NRC Staff Preliminary Assessment of Natural Hazards other than Flooding and Seismic

April 5, 2016
## Agenda – Other Natural Hazards
(ADAMS Accession No. ML16039A054)

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>9:00 – 9:10</td>
<td>Introduction</td>
<td>NRC</td>
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<tr>
<td>9:10 – 9:30</td>
<td>Overview, including overview of 4 step process and results of step 1</td>
<td>NRC</td>
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<td>9:30 – 9:50</td>
<td><strong>Public Questions/Comments</strong>*</td>
<td>All</td>
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<tr>
<td>9:50 – 10:10</td>
<td>Overview of Staff’s assessment of low water conditions</td>
<td>NRC</td>
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<td>10:10 – 10:30</td>
<td><strong>Public Questions/Comments</strong>*</td>
<td>All</td>
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<td>10:30 – 10:40</td>
<td>Break</td>
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<td>10:40 – 10:55</td>
<td>Overview of Staff’s assessment of extreme ambient temps</td>
<td>NRC</td>
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<td>10:55 – 11:20</td>
<td><strong>Public Questions/Comments</strong>*</td>
<td>All</td>
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<tr>
<td>11:20 – 11:30</td>
<td>Overview of Staff’s assessment of snow loads</td>
<td>NRC</td>
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<td>11:30 – 12:00</td>
<td><strong>Public Questions/Comments</strong>*</td>
<td>All</td>
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<td>12:00 – 1:00</td>
<td>Break</td>
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<tr>
<td>1:00 – 1:30</td>
<td>Overview of Staff’s assessment of tornadoes and hurricanes</td>
<td>NRC</td>
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<td>1:30 – 2:00</td>
<td><strong>Public Questions/Comments</strong>*</td>
<td>All</td>
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<td>2:00 – 3:00</td>
<td>Time period for additional questions/comments and closing remarks</td>
<td>Public/All</td>
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* In addition to comments received at the meeting, comments can be submitted via email to JLD_Public.Resource@nrc.gov. Comments received by April 12, 2016 will be considered by the staff.
Fukushima Dai-ichi lessons learned developed and prioritized in a three-tiered approach (see SECY-11-0093 and SECY-11-0137)
Mitigation of Beyond-Design Basis Events Rulemaking

Note: FLEX refers to the industries term for mitigation strategy equipment.
Background

• Some Tier 2 and 3 activities subsumed by Tier 1 activities
• Resolution plan for remaining Tier 2 and 3 activities provided in SECY 15-0137, “Proposed Plans For Resolving Open Fukushima Tier 2 and 3 Recommendations”
• Advisory Committee on Reactor Safeguards (ACRS) provided a November 16, 2015, letter report with its assessment of NRC staff recommendations.
• SECY-15-0137 discussed in several public meetings including:
  – October 6, 2015: ACRS Subcommittee Meeting
  – October 20, 2015: Public meeting with industry’s Fukushima steering committee
  – November 5, 2015: ACRS Full Committee Meeting
  – November 17, 2015: Commission Meeting
SECY-15-0137 Resolution Groups

Group #1 – Can be closed now based on completed evaluations, progress made, and existing processes available to address future work.

Group #2 – Sufficient information available and staff’s initial technical assessment complete; closure approach would benefit from interactions with ACRS/external stakeholders; work to be completed by March 2016.

