TerraPower

NATRIUM

Consensus Codes and Standards

a TerraPower & GE-Hitachi technology

NATD-LIC-PRSNT-0031

SUBJECT TO DOE COOPERATIVE AGREEMENT NO. DE-NE0009054

Agenda

- Natrium™ Overview
- Code of Record
- 10 CFR 50.55a
- Regulatory Guides
- Next Steps

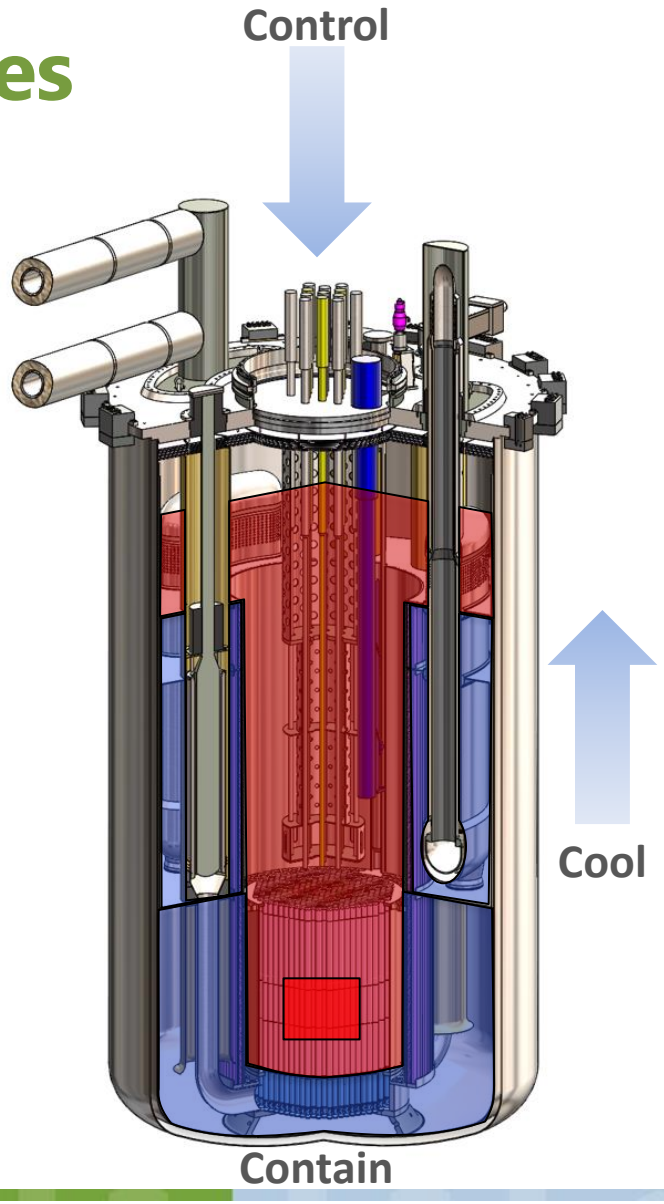
Natrium Reactor Overview

- The Natrium project is demonstrating the ability to design, license, construct, startup and operate a Natrium reactor within a seven-year timeframe.

- Pre-application interactions are intended to reduce regulatory uncertainty and facilitate the NRC's understanding of the Natrium design and its safety case.

Natrium Safety Features

- Pool-type Metal Fuel SFR with Molten Salt Energy Island
  - Metallic fuel and sodium have high compatibility
  - No sodium-water reaction in steam generator
  - Large thermal inertia enables simplified response to abnormal events
- Simplified Response to Abnormal Events
  - Reliable reactor shutdown
  - Transition to coolant natural circulation
  - Indefinite passive emergency decay heat removal
  - Low pressure functional containment
  - No reliance on Energy Island for safety functions
- No Safety-Related Operator Actions or AC power
- Technology Based on U.S. SFR Experience
  - EBR-I, EBR-II, FFTF, TREAT
  - SFR inherent safety characteristics demonstrated through testing in EBR-II and FFTF



Control

- Motor-driven control rod runback
- Gravity-driven control rod scram
- Inherently stable with increased power or temperature

Cool

- In-vessel primary sodium heat transport (limited penetrations)
- Intermediate air cooling natural draft flow
- Reactor air cooling natural draft flow – always on

Contain

- Low primary and secondary pressure
- Sodium affinity for radionuclides
- Multiple radionuclides retention boundaries

