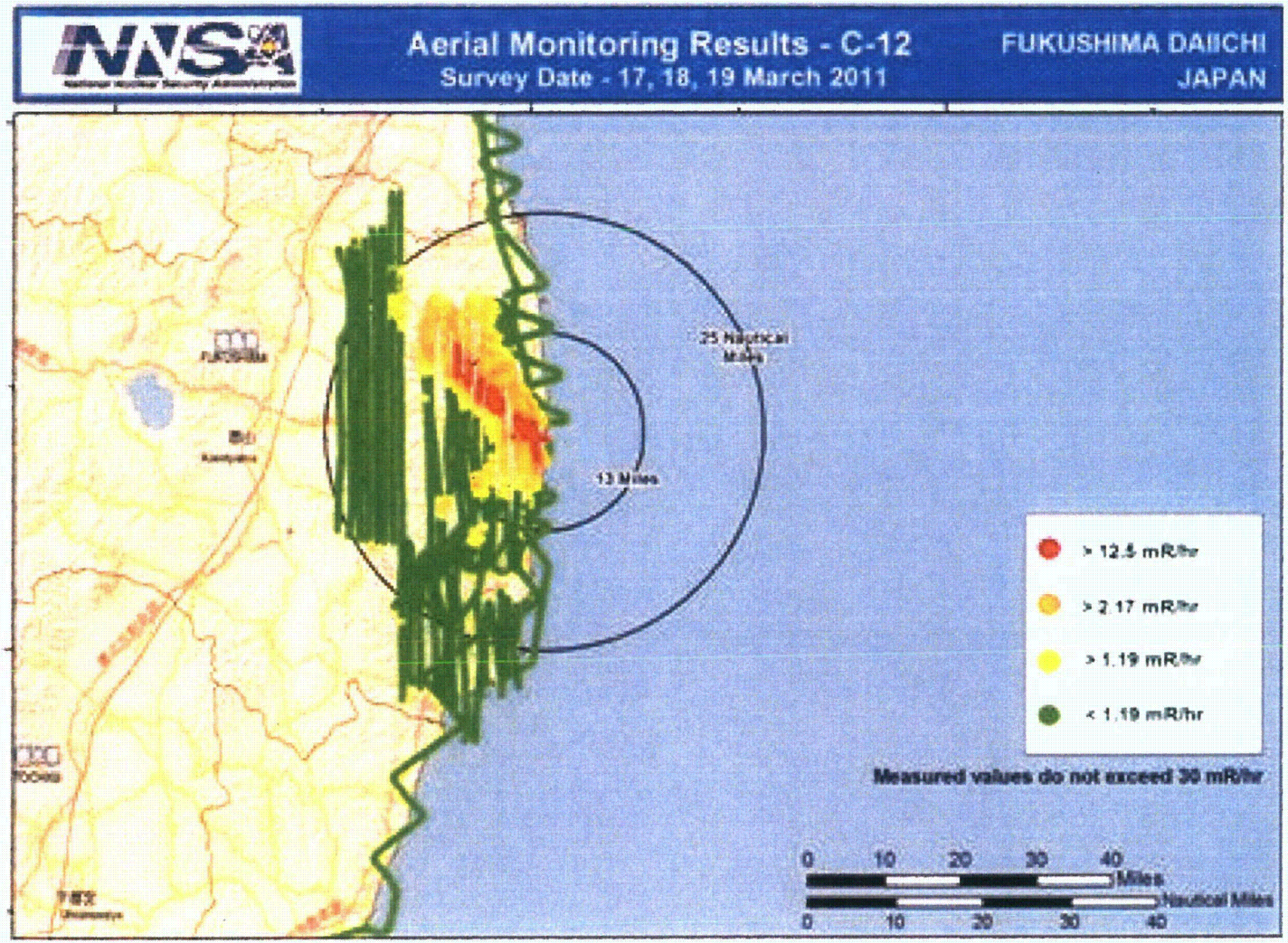
- **The staff's conclusion that SAMGs cannot be quantitatively justified has been questioned:**

"I've got real problems with the way you refer to those technical analyses for the CPRR as evidence that SAMGs don't improve risk... to point to that limited, and in my opinion very flawed technical analysis to say that that the NRC can draw a conclusion that SAMGs ... do not improve risk ... is misleading at best." – John Stetkar, ACRS, Fukushima Subcommittee Meeting, March 20, 2015.

