U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

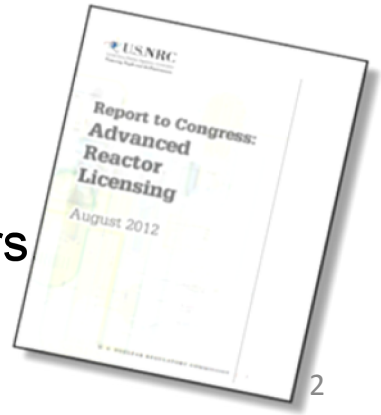
Licensing Framework for Advanced Reactors DOE-NRC Joint Initiative

Jan Mazza
USNRC
Presented to
Fifth Joint IAEA-GIF Technical Meeting/Workshop on
SAFETY OF SODIUM-COOLED FAST REACTORS

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



U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

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.

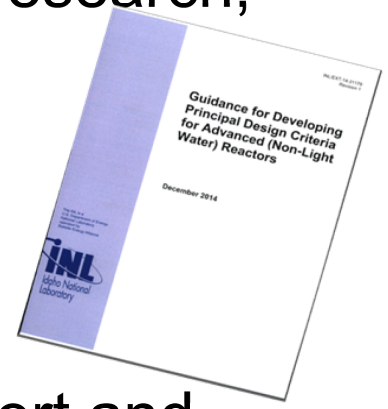
U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

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

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

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

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

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

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

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.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

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.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Licensing Framework Initiative Phase 1 - Content

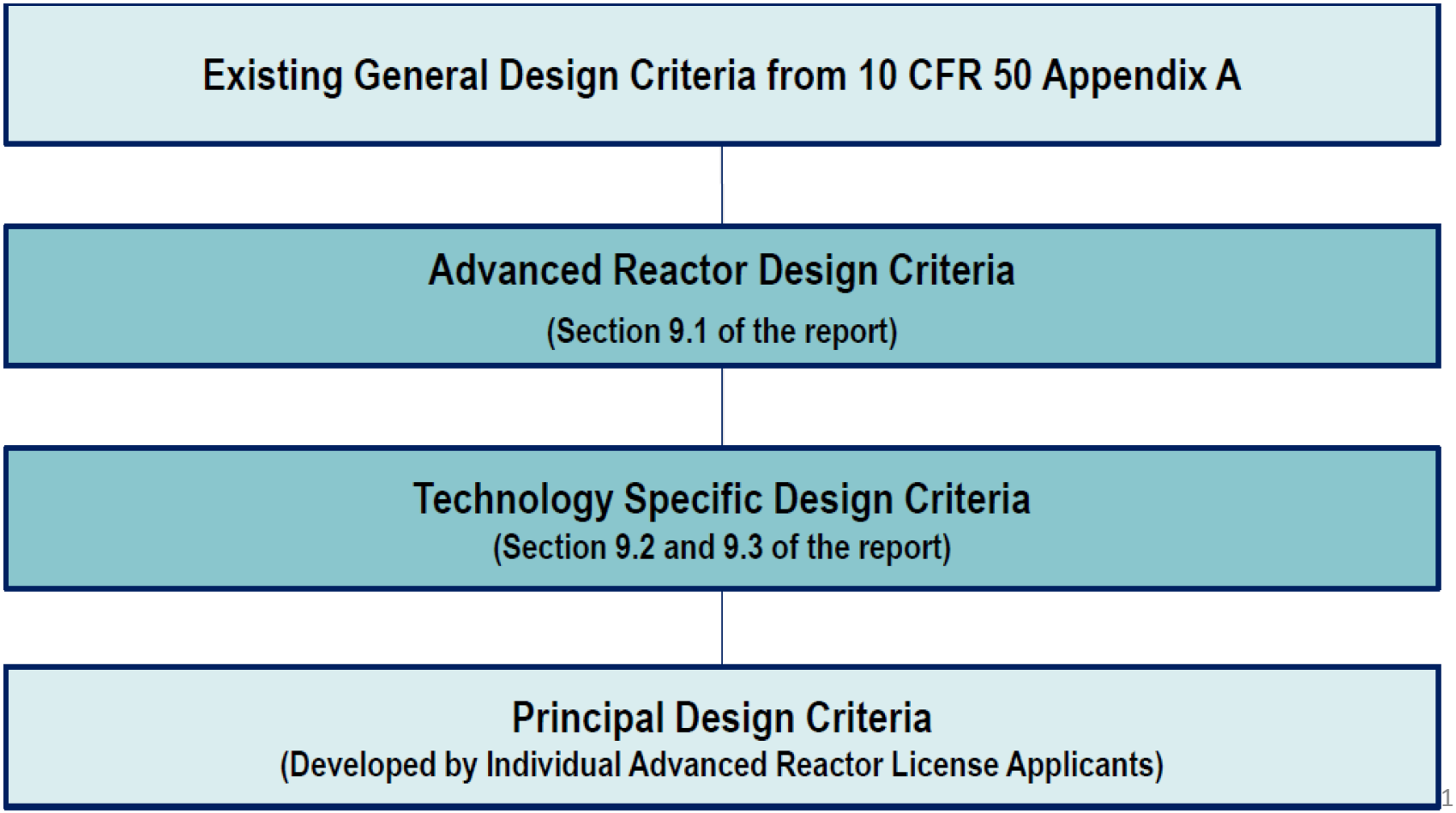
Technology Specific Design Criteria for SFRs

- Based on the comments made during the regulatory reviews of the Clinch River Breeder Reactor (CRBR) and GE-Hitachi PRISM reactors, DOE determined that additional provisions would be needed to address SFR-specific issues not covered by the LWR-focused GDC:
  - Design of the intermediate loop.
  - Design of sodium heating system.
  - Design of systems to maintain reactor coolant & cover gas purity.
  - Design of systems to accommodate for the reactive nature of the sodium coolant in both the primary and intermediate heat transport systems.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Licensing Framework Initiative Phase 1 –

DOEs Proposed Relationship Between Existing GDC and PDC for Advanced Reactors



U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Licensing Framework Initiative Phase 2

- NRC began reviewing the DOE report in December 2014.
- Some of the milestones completed since initiation of the review include:
  - January 21, 2015 public meeting to discuss the report and NRC's plans to develop guidance for advanced non-LWRs
  - February 18, 2015 DOE-NRC workshop on SFR technology
  - February 25, 2015 DOE-NRC workshop on mHTGR technology
  - June 6, 2015 NRC letter to DOE containing NRC staff questions on the DOE report

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Licensing Framework Initiative Phase 2 - NRC Guidance Development Timeline

NRC Guidance Development Task	Task Completion Schedule
Receive DOE Report	December 8, 2014 (complete)
Public Meeting	January 21, 2015 (complete)
Technology Workshops	February 18 & 25, 2015 (complete)
Develop questions for DOE	June 5, 2015 (complete)
Develop NRC version of Advanced Reactor GDCs	August 2015
Public meeting(s) to discuss NRC version of GDC	September 2015
Develop NRC draft guidance document	December 2015
Commence NRC regulatory guidance approval process	January 2016
Issue Regulatory Guidance	December 2016

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

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 significantly reduce regulatory uncertainty for both industry stakeholders and the NRC staff.
- DOE's licensing team collected information, conducted research, and performed analysis that resulted in a technical report.
- NRC is considering this information in developing regulatory guidance.