



# Generic Licensing Topics and Policy Issues for SMRs

Legacy Meeting Centre  
February 2, 2012

<Presentation Name>

- **Bullet 1**
  - 1<sup>st</sup> Indent
    - 2<sup>nd</sup> Indent
- **Bullet 2**
- **Bullet 3....**



# Environmental Alternatives

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## Environmental Alternatives

### **40 CFR 1502.14**

- Alternatives Including the Proposed Action - This section is the heart of the environmental impact statement. Based on the information and analysis presented in the sections on the Affected Environment (Sec. 1502.15) and the Environmental Consequences (Sec. 1502.16), it should present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public.

## **Applicable NRC Regulations**

- NRC's regulations which address alternatives analyses are in 10 CFR Part 51
- 10 CFR 51.45 and 10 CFR 51.50 address alternatives in the Environmental Report
- 10 CFR 51.71 addresses alternatives analysis in the Draft EIS
- 10 CFR 51.93 addresses alternatives analysis in the Final EIS

# Environmental Alternatives

## **Reg Guide 4.2**

- Chapters 9 and 10 discuss what needs to be in the ER in terms of alternate sites, energy sources, and system designs

## Standard Review Guidance

- NUREG-1555, Environmental Standard Review Plan (ESRP) directs the staff's analysis and evaluation of alternatives
- Chapter 9, Alternatives to the Proposed Action, has been recently updated and will be used by the staff in the review of an applications for construction and operations of SMRs

## **Purpose and Need Relationship to Alternatives**

- The purpose and need statement for the EIS defines the range of reasonable alternatives
- Reasonable alternatives:
  - Support the purpose and need statement
  - Within scope of the proposed action
  - Implementable
  - Technically feasible



## **Alternatives to be Analyzed**

- Proposed Action
- No Action Alternative
- Alternative sites
- Energy Alternatives
- System Design Alternatives

## Alternative Sites

- Staff looking to see if the ER defines the rationale used to identify the alternative sites
- Use reconnaissance level information
- Determination of “obviously superior”

## **Alternative Sites (con't)**

- Process must be logical and consistent
- Must align with purpose and need
- First focus is on environmental issues

## **Revised Chapter 9.3 from NUREG-1555**

The scope of the review directed by this plan should include the analysis and evaluation of the applicant's process and results related to the selection of the region of interest, candidate areas, potential sites, candidate sites, and the selection of the proposed site, and a reasonable number of alternative sites from among the candidate sites.



Questions?



# Applicability and Implementation Of Fukushima Lessons Learned

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## NTTF – New Reactors

### SECY-11-0093, “Near-term Report and Recommendations for Agency Actions Following the Events in Japan” – July 12, 2011

- Task Force has considered the applicability and implementation of its recommendations for new reactors, including certified designs, designs in the certification process, certified designs applying for renewal, early site permits, and applications for operating licenses and COLs. ...
- Recommendation 8 for the integration of EOPs, SAMGs, and EDMGs and for controlling accident decisionmaking under technical specifications would be applicable to COLs. ...
- Task Force concludes that all of the current early site permits already meet the requirements of detailed recommendation 2.1, relating to the design-basis seismic and flooding analysis, and all of the current COL and design certification applicants are addressing them adequately ...
- The Task Force concludes that Recommendation 4, with new requirements for prolonged SBO mitigation, and Recommendation 7, about spent fuel pool makeup capability and instrumentation, should apply to all design certifications or to COL applicants if the recommended requirements are not addressed in the referenced certified design. The Task Force recommends that design certifications and COLs under active staff review address this recommendation before licensing.
- The Task Force recommends the SBO additions on the basis of adequate protection, the NRC should impose them as new requirements in accordance with 10 CFR 52.59(b)(1) ...
- The recommendations related to expanding 10 CFR 50.54(hh) and the EP requirements to fully address multiunit accidents and SBO conditions should apply to COL applicants. Near-term COLs could implement these recommendations through ITAAC.