- **The staff's long-overdue update of the value of a statistical life (to $9 million, or $5,100/person-rem) will have an impact on quantitative cost-benefit determinations**

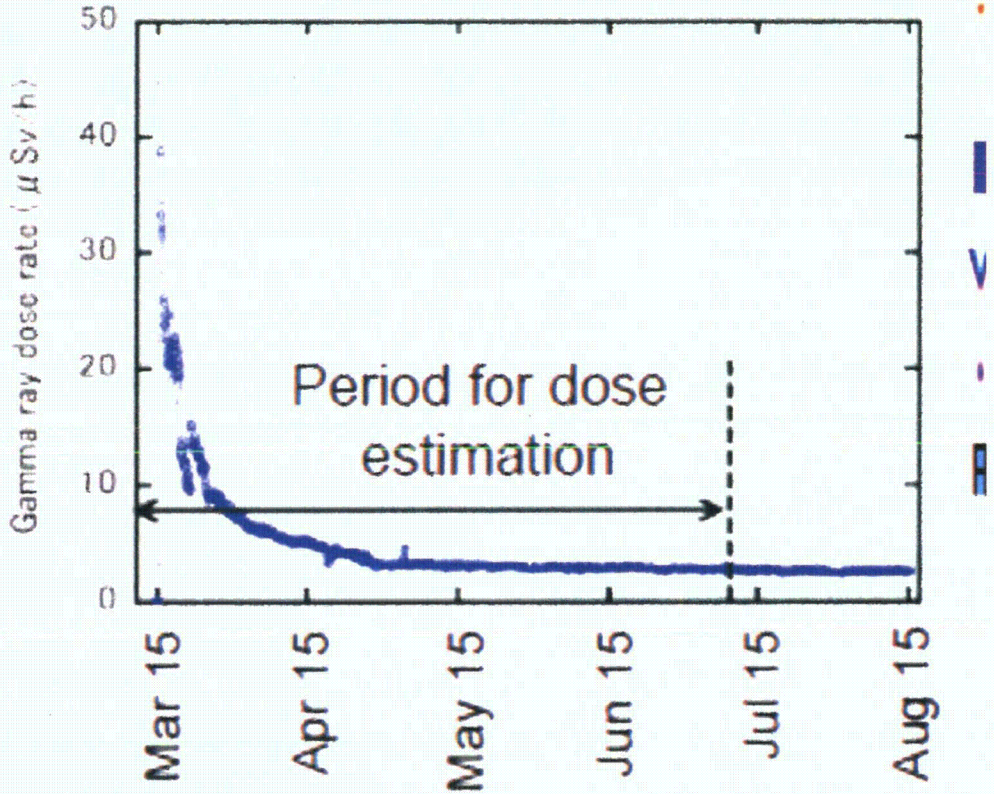
EPZ size and KI distribution

- The NRC needs to seriously consider expansion of the plume exposure EPZ radius beyond 10 miles in light of Fukushima
- Environmental Protection Agency protective action guide for evacuation (1 rem in 4 days) likely exceeded at least 20 miles away from Fukushima Daiichi
- More severe releases were projected to exceed PAGs much further away
- Japan has expanded its evacuation planning zone to 30 km (18.6 miles)
- Assertion that larger areas can be effectively evacuated on an ad hoc basis after an accident occurs for any U.S. plant needs to be reassessed


NNSA
Aerial Monitoring Results - C-12
Survey Date - 17, 18, 19 March 2011
FUKUSHIMA DAIICHI
JAPAN
25 Nautical Miles
13 Miles
> 12.5 mR/hr
> 2.17 mR/hr
> 1.19 mR/hr
< 1.19 mR/hr
Measured values do not exceed 30 mR/hr
0 10 20 30 40
Miles
Nautical Miles
0 10 20 30 40