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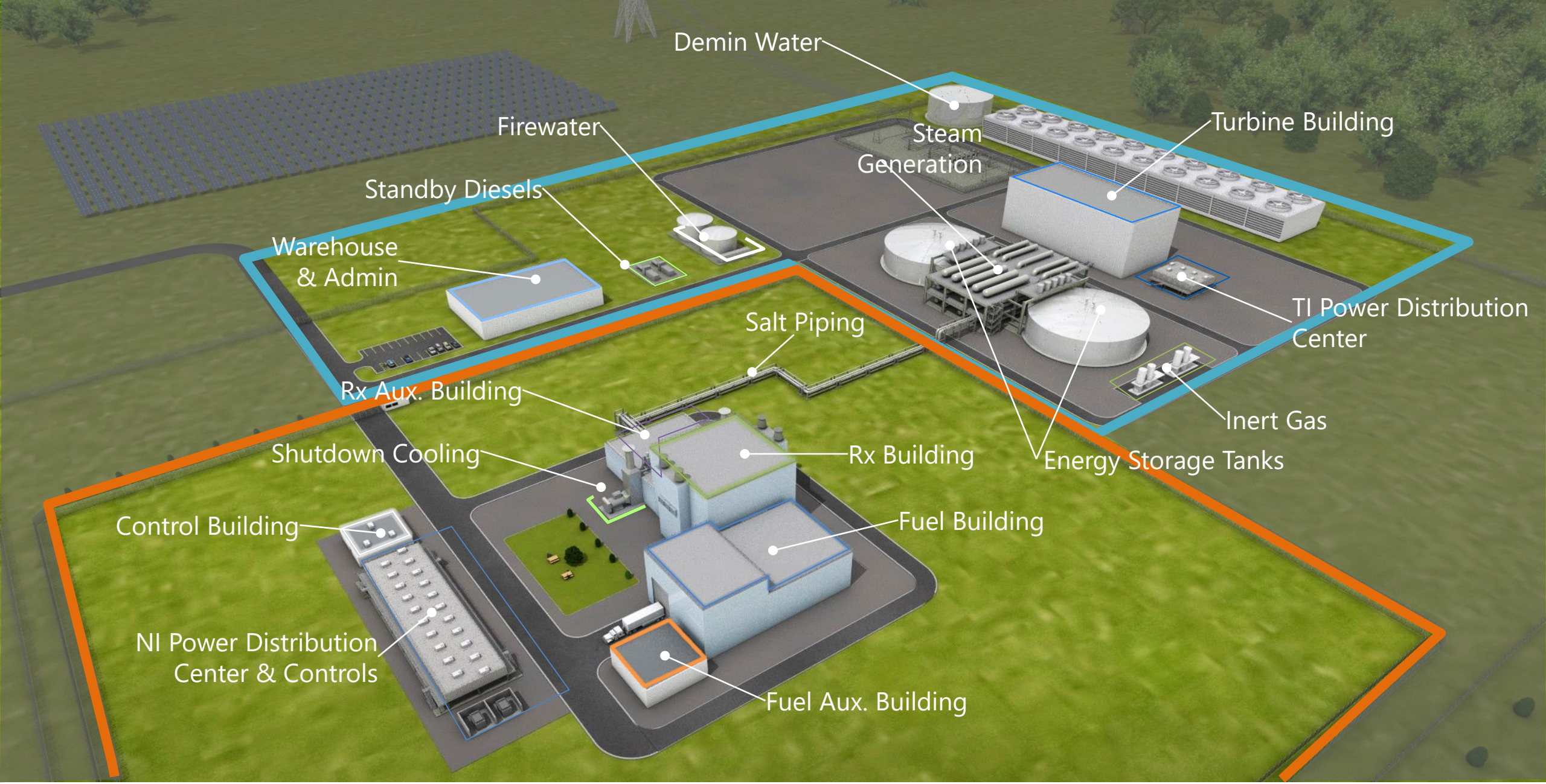