# Prioritization

SECY-11-0137, “Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned” – October 3, 2011

- For **new reactor** designs currently under review, safety issues should be resolved at the design stage, to the extent practical.
- Consistent with the Commission policy encouraging standardization, it would be prudent to implement safety enhancements prior to certification or design certification renewal. As such, the staff intends to begin interactions with new reactor stakeholders in the near term to allow sufficient opportunity for design certification applicants and design certification renewal applicants to address recommended design-related safety enhancements prior to completion of the staff’s review.
- **The staff will encourage reactor vendors to provide enhanced safety features and safety margins consistent with the Commission policy on advanced reactors ...**





# Stakeholder Interactions (partial)

## NRC Staff

- Public meetings – December 2011
- Industry/NRC Joint Steering Committee meeting – 01/13/12
- Recommendation-specific public meetings – 01/17-19/12
- Steering Committee Meeting – 01/20/12
- SECY-12-XXXX – orders and 50.54(f) letters – [Feb xx, 2012]

## Industry

- INPO initiative
- Diverse & Flexible Coping Capability (FLEX) – 12/16/11, revisions
- On-going interactions with NRC staff
- NEI White Papers (Tier 1 topics)
- Feedback regarding orders and 50.54(f) letters



# Enhanced Tier 1 Recommendations (January 13, 2012 – Public Meeting)

## 2.1 – Seismic and flooding reevaluation 50.54(f) letters

- Expanded by Appropriations Bill and ACRS recommendations to include “other external hazards”

## 2.3 – Seismic and flooding walkdown 50.54 (f) letters

- Expanded by Appropriations Bill and ACRS recommendations to include “other external hazards”

## 4.1 – Station blackout rulemaking

- Enhanced by SRM-SECY-11-0124 and ACRS recommendations to include an ANPR

## 4.2 – Mitigating strategies for beyond design basis events Order

- Informed by Industry’s FLEX paper, loss of ultimate heat sink additional issue, and ACRS recommendations

## 5.1 – Reliable hardened vent Order for Mark I and II containments

- Expanded by SRM-SECY-11-0137 to include consideration of filters

## 7.1 – Spent fuel pool instrumentation Order

- Enhanced by ACRS recommendations

## 8.0 – Integration of emergency procedures rulemaking

## 9.3 – Enhanced EP staffing and communications 50.54(f) letter

## New / Advanced Reactors

For each design, address:

- Enhanced Tier 1 Recommendations
  - Consider regulatory approach / resolution for operating plants
  - Rule – compliance
  - Guidance – application may be challenge for some designs
- Tier 2 Recommendations (SECY-11-0137)
  - 7.2, 7.3, 7.4, and 7.5 – SFP makeup capability
  - 9.3 – Emergency preparedness (remaining 9.3 items with exception of ERDS)



## NRO Approach

- Design Certifications and COL Applications Under Active Review
  - Design certification applicants should address recommended design-related safety enhancements prior to completion of the staff's review [SECY-11-0137]
  - Reactor vendors are encouraged to provide enhanced safety features and safety margins consistent with the Commission policy on advanced reactors [SECY-11-0137]
- New and advanced DC or license applications not yet submitted
  - Expect applicants to address Commission-approved Fukushima requirements in applications, prior to submittal, to fullest extent practicable

## Bibliography (partial)

- SECY-11-0093, “Near-term Report and Recommendations for Agency Actions Following the Events in Japan” – July 12, 2011
- SECY-11-0117, “Proposed Charter for the Longer-Term Review of Lessons Learned from the March 11, 2011, Japanese Earthquake and Tsunami”
- SECY-11-0124, “Recommended Actions to be Taken without Delay from the Near-Term Task Force Report”
- SECY-11-0137, “Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned” – October 3, 2011
- SECY-12-XXXX, “Proposed Initial Orders and Requests for Information Pursuant to 10 CFR 50.54(f) In Response to Lessons Learned from the March 11, 2011, Japanese Earthquake and Tsunami”
- <http://www.nrc.gov/japan/japan-meeting-briefing.html>



# Initiative for the Licensing Review of Instrumentation and Controls (I&C) for the mPower Small Modular Reactor Design

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## Objective

- Present plans for changes to Chapter 7 of the mPower Design-Specific Review Standard (DSRS)

## Expected Outcome

- Achieve early cognizance and understanding of the initiative's background, objectives, key areas, challenges, status, and path forward

# Agenda

- Background
- Lessons Learned
- Goals and Framework
- Challenges
- Status and Schedule
- Summary



## Background

- Licensing reviews of I&C have been a significant challenge from the perspective of both safety demonstration and schedule/resources for all design centers for new large light water reactors.
- NUREG-0800, Standard Review Plan , Chapter 7 is a primary staff guidance, and the staff's use of the current Revision (issued 2007) has been adequate; however, more improved technical/regulatory review can be achieved if lessons learned are applied in a timely manner.