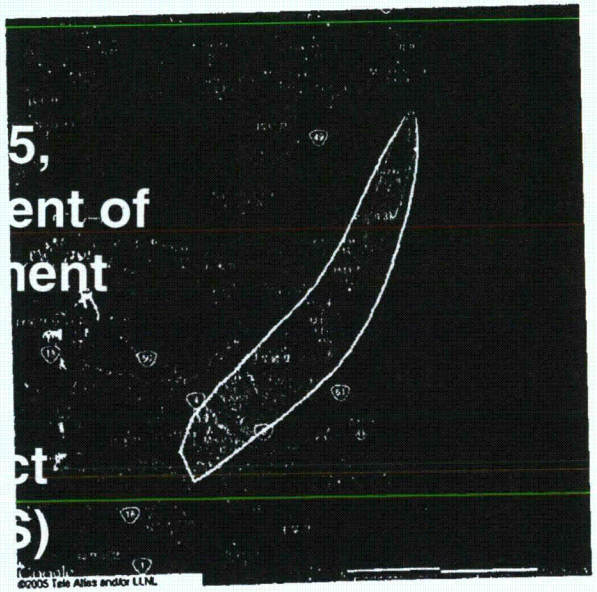
External dose rate: Iitate Village (25 miles from Fukushima Daiichi)

Approx. 300 mrem external dose in first 4 days; internal doses from plume exposure unknown



3. Plausible Severe Release

Release from 2 Spent Fuel Pools



The graphic indicates where the 96-hour total effective dose including plume passage exceeds 1 rem (yellow) and 5 rem (orange)

- In this hypothetical scenario, the US EPA Protective Action Guidelines for the total effective dose MAY be exceeded in Tokyo, as well as at locations closer to the release point.
- In this hypothetical scenario, the US EPA Protective Action Guidelines for both the adult and child thyroid dose will NOT be exceeded in Tokyo, but are exceeded at locations closer to the release point

U.S. worst case dose projections

		Summary					
	Distance (km)	96-hour Adult Dose (mrem)			Child Thyroid Dose (mrem)		
Cs-137/I-131 rel (Ci)		low	median	high	low		high
Southern Alaska		0.05	0.30	80			
Hawaii	6200	0.01	0.12	3	0.4	700	1800
Midway	4100	0.003	0.29	10			
Wake	3200	0.002	0.06	1			
West Coast	8000	0.01	0.09	0.8	0.06	400	4500

Acronyms

- CPRR: Containment Protection and Release Reduction
- DID: Defense-in-Depth
- EPZ: Emergency Planning Zone
- NTTF: Near-Term Task Force
- PAGs: Protective Action Guides
- PRA: Probabilistic Risk Assessment
- RCP: Reactor Coolant Pump
- SAMGs: Severe Accident Management Guidelines