Group #3 – More detailed assessment and/or justification for resolution being prepared; ACRS/external stakeholder interactions would inform resolution of the recommendation; work to be completed in 2016.
SECY-15-0137 Proposed Resolution

• **Group 1** – Proposed to be Closed
  – NTTF Recommendation 3 – Seismically-Induced Fires and Floods
  – Additional Staff Recommendation – Basis of EPZ Size and Pre-Staging KI
  – NTTF Recommendation 12.1 – ROP Modifications to Reflect Defense-in-Depth Framework
  – NTTF Recommendation 12.2 – Staff Training on Severe Accidents and SAMGs
SECY-15-0137 Proposed Resolution

• **Group 2** – Additional Stakeholder Interactions Planned
  – NTTF Recommendation 5.2 – Vents for Containment Designs Other Than BWR Mark I and Mark II
  – NTTF Recommendation 6 – Hydrogen Control and Mitigation
  – ACRS Recommendation – Reactor and Containment Instrumentation Enhancements for Beyond-Design-Basis Events
SECY-15-0137 Proposed Resolution

• Group 3 – Further Assessment, Documentation, and Stakeholder Interaction Needed Before Closure
  – NTTF Recommendation 11.3 – Radiation Monitoring
  – ACRS Recommendation/Appropriations Act – Evaluation of Other Natural Hazards
  – NTTF Recommendation 2.2 – Periodic Reconfirmation of Natural Hazards
Background

• Commission decision on SECY-15-0137
  – Closed Group 1 items
  – Group 2 updated assessment to be provided end of March 2016
  – Other Natural Hazards interim status to be provided end of May 2016

• Purpose of Meeting is to Discuss Group 3 Recommendation Associated with Evaluation of Natural Hazards Other Than Seismic and Flooding

• Agenda
  – Staff will provide an overview of evaluation for a section of the paper
  – Questions and comments from stakeholders

• Next Steps for Other Natural Hazards Assessment
  – Address comments
  – ACRS Fukushima Subcommittee and Full Committee meetings in late April and early May 2016
  – Provide Updated Assessment to Commission by end of May 2016
  – Completed Assessment due to Commission by end of December 2016
Background

Evaluation of Possible Regulatory Actions

- NUREG/BR-0058
- 10 CFR 50.109 (Backfitting)
- Guidance from
  - Office of Management and Budget (OMB)
  - Government Accountability Office (GAO), and
  - Executive Orders

Statement of Problem and Objectives

Identification and Preliminary Analysis of Alternatives

Safety Goal Evaluation
  Safety Goal Screening Criteria Met?
    - NO
    - YES

Estimation and Evaluation Of Values and Impacts
  Values Exceed Impacts?
    - NO
    - YES

Presentation of Results

Decision Rationale

Implementation

Exception for Actions Needed for Reasonable Assurance of Adequate Protection of Public Health and Safety
Overview of 4 Step Process for Evaluation of Other Natural Hazards

Four Step Process

1) Define natural hazard other than seismic and flooding to determine those hazards that could pose a threat to nuclear power plants

2) Determine and apply screening criteria to exclude certain natural hazards from further generic evaluations, or exclude some licensees from considering certain hazards

3) Perform a technical evaluation to assess the need for additional actions if the hazard or licensee was not screened out generically in Task 2
   • Consider whether a request for information in accordance with 10 CFR 50.54 (f) is appropriate (approach taken for seismic and flooding)
   • Enough information at this stage to require action in accordance with 10 CFR 50.109 (backfit process)

4) Based on results of Task 3, determine if additional regulatory actions are needed
Preliminary Results of Step 1 Assessment

- Hazards identified for consideration found in Appendix A of white paper
- Man-made hazards excluded from further consideration
- Natural hazards listed in Appendix A Table A-1
- Natural Hazards excluded from further consideration (basis provided in Appendix A) include:

<table>
<thead>
<tr>
<th>Animals</th>
<th>Avalanche</th>
<th>Biological Events, coastal erosion, ice barrier, ice cover, biological plugging of intakes</th>
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</thead>
<tbody>
<tr>
<td>Corrosion</td>
<td>External flooding*</td>
<td>Extreme air pressure</td>
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<td>Fog/mist, frost, hail, landslide</td>
<td>Dust storms, forest fire, grass fire, ice storm/freezing rain, sleet, lightening, sandstorms, salt storm</td>
<td>Land rise, sink holes, soil shrink-swell, underwater landslide (impact on soil, that is not a tsunami)</td>
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<tr>
<td>Meteorite</td>
<td>Seismic activity*</td>
<td>Geomagnetic storms**</td>
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<tr>
<td>Waterspout</td>
<td>Volcanic activity**</td>
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*Seismic and Flooding being evaluated in accordance with Recommendation 2.1
** Additional discussion regarding geomagnetic storms and volcanic activity on next slide
Preliminary Results of Step 1 Assessment