## Background

- The Office of New Reactors Division of Advanced Reactors and Rulemaking has begun to develop the DSRS, i.e., design-specific SRP, for individual advanced reactor designs beginning with mPower.
- The staff has identified that the DSRS development and the timing of the projected licensing applications provide a great opportunity to incorporate the broad set of I&C lessons learned in addition to the generic improvements envisioned by the Division of Advanced Reactors and Rulemaking.
- The staff has initiated this innovative approach for Chapter 7 to customize the staff guidance for mPower (and beyond) so that a more effective (e.g., safety focus) and efficient (e.g., reduced questions) can be achieved.

## Key Lessons Learned #1

The structure of the current Chapter 7 SRP uses a system-based structure (e.g., Reactor Protection System, Interlock Systems, and Data Communication Systems). However, new and advanced reactor I&C designs are highly integrated and platform-based.

**Key Challenge:** Repetitions of same requirements and issues in each subsection have caused unnecessary duplication of review effort and in any one section, an incomplete safety finding without reviewing all other applicable sections.

## Key Lessons Learned #2

The current Chapter 7 SRP contains requirements and guidance that are not applicable to new and advanced reactors.

**Key Challenge:** It has caused distractions and unnecessary burden to the staff and the applicants (e.g., document and confirm that the requirements and guidance are in fact not applicable).

## Key Lessons Learned #3

In the current SRP Chapter 7, which is detailed and voluminous, the safety/risk-significant requirements and guidance for design are scattered, repeated, and mixed with programmatic and process requirements.

**Key Challenge:** The staff's licensing reviews have been lengthened and made more difficult. For example, the staff's focus on the most important aspects of the design has often been distracted by having had to untangle the shortcomings and to address all aspects listed in staff guidance including issues of low significance or areas that are programmatic/process-driven in nature.

## Key Lessons Learned #4

The current staff guidance is not structured to the design's clear demonstration of the fundamental principles of a good I&C system design such as redundancy, independence, deterministic behavior, and diversity as well as simplicity.

**Key Challenge:** It has posed additional work and licensing review challenges to the staff and the applicants as changes to the licensing documents, requests for additional information, additional interactions were needed to address the principles through the various phases of the licensing process including interactions with the ACRS.

## Key Lessons Learned #5

The intent and application of Design Acceptance Criteria (DAC) and Inspections, Tests, Analyses and Acceptance Criteria (ITAAC) for digital I&C are not well understood across all stakeholders.

Key Challenge: It has caused significant staff and applicant efforts to reach an adequate resolution regarding the use of DAC causing lengthened licensing reviews and distractions from important safety issues. The proposed DAC/ITAAC language did not often meet the intent causing iterative interactions with the applicants.

## Key Lessons Learned #6

The current Chapter 7 SRP lacks clarity on the relationship between licensing and verification (i.e., inspection), especially with respect to the level of detail in licensing.

**Key Challenge:** It has led to inefficiency and ineffectiveness in staff reviews as time and licensing resources are expended on activities better suited for inspection/verification.



## Goals

- Improve the safety focus of the staff reviews by ensuring an applicant has sufficient licensing-basis detail presented in their licensing application to clearly demonstrate that the applicable regulations are met and the key design principles are addressed.
- Improve the efficiency of reviews by eliminating unnecessary information from being docketed and reviewed, and by improving guidance to avoid unnecessary RAIs.

## Framework

- Restructuring the existing guidance
- Developing integrated hazards analysis approach
- Defining scope and level of detail of the information to support licensing finding
- Leveraging third-party assessment of safety-system software development processes

## Restructured Guidance

- Fundamental framework (redundancy, independence, diversity, determinism, and simplicity)
- Integration of lessons learned
- Structured coverage of applicable regulations
  - one issue, one review, one place
- Better understanding by all stakeholders on the use of DAC/ITAAC and the level of detail required in licensing basis

## Restructured Guidance

- Deletion of non-applicable regulations and guidance
- Restructuring (integrated/platform-based versus system-based)
- Evaluation and incorporation of the ORNL-completed work
- Additional guidance on new areas (e.g., interlocks)
- Incorporation of Multinational Design Evaluation Program generic common positions

## User need request from NRO to RES

- Develop technical basis to evaluate digital I&C hazard analysis
  - Support identification of issues early in project
  - Integrate key considerations, e.g.,
    - Redundancy
    - Independence
    - Defense in depth and diversity
    - Determinism
    - Simplicity
- Suggest how to integrate in the DSRS

## Licensing Versus Inspection

- Common understanding between the staff and licensee on the scope and level of detail needed to reach reasonable assurance of safety findings and the information that needs to be part of an applicant's licensing basis.
- Necessary DAC and ITAAC description language and corresponding mapping to licensing basis, including traceability to high-level safety principles.
- Verification of implementation of the licensing basis and safety findings through inspection.