Acronyms

- **UCS: Union of Concerned Scientists**

U.S.NRC

United States Nuclear Regulatory Commission

Protecting People and the Environment

Briefing on the Status of Lessons Learned from the Fukushima Daiichi Accident

Michael Johnson

Deputy Executive Director for Reactor and Preparedness Programs

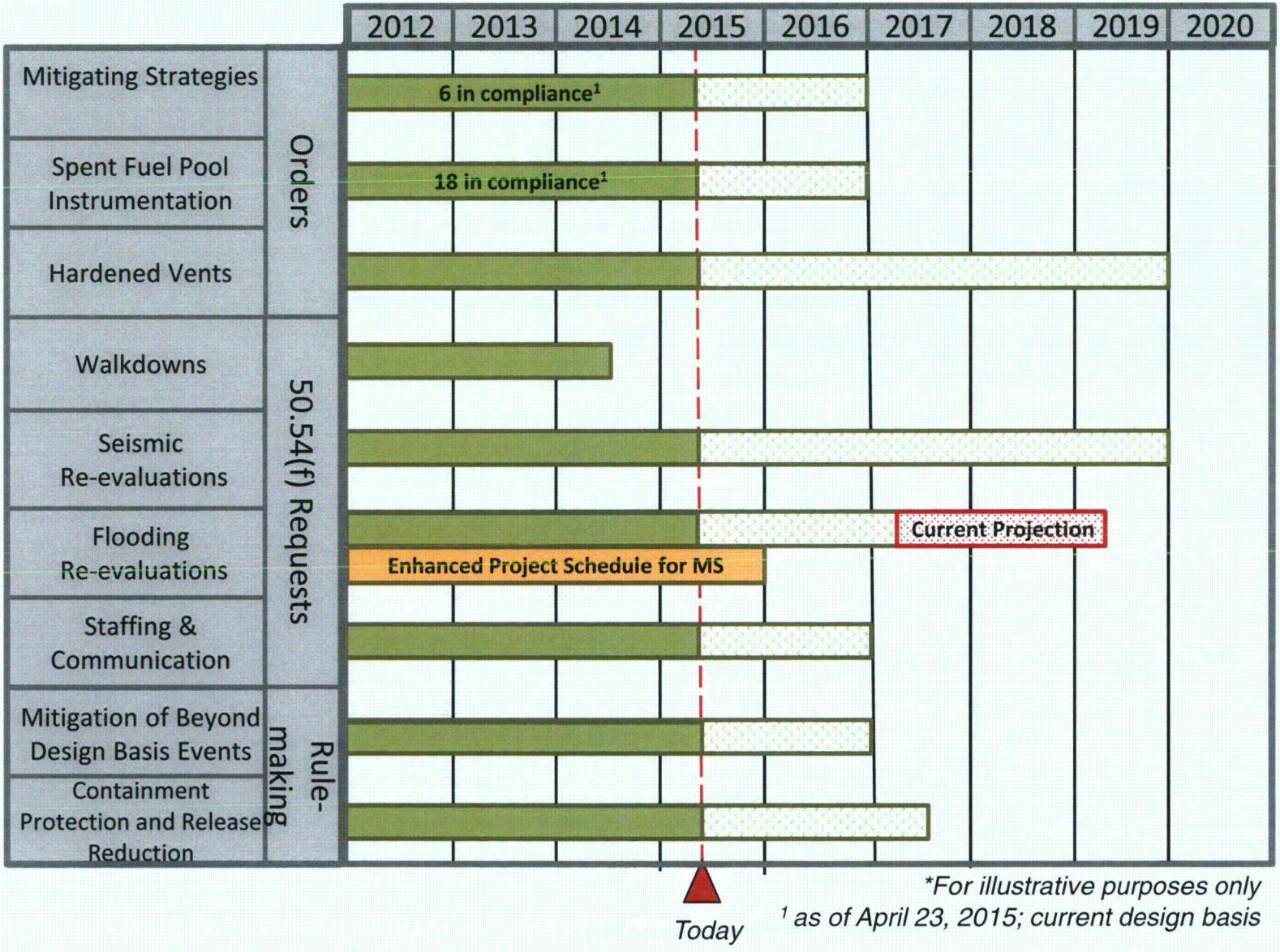
April 30, 2015

Speakers

- **William Dean, Director, Office of Nuclear Reactor Regulation**
  - **Overall Progress**
- **Jack Davis, Director, Japan Lessons-Learned Division**
  - **Orders, Rulemaking, and Tier 2/3 Activities**
- **Scott Flanders, Director, Division of Site and Environmental Analysis**
  - **Seismic and Flooding Hazard Reevaluations**
- **Ray Lorson, Director, Division of Reactor Safety, Region I**
  - **Regional Perspective**

Tier 1 Implementation*

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



*For illustrative purposes only

[1] *as of April 23, 2015; current design basis*

Substantial Safety Enhancements in Place

- Plants are coming into compliance with mitigating strategies & spent fuel pool instrumentation orders
- Seismic and flooding interim actions further enhance safety, where needed
- Other activities are in progress and nearly all are on schedule

Improved Efficiency for Recommendation 2.1 Flooding Activities

- Ensure licensees address the reevaluated flood hazard levels within mitigating strategies
- Assess the use of targeted strategies, if appropriate
- Modify Phase 1 guidance and develop Phase 2 guidance

Action Plan Being Prepared

- For Commission approval
- Goal is to focus reviews on areas with most potential safety benefit
- Plans will ensure mitigating strategies are protected from reevaluated hazards

Mitigating Strategies & Spent Fuel Pool Instrumentation Orders On Schedule

- Audits are being used to confirm licensee progress
- Progress towards compliance:
  - End of Spring 2015 outages: ~25%
  - End of 2015: >50%
- Safety benefit achieved by the end of 2016
  - Some modifications extend beyond