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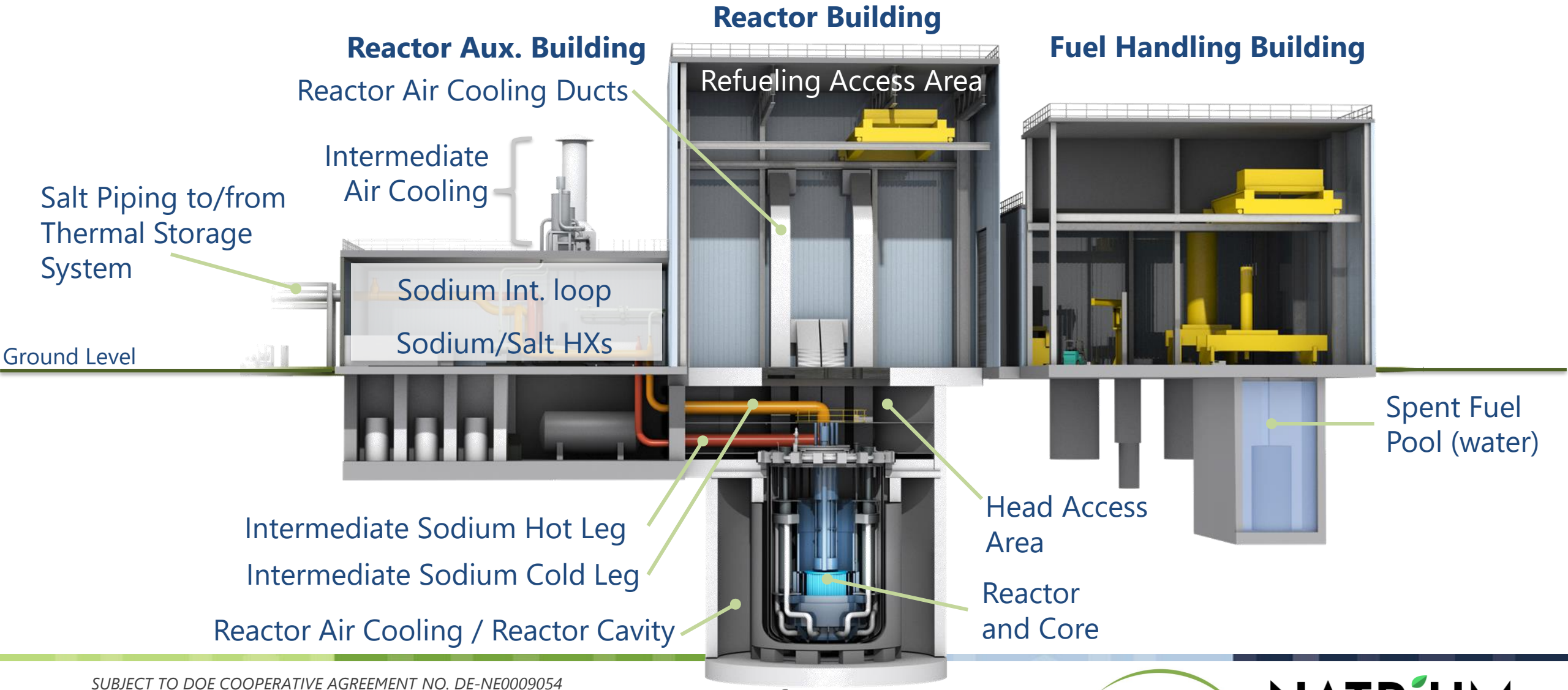
Plant Overview



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Code of Record

- The Natrium Code of Record will select Codes and Standards from the following:
  - Approved for incorporation by reference in 10 CFR 50.55a
  - Endorsed or referenced by Regulatory Guides
  - Identified during engineering and design processes

- The Natrium Code of Record is a living document under configuration control that may evolve as the design progresses.

Code of Record

- Safety-related SSCs will be designed in accordance with NRC endorsed Codes and Standards, or proposed alternatives, determined to be applicable to Sodium Fast Reactor technology.

- Code and Standard application will be addressed on a case-by-case for NSRST SSCs. A graded approach through partial use of a Code or Standard may be used.

- Non-safety-related SSCs requiring no special treatment will be designed in accordance with current and appropriate engineering practices, Codes, Standards, methods of design, construction, and operation for commercial quality equipment.

Code of Record

- Codes and Standards referenced in 10 CFR 50.55a, applicable Regulatory Guides, and other NRC guidance will be compared to design activities to define the Code of Record.

- Sodium Fast Reactor applicability is not fully addressed by Codes and Standards currently endorsed and referenced by the NRC. Coordination with Standards Organizations and NRC is ongoing.

- Future submittal is planned to identify:
  - Consensus Codes and Standards or Code Cases intended for use
  - Standards or Code Cases that have not been endorsed or previously accepted by the NRC

10 CFR 50.55a

ASME Boiler and Pressure Vessel Code Section III	
Current IBR	2017

ASME Boiler and Pressure Vessel Code Section XI	
Current IBR	2017
In rulemaking	2019 (expected soon)
Expected use	Edition in place 18 months prior to fuel load

ASME Code Cases
Assessment in progress

10 CFR 50.55a

ASME Operation and Maintenance (OM) Code	
Current IBR	2017
In rulemaking	2020 (expected soon)
Expected use	