• Natural Hazards reviewed in accordance with Step 1 (continued)
  – Volcanic Activity
    • References work performed in accordance with 10 CFR 2.206 petition
    • Based on previous evaluations that concluded volcanic activity is hazard that should be considered, but only at the Trojan and Columbia sites. All other nuclear plant sites are too far away from active U.S. volcanos to have to consider this threat
    • Columbia evaluation of volcanic activity found in Updated Safety Analysis Report
    • Response to Mitigation strategies order addresses volcanic activity and notes that structure housing phase 2 equipment to withstand loads placed on the structure from volcanic ash
Preliminary Results of Step 1 Assessment

• Natural Hazards reviewed in accordance with Step 1 (continued)
  – Geomagnetic storms
    • Being evaluated as part of Tier 1 activity under mitigation of beyond-design-basis event rulemaking
    • Petition for rulemaking (PRM) 50-96 referenced in MBDBE proposed rule
    • NRC staff has received comments on geomagnetic storms in response to MBDBE rule and is currently assessing these comments
    • Because Geomagnetic storms are being evaluated as Part of a Tier 1 activity and Commission will be informed of results of staff review as part of this activity, geomagnetic storms are proposed to be closed as part of Step 1 of the Tier 2 activity
Preliminary Results of Step 1 Assessment

• Natural Hazards reviewed in accordance with Step 1 (continued)
  – Hazards proposed to proceed to Step 2 of the process
    • Wind and missile loads from tornadoes and hurricanes
    • Snow and ice loads for roof designs
    • Drought and other low water conditions
    • Extreme temperatures
Public Comments or Questions on Overview and Step 1 of the Process
Preliminary Results of Step 2 Assessment

• Wind and missile loads from hurricanes and tornadoes and snow loads move to Step 3 of the process

• Drought and other low water conditions and extreme temperatures evaluated as part of Step 2
Preliminary Assessment of Low Water Conditions

• Three low water conditions evaluated
  – Drought
  – Low water conditions due to downstream dam failure
  – Low water conditions due to a seiche
• Criteria applied include
  – Conservatism of design
  – Operational limits
  – Warning time
• Drought
  – Warning time that would allow licensees to take appropriate actions
Preliminary Assessment of Low Water Conditions

- Low water conditions due to downstream dam failure
  - Process for review outlined in March 11, 2016, pregeneric issue (ADAMS Accession No. ML152553A365)
Preliminary Assessment of Low Water Conditions

• Low water conditions due to downstream dam failure
  – Pre-generic issue March 11, 2016, letter hi-level assessment
  • Licensees addressing non-seismically qualified dam failures as part of mitigating strategies order
  • Risk assessment performed for seismically qualified downstream dams
    – Majority of sites screen out for generic issue based on risk (with the exception of Robinson)
    – Robinson evaluated separately
      – Based on capabilities of deepwell pumps and further seismic evaluation of dam as part of Recommendation 2.1 being performed staff determined additional regulatory actions for Robinson not warranted
  – Preliminary Conclusion
    • Additional regulatory action to address downstream dam failures not warranted
Preliminary Assessment of Low Water Conditions