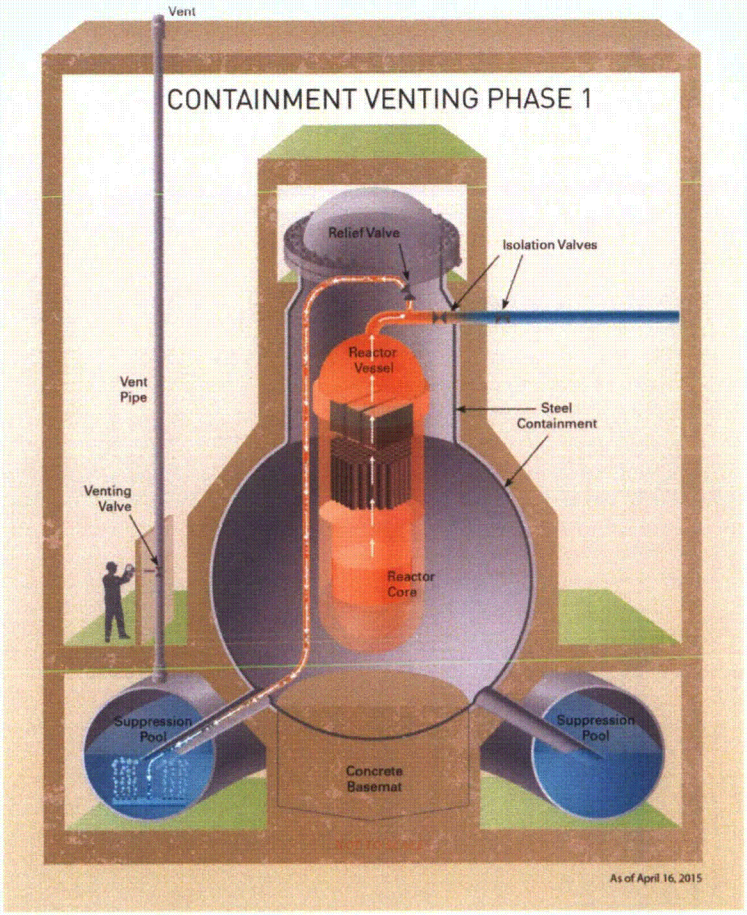
Next Steps on Mitigating Strategies & Spent Fuel Pool Instrumentation Orders

- Complete safety evaluations for Spring 2015 compliance sites
- Perform inspections at sites as compliance is achieved
- Further work to ensure that mitigating strategies can be implemented under reevaluated hazard conditions
- Development of an oversight program

Containment Vent Order On Schedule

- **Phase 1**

  (Wetwell Vent)
  - **Plans received from all licensees**
  - **Interim staff evaluations issued ahead of schedule**



