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Licensing Framework for Advanced Reactors DOE-NRC Joint Initiative

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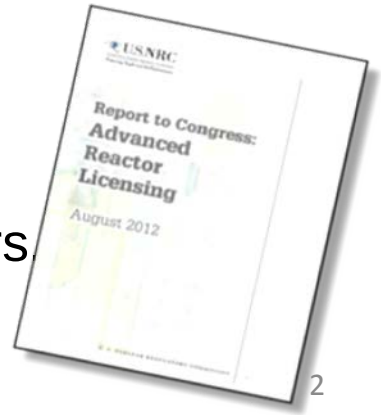
USNRC

Workshop on Molten Salt Reactor Technologies October 2015

Need for a Licensing Framework for Advanced Reactors

- During 2012 DOE instituted an Advanced Reactor Concepts Technical Review Panel (TRP) process to evaluate viable reactor concepts from industry and to identify R&D needs.
  - TRP members and reactor designers noted the need for a regulatory framework for non-light water advanced reactors.

- Also in 2012, in response to Congressional direction, the NRC provided a report to Congress on advanced reactors.
  - The NRC report assessed the licensing framework applicability and research needs for advanced reactors.



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Licensing Framework Initiative

- NRC Regulations Title 10, Code of Federal Regulations Part 50 (10 CFR 50) requires applicants to establish principal design criteria (PDC) derived from the General Design Criteria (GDC) of 10 CFR 50 Appendix A.

- Since the GDC in Appendix A are specific to light water reactors (LWRs), this requirement is especially challenging for potential future licensing applicants pursuing advanced (non-light water) reactor technologies and designs.

- DOE-NE and NRC representatives agreed in June 2013 to pursue a joint initiative to formulate guidance for developing principal design criteria for advanced non-light water reactors.

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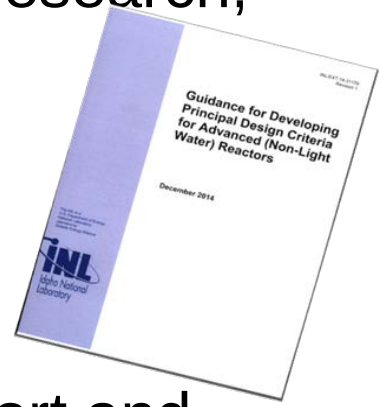
Licensing Framework Initiative - Purpose

- Overall purpose of this initiative is to establish clear guidance for the development of the PDC that advanced non-LWR developers will be required to include in their NRC license applications.
- Completion of this effort and the NRC's future issuance of the associated regulatory guidance are expected to provide the following key benefits:
  - Reduced regulatory uncertainty for advanced non-light water reactor developers.
  - Improved guidance for NRC staff reviewing future advanced reactor license applications.
  - Improved timeliness and efficiency of licensing activities for both applicants and NRC staff.

Licensing Framework Initiative - Approach

- Phased Approach
  - **"Phase 1" –** DOE expertise is applied to research, analysis, evaluation, documentation
    - Deliverables – technical report to NRC completed December 2014



  - **"Phase 2" –** NRC considers the DOE report and develops regulatory guidance
    - Issue regulatory guidance commensurate with an official NRC staff position

Licensing Framework Initiative Phase 1 - Team

Licensing Initiative Team for Phase 1 - Developing the DOE Report:

- Department of Energy
  - DOE Office of Nuclear Energy
  - DOE Office of General Counsel
- Laboratories
  - Argonne National Laboratory
  - Idaho National Laboratory
  - Oak Ridge National Laboratory
- Selected individual licensing consultants

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Licensing Framework Initiative Phase 1 - Stakeholders

Stakeholder organizations that submitted comments and inputs to DOE on the draft design criteria:

American Nuclear Society
AREVA
Argonne National Laboratory
Flibe Energy
CBI Federal Services
General Atomics
General Electric
Gen4 Energy, Inc.
Hybrid Power Technologies LLC
Japan Atomic Energy Agency
Korea Atomic Energy Research Institute
TerraPower
Toshiba
X-Energy

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Licensing Framework Initiative Phase 1 - Content

The DOE report on advanced reactor design criteria contains:

- A proposed set of Advanced Reactor Design Criteria, generally applicable to:
  - Sodium-cooled Fast Reactors (SFRs)
  - Lead Fast Reactors (LFRs)
  - Gas-cooled Fast Reactors (GFRs)
  - Modular High Temperature Gas-cooled Reactors (mHTGRs)
  - Fluoride High Temperature Reactors (FHRs)
  - Molten Salt Reactors (MSRs)
- A proposed set of Sodium-cooled Fast Reactor Design Criteria.
- A proposed set of modular High Temperature Gas-cooled Reactor Design Criteria.
- DOEs technical justification for adaptations of the original GDC.