## Leveraging Third-Party Assessment

- Opportunity to leverage mPower I&C vendor experience with the use of Capability Maturity Model Integration (CMMI) framework for other mission critical/safety critical applications.
- Enabling of NRC staff to better focus licensing reviews on safety/risk significant areas and establishment of required processes as opposed to ensuring a vendor has the capability to follow their committed processes (an inspection function).

## Leveraging Third-Party Assessment

- CMMI is a process improvement framework not the process itself. It complements some of the existing development processes by providing best practices but in some areas this is not sufficient. Therefore, the staff needs to ensure there is sufficient information in the licensing basis as well as any applicable ITAAC to support a licensing/safety finding.
- Based on the success of this initiative, the NRC staff will explore other third-party frameworks and how to integrate third-party certifications into the licensing reviews.



## Challenges

- Collaboration with applicant
- Workload/schedule
- Necessary level of integration among framework areas
- Developing the framework in such a way that it could be applied to other small, advanced and existing reactors

## Status and Schedule

- Continued interactions with B&W, vendors, and stakeholders
- November 2012 to have the DSRS in place for public comment
- Support from RES/engagement with NRR for consistency
- Evaluation and incorporation of ORNL input to DSRS
- Incorporation of other lessons learned
- Consideration of MDEP Digital I&C generic common positions

## Summary

- Licensing review of I&C has been a significant challenge from the perspective of both safety demonstration and schedule/resources for all design centers for new large light water reactors.
- The staff has started efforts to address the lessons learned for increased effectiveness and efficiency.
- This initiative is multi-faceted and challenging but is an opportunity not to be missed.
- It is ongoing working closely with internal and external stakeholders.

# Current SRP, Chapter 7: System-based Approach

	7.2 - Reactor Trip System	7.3 - Engineered Safety Features Systems	...	7.9 - Data Communication Systems
Regulations	50.34(f)(2) 50.55a(a)(1) 50.55a(h)(1) 50.62 52.47(b)(1) 52.80(a) GDC 1 GDC 2 GDC 4 GDC 10 GDC 13 GDC 15 GDC 19 GDC 20 GDC 21 GDC 22 GDC 23 GDC 24 GDC 25 GDC 29 IEEE 603-1991	50.34(f)(2) 50.55a(a)(1) 50.55a(h)(1) 52.47(b)(1) 52.80(a) GDC 1      GDC 2 GDC 4      GDC 10 GDC 13     GDC 15 GDC 16     GDC 19 GDC 20     GDC 21 GDC 22     GDC 23 GDC 24     GDC 29 GDC 33     GDC 34 GDC 35     GDC 38 GDC 41     GDC 44 IEEE 603-1991	...	50.34(f)(2) 50.55a(a)(1) 50.55a(h)(1) 50.62 52.47(b)(1) 52.80(a) GDC 1 GDC 2 GDC 4 GDC 13 GDC 19 GDC 21 GDC 22 GDC 23 GDC 24 GDC 29 IEEE 603-1991

# Current SRP, Chapter 7: System-based Approach

	7.2 - Reactor Trip System	7.3 - Engineered Safety Features Systems	...	7.9 - Data Communication Systems
Areas of Review	<ul style="list-style-type: none"> <li>• Design basis</li> <li>• Diversity and Defense-in-Depth</li> <li>• Independence</li> <li>• ITAAC</li> <li>• Quality assurance</li> <li>• Single-failure criterion</li> <li>• Setpoint determination</li> <li>• System testing and surveillance</li> <li>• Use of digital systems</li> </ul>	<ul style="list-style-type: none"> <li>• Design basis</li> <li>• Diversity and Defense-in-Depth</li> <li>• ESF control systems</li> <li>• Independence</li> <li>• ITAAC</li> <li>• Quality assurance</li> <li>• Setpoint determination</li> <li>• Single-failure criterion</li> <li>• System testing and surveillance</li> <li>• Use of digital systems</li> </ul>	...	<ul style="list-style-type: none"> <li>• Control of access</li> <li>• Diversity and Defense-in-Depth</li> <li>• EMI/RFI susceptibility</li> <li>• ITAAC</li> <li>• Independence</li> <li>• Performance</li> <li>• Quality assurance</li> <li>• Reliability</li> <li>• Single-failure criterion</li> <li>• System testing and surveillance</li> <li>• Use of digital systems</li> </ul>