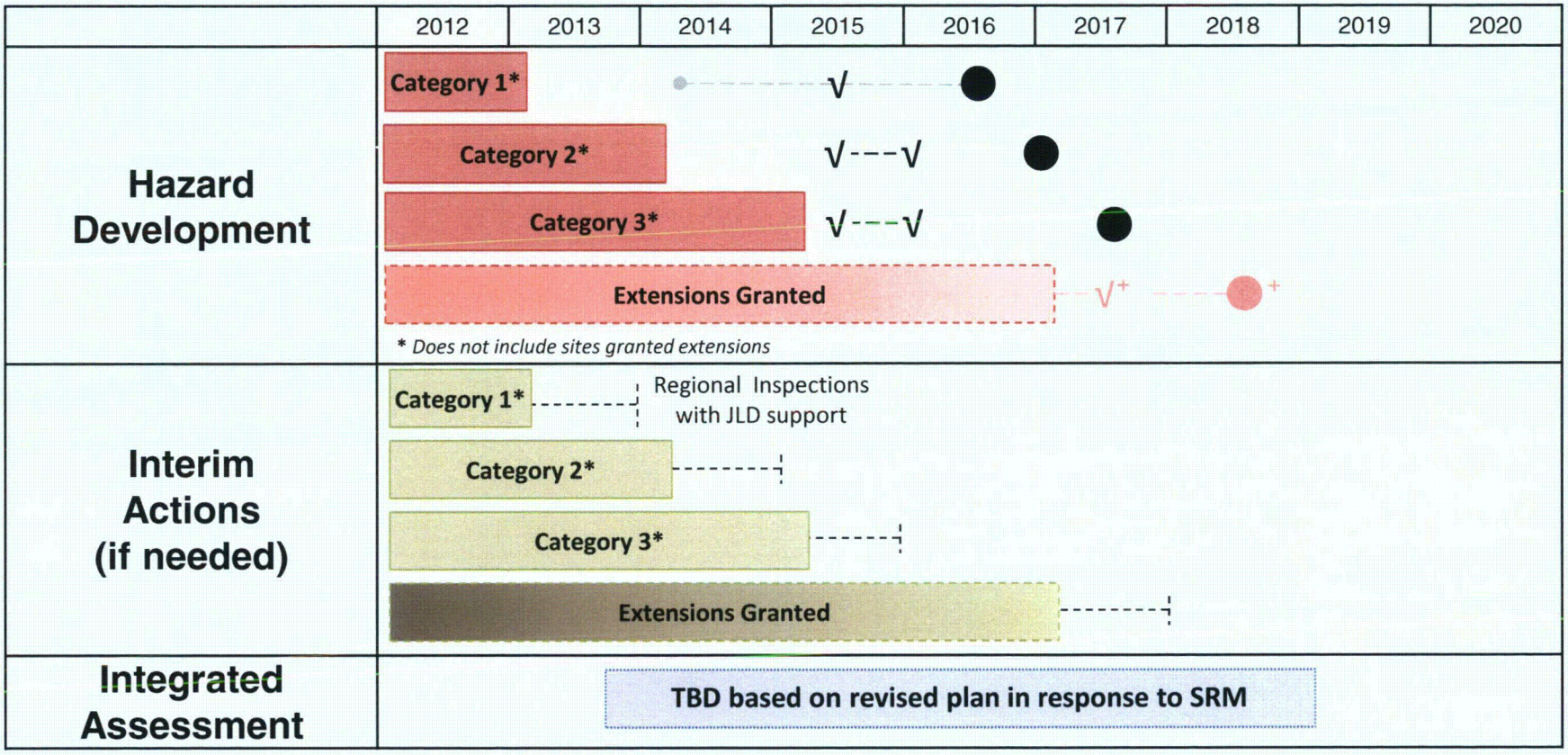
Next Steps on Containment Vent Order

- Phase 2 (Drywell Vent or Strategy)
  - Interim staff guidance to be issued imminently
- NRC to issue safety evaluations and perform inspections after Phases 1&2 are complete

Progress Continues on Flooding Hazard Reevaluations

- Category 1&2
  - Interim action reviews are complete
  - Ten staff assessments issued to date
- Category 3
  - Twenty reevaluated hazards and three extension requests received by March 12, 2015
  - Reviewing interim actions
- To support the Mitigating Strategies' timelines, staff is identifying alternative approaches to provide earlier feedback on reevaluated hazards