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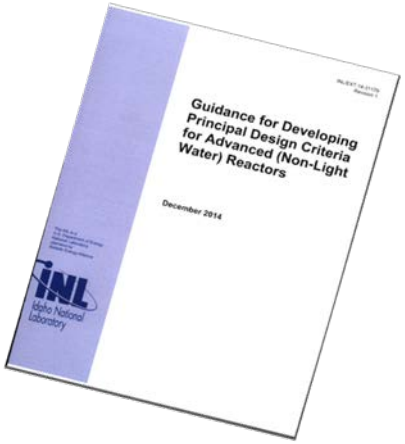
Licensing Framework Initiative Phase 1 - Content

- DOE also developed technology-specific design criteria for SFRs and mHTGRs to address design features not encompassed by the LWR-focused GDC:
  - Expands existing design criteria to address new structures, systems, and components important to safety.
  - Expands existing design criteria to address technology specific hazards.

NRC-DOE Joint Initiative Phase 2

- NRC began implementing phase 2 of the initiative to develop general design criteria (GDC) for non-Light Water Reactors (non-LWRs) in December 2014
  - NRC conducted a public meeting in January 2015 to discuss the DOE report and NRC's plans for developing regulatory guidance
    - NRC presented background and overview of the initiative
    - DOE provided information on how the advanced reactor design criteria were developed
  - Two DOE workshops were provided to the NRC in February 2015:
    - Modular High Temperature Gas Reactors (mHTGRs)
    - Sodium-Cooled Fast Reactors (SFRs)



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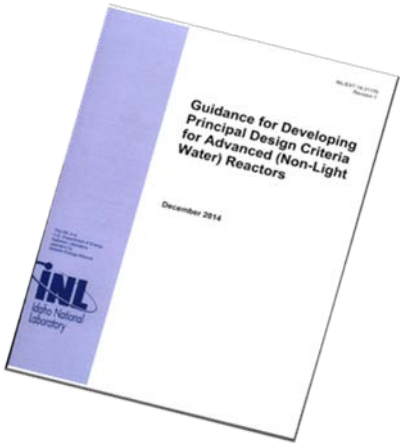
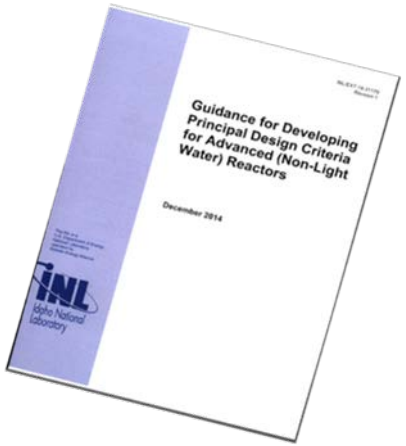
NRC-DOE Joint Initiative Phase 2

- NRC team from across the agency has been assembled and is reviewing each set of proposed GDCs
- NRC issued two sets of questions to DOE to clarify certain aspects of DOE report. DOE responded to the first set on July 15, 2015, and the second set September 15, 2015. General topics of NRC staff's questions included:
  - Use of specified acceptable core radionuclide release design limits for mHTGRs
  - Clarification on inventory control for mHTGRs
  - Clarification of the necessity and safety function of the intermediate heat exchanger for SFRs
  - Requirements for offsite electric power for non-LWRs and protective measures against grid transients
  - Clarification of the residual heat removal system's role for normal operations, anticipated operational occurrences, and during postulated accidents.



NRC-DOE Joint Initiative Phase 2

- NRC plans to issue proposed NRC GDCs for non-LWRs for informal public comment in late 2015
  - The proposed NRC GDCs will be posted on the NRC's public non-LWR website and subscribers to NRC's GovDelivery service will be notified
  - There will be a 30 day informal public comment period
- NRC will complete the draft regulatory guide in early 2016 and move forward with the normal regulatory guide approval process, which includes a formal 60 day public comment period
- Goal is to issue the final regulatory guide by the end of 2016



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Summary

- Purpose of this initiative is to establish guidance for the development of principal design criteria (PDC) that can be used by advanced non-light water reactor developers.

- NRC's future issuance of the associated regulatory guidance for advanced reactors will reduce regulatory uncertainty for both industry stakeholders and the NRC staff.