- Low water conditions due to a seiche
  - March 18, 2015, NRC Region III letter identified possible generic issues regarding seiches (ADAMS Accession No. ML15078A284)
    - Concern is storm surge can cause low level conditions that results in damage to safety related ultimate heat sink pumps
    - Hi-level storm surges evaluated as part of Recommendation 2.1 flooding
    - Plants along the Great Lakes and Chesapeake Bay evaluated
  - Staff evaluation of sites that could be impacted
    - Majority of sites have at least a 24 hour water supply to provide decay heat removal capabilities
    - Units that do not have 24 hour water supply are either considered not as susceptible to low water conditions from a seiche because of their design, or because of other nearby alternate water supplies
  - Preliminary Conclusion
    - Additional regulatory action to address seiche not warranted
Public Comments or Questions on Overview of Low Water Conditions Assessment
Preliminary Assessment of Extreme Temperatures

- Extreme Temperature Assessment considered high and low extreme temperatures
  - Extreme high-temperature
    - Evaluation considered technical specification requirements
      - Example technical specifications includes ultimate heat sink, containment air temperature and control room emergency air temperature
    - If air temperatures outside of design basis temperature are expected, licensees are expected to take actions
- Subject to NRC inspection
- Mitigation strategies equipment consider potential impacts of high temperature (both procurement and operation (e.g., consideration of expansion of sheet metal))
Preliminary Assessment of Extreme Temperatures (continued)

– Extreme low-temperature
  • If air temperatures outside of design basis temperature are expected, licensees are expected to take actions
  • Information notices associated with cold temperatures
    – IN 96-06 on degradation of cooling water systems due to icing
    – IN 98-02 on cold weather protective measures
  • Subject to NRC inspection
  • Mitigation strategies equipment consider potential impacts of low temperature (both procurement and operation (e.g., consideration of ice blockage and frazil ice))

• Preliminary Conclusion
  – Additional regulatory action to address extreme temperature not warranted
Public Comments or Questions on Overview of Extreme Temperature Assessment
Preliminary Results of Step 3 Assessment

- Wind and missile loads from hurricanes and tornadoes and snow loads move to Step 3 of the process
- Staff identifies issues
  - New guidance provided in both areas after current operating fleet began operation
  - Preliminary assessment includes a discussion of the issue and staff’s preliminary process for evaluating issues
  - Staff to provide complete assessment to the Commission by end of December 2016
Preliminary Results of Step 3 Assessment

• Snow loads
  – DC/COL Interim Staff Guidance 007, “Assessment of Normal and Extreme Winter Precipitation Loads on Roofs of Seismic Category I Structures,” issued July 1, 2009, provides guidance for:
    • Calculating 100 year snow loads
    • Calculating extreme snow loads
      – Combination of 100 year snow load and 48 hour probable maximum precipitation event
Preliminary Results of Step 3 Assessment

- Snow loads (continued)
  - Preliminary Assessment
    - DC/COL ISG-007 guidance consistent with 1975 version of the SRP and branch technical position
    - 100 year snow load typically bound by plant design or structural margin associated with design
    - When extreme snow loads are evaluated against structural margin, staff’s preliminary assessment is that a beyond-design-basis snow load is not likely to cause a catastrophic failure of a seismic Category I roof that leads to core damage
  - As part of Task 3 the staff will continue to assess design conservatism and warning time (including actions licensees take in the event of an extreme snow event) to determine if additional regulatory actions are warranted
Public Comments or Questions on Overview Snow Load Assessment
Preliminary Results of Step 3 Assessment

• Wind and missile loads from hurricanes and tornadoes
  – New guidance documents recently issued
    • Regulatory Guide 1.76 Revision 1 on design-basis tornadoes and tornado missiles issued in March 2007
    • Regulatory Guide 1.221 on design-basis hurricanes and hurricane missiles issued in October 2011
  – RG 1.76 Rev 1 tornado wind speeds generally went down
    • Different missile spectrum from 1975 version of standard review plan
    • Automobile missile speeds for same weight automobile went up in some areas
Preliminary Results of Step 3 Assessment