Schedule for Flood Hazard Reevaluation and Subsequent Actions



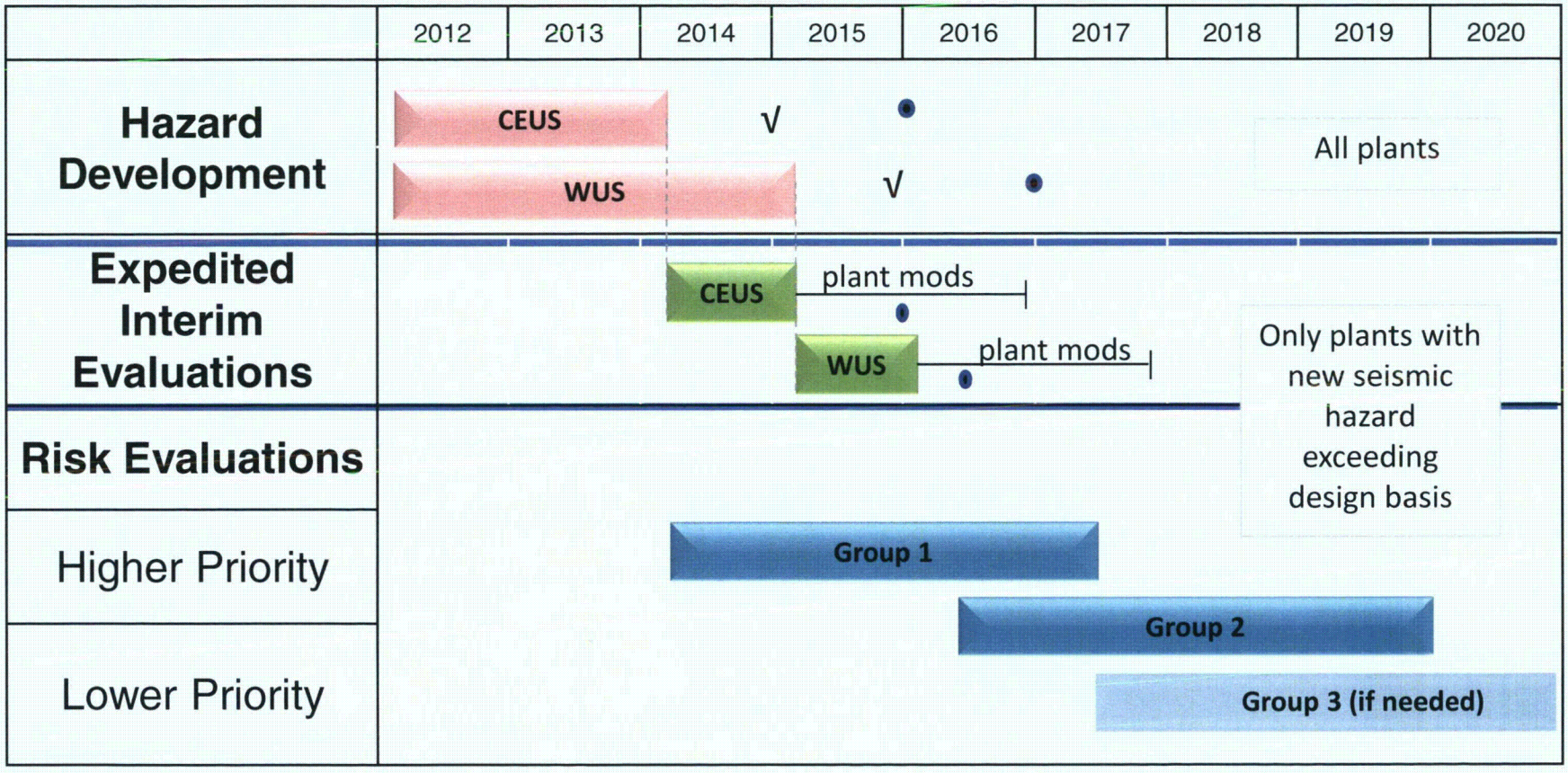
√ Staff acknowledges hazard to use for mitigating strategies (MS) ● Last Staff Assessment issued ● Staff Assessments issued

Schedule for Seismic Hazard and Risk Evaluations

Hazard Analyses
Expedited Interim Evaluations
Risk Evaluations

√ Staff acknowledgement to use GMRS for risk evaluation and MS

• Staff Assessment or response



Significant Progress on Seismic Hazard Reevaluations

CEUS

- Screening complete
- No immediate safety concerns
- GMRS review completed
- Hazard assessments ahead of schedule
- ESEP reports under review

WUS

- Screening letter by mid-May 2015
- No immediate safety concerns

Next Steps on Seismic Risk Evaluations

- Alternative approaches for high frequency and spent fuel pool evaluations
- Use of risk insights for relief from risk evaluations (SPRA) for certain sites
- SPRA template for Group 1 submittals Phase 2 decision criteria

Proposed Rule on Mitigation of Beyond-Design-Basis Events is Nearing Completion

- Codifies Order EA-12-049
- Reflects extensive interaction with stakeholders
- Incorporates lessons learned and addresses additional regulatory initiatives

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*

Progress on Containment Protection and Release Reduction Strategies

- Completed analyses and developing draft regulatory basis
- Analysis indicates that installation of filters is not justified
- Will issue draft regulatory basis for public comment
- Will schedule public meetings

Progress Made on Tiers 2&3

-	Expedited transfer of spent fuel to dry cask storage (complete)
7.2 – 7.5	Spent Fuel Pool Makeup Capability (subsumed in Tier 1)
9.1/9.2	Emergency preparedness (EP) enhancements for prolonged SBO and multiunit events (subsumed in Tier 1)
9.3	Emergency Preparedness (subsumed in Tier 1)
9.4	Improve ERDS capability (subsumed in Tier 1)
3	Enhanced capability to prevent /mitigate seismically induced fires & floods (in progress)
5.2	Reliable hardened vents for other containment designs (in progress)
6	Hydrogen control and mitigation inside containment or in other buildings (in progress)
10	Additional EP topics for prolonged SBO and multiunit events (in progress)
11	EP topics for decision-making, radiation monitoring, and public education (In progress)
12.1	Reactor Oversight Process modifications to reflect DID framework (in progress)
12.2	Staff training on severe accidents and resident inspector training on SAMGs (in progress)
-	Reactor and Containment Instrumentation (in progress)
-	Reevaluation of "Other" External Hazards (planned)
2.2	Periodic confirmation of seismic and flooding hazards (planned)
-	Revisit Emergency Planning Zone Size (planned)
-	Prestage potassium iodide beyond 10 miles (planned)

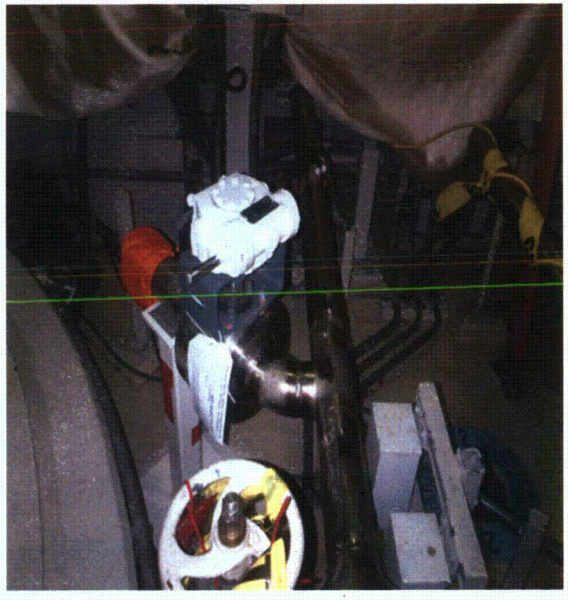
Completed | Subsumed in Tier 1 | In Progress | Planned

Staff is Reassessing Initial Project Plans

- Staff expects to identify recommendations to move forward ahead of schedule
- Staff will engage the Commission when appropriate
- Opportunity for stakeholder input moving forward

Strong Regional Support for Fukushima Lessons-Learned Activities

- **Essential part of agency response**
  - **Independently verify licensee actions to ensure safety**
  - **Communications with stakeholders**
- **Assist with audits and development of program guidance**
- **Continue to ensure operational safety as licensees implement NRC Orders related to Fukushima**



Ready to Inspect Implementation of NRC Orders

- Temporary Instruction (TI) 191 issued to provide inspection guidance for confirmation of NRC Orders
  - Mitigation strategies for beyond design basis events
  - Spent fuel pool instrumentation
  - Communications/staffing for large-scale events
- Inspector training on TI
- Pilot inspection conducted at Watts Bar in March 2015
  - Observed by all regions and NRR
- Assessment panel formed to ensure consistent treatment of inspection findings

Successful TI-191 Pilot Inspection

- Licensee was effective at implementing NRC Orders
- Some preliminary observations related to labelling and procedure adequacy
- Developed insights to improve the TI

Continued Collaboration with International Partners

- General consistency in lessons learned activities
- The NRC plays a leadership role in worldwide nuclear safety
- NRC benefits and learns from other countries

Conclusions

- Continuous focus on the safety and security of operating plants
- Steady progress towards on schedule completion
- Demonstrable improvement in safety as the lessons are implemented

Acronyms

CEUS	Central and Eastern United States	MS	Mitigating Strategies
CFR	Code of Federal Regulations	NEI	Nuclear Energy Institute
CPRR	Containment Protection and Release Reduction	SA	Staff Assessments
EA	Enforcement Action	SAMGs	Severe Accident Management Guidelines
EP	Emergency Preparedness	SBO	Station Blackout
ERDS	Emergency Response Data System	SFP	Spent Fuel Pool
ESEP	Expedited Seismic Evaluation Process	SFPI	Spent Fuel Pool Instrumentation
GMRS	Ground Motion Response Spectra	SPRA	Seismic Probabilistic Risk Assessment
HF	High Frequency	WUS	Western United States
MBDBE	Mitigation of Beyond Design Basis Events		