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Policy Activities That May Affect Non-Light Water Reactors

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Policy Activities

- Staff has been planning for small modular reactor (SMR) applications for several years
- In 2010, staff identified several critical policy issues that would benefit from assessment; for example,
  - Emergency preparedness
  - Fees
  - Source term
- NRC staff recognizes that many of these issues could apply to non-light water reactor (LWR) designs in the future
- The non-LWR community may want to pay attention to developments in these areas

Emergency Preparedness

- Options for Emergency Preparedness for SMRs and Other New Technologies (SECY-15-0077, 5/29/15)
  - Scope - Requested Commission approval for a rulemaking to revise regulations and guidance for emergency preparedness for SMRs and other new technologies such as non-LWRs, and medical isotope facilities
  - Proposes a consequence-based approach to establishing requirements as necessary for offsite emergency preparedness
  - Requirements would be commensurate with potential consequences to public health and safety and common defense and security at these facilities
  - The Commissioners approved this approach on August 4, 2015
  - Staff is drafting the plan and schedule

Fees

- Proposed Variable Annual Fee Structure for Small Modular Reactors (SECY-15-0044, 3/27/15)
  - Scope – Requested Commission approval for a rulemaking to amend Part 171 of Title 10 of the Code of Federal Regulations to include a variable annual fee structure for SMRs
  - Currently 10 CFR Part 171 fees are allocated equally amongst operating power reactor licensees
  - Proposed rulemaking would allocate the annual fee for each licensed power reactor as a function of its licensed thermal power rating
  - The Commissioners approved this proposal on May 15, 2015
  - Staff is drafting the proposed rule for public comment

Mechanistic Source Term

- Mechanistic source term has been discussed in various contexts over several years
  - SECY-93-092, “Issues Pertaining to the Advanced Reactor (PRISM, MHTGR, and PIUS) and CANDU 3 Designs and Their Relationship to Current Regulatory Requirements” (4/8/93)
  - SECY-03-0047, “Policy Issues Related to Non-Light Water Reactor Designs”
  - SECY-10-0034, “Potential Policy, Licensing, and Key Technical Issues for Small Modular Nuclear Reactor Designs” (3/28/10)
  - Next Generation Nuclear Plant Fuel Qualification and MST white papers and assessment reports
  - Commission memo on status of MST (6/20/14)
- Staff is preparing a SECY paper that will discuss details related to assessing MST appropriately

Insurance and Liability

- Insurance and Liability Regulatory Requirements for Small Modular Reactor Facilities (SECY-11-0178, 12/22/11)
  - Scope - Informs Commission of the staff's approach to the resolution of issues concerning the applicability of insurance and liability regulatory requirements to SMRs
  - Mainly affects designs that are less than 100 MWe per module
  - NRC staff is preparing a comparative analysis of different designs to determine if an inequity exists between the treatment of reactors producing electrical power greater than 100 MWe and those with individual modules producing less than 100 MWe

Security Regulatory Framework

- Security Regulatory Framework for Certifying, Approving, and Licensing Small Modular Nuclear Reactors (SECY-11-0184, 12/29/11)
  - Scope – Inform the Commission on the results of the staff's assessment of the adequacy of the current security regulatory framework for certifying, approving and licensing SMRs and non-LWRs
  - Staff's preliminary conclusion is that the current security regulatory framework is adequate for non-LWRs, but limited information is available regarding designs and operations
  - As designs mature and details are available, the staff will assess the security and material control and accounting requirements to identify any regulatory gaps and potential policy issues

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Control Room Staffing

- Operator Staffing for Small or Multi-Module Nuclear Power Plant Facilities (SECY-11-0098, 7/22/11)
  - Scope – Inform Commission of staff's ongoing efforts for the resolution of the application of the NRC's on-site operator staffing requirements
  - Staff concluded that deviations from the NRC's current regulations should be addressed on a case-by-case basis using the exemption process
  - Staff also concluded that the current versions of NUREG-0800 Chapter 18 and NUREG-0711 provide adequate guidance for performing the exemption request evaluations
  - Need for a longer term approach will be evaluated as staff gains experience in licensing new designs

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Decommissioning Funding

- Decommissioning Funding Assurance for Small Modular Nuclear Reactors (SECY-11-0181, 12/22/11)
  - Scope - Inform the Commission of the staff's plans for ensuring that SMR licensees provide reasonable assurance that funding will be available for decommissioning SMRs
  - Design-specific features will influence decommissioning costs
  - The near-term approach is to consider allowing SMR applicants to deviate from existing regulations through exemption requests with supporting analysis
  - The long-term approach is to propose rulemaking based on the near-term exemption experience

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Other NRC Activities Related to non-LWRs

- Advanced Non-LWR Workshop September 2015
- GDC Initiative
- Development of prototype guidance
- Revision of Regulatory Guide 1.206
- Update of the 2012 report to Congress on advanced reactor licensing
- Participation in ANS standards development for sodium cooled fast reactors and fluoride salt cooled high temperature reactors
- Participation in discussions with international regulators

Concluding Remarks

- NRC activities related to SMRs or other new reactors may have applicability to non-LWR designs
- NRC activities specifically related to non-LWRs are commensurate with industry commercial maturity
- NRC encourages stakeholder participation and comments on its documents
- Industry can respond to RIS 2015-07
- Please subscribe to the NRC's GovDelivery service on the NRC webpage under "Advanced Reactors" to receive email notifications on non-LWR activities