• Wind and missile loads from hurricanes and tornadoes (continued)
  – RG 1.221 hurricane
    • Hurricane wind speeds generally bound by tornado wind speeds for a given site
    • Hurricane missile speeds higher than comparable tornado for sites susceptible to hurricanes
      – Hurricane-generated missile has longer time in hurricane wind field than tornado wind field
  – Staff assessment consists of:
    • Evaluation of Pre-General Design Criteria Plants
    • Plants evaluated against 1975 version of the standard review plan
Preliminary Results of Step 3 Assessment

• Wind and missile loads from hurricanes and tornadoes (continued)
  – Insights from RIS 2015-06 and Enforcement Guidance Memorandum (EGM) 15-002
    • Tornado missile protection design basis requirements are conservative
    • Staff using existing processes to ensure licensees continue to meet requirements in this area
    • EGM 15-02 provides a basis for enforcement discretion noting that tornado missile scenarios that lead to core damage are very low probability events
Preliminary Results of Step 3 Assessment

- Wind and missile loads from hurricanes and tornadoes (continued)
  - New wind load guidance generally bound by current plants design basis
Preliminary Results of Step 3 Assessment

• Wind and missile loads from hurricanes and tornadoes (continued)
  – Hurricane and Tornado missile spectrum chosen to:
    • Assess design of safety related structures to provide protection against a missile damaging equipment internal to the structure (missile’s penetration capability)
    • Assess design of safety related structures to withstand impact loads (automobile missile)
    • Assess design of safety related structures to protect against small wind-born missiles
  – Ability of wind-born missiles to penetrate concrete
    • Majority of sites have design basis missile characteristics that bound missile characteristics found in latest regulatory guidance
  – Impact loads
    • Automobile missile’s in current guidance higher than that found in current plant updated safety analysis reports
Preliminary Results of Step 3 Assessment

• Wind and missile loads from hurricanes and tornadoes (continued)
  – Staff Assessment continuing as part of Task 3
    • Consider insights gained from past IPEEEs and current high wind studies
    • Gain further understanding of licensees anticipatory actions in preparation for approaching hurricanes
    • Updated assessment to be completed by December 2016
Public Comments or Questions on Overview Hurricane and Tornado Assessment
Public Comments or Questions on White Paper on Evaluation of Natural Hazards other than Seismic and Flooding
Next Steps

• NRC Staff will assess comments received during the meeting

• Additional comments can be provided via email to JLD_Public.Resource@nrc.gov
  – Comments received by April 12, 2016, will be considered

• Staff contacts for additional information:
  – Joe Sebrosky, joseph.sebrosky@nrc.gov, 301-415-1132
  – William Reckley, william.reckley@nrc.gov, 301-415-7490

• Additional milestones
  – ACRS Fukushima Subcommittee and Full Committee meetings in late April and early May 2016
  – Provide Updated Assessment to Commission by end of May 2016
  – Completed Assessment due to Commission by end of December 2016
Acronyms
(Alphabetical)

- ACRS – Advisory Committee on Reactor Safeguards
- ADAMS – Agencywide Document Access and Management System
- BWR – Boiling Water Reactor
- CFR – Code of Federal Regulations
- COL – Combined License
- DC – Design Certification
- EGM – Enforcement Guidance Memorandum
- EPZ – Emergency Planning Zone
- FLEX – diverse and flexible coping capability
- IN – Information Notice
- IPEEE– Individual Plant Examination of External Events
- JLD – Japan Lessons Learned Division
- KI – Potassium Iodide
- MBDBE – Mitigation of Beyond-Design-Basis Events
- NPP – Nuclear Power Plant
- NRC – Nuclear Regulatory Commission
- NTTF – Near-Term Task Force
- NUREG/BR – NRC technical report printed in a brochure
- RG – Regulatory Guide
- RIS – Regulatory Issue Summary
- SAMGs – Severe Accident Management Guidelines
- SECY – Office of the Secretary of the Commission
- SRP – Standard Review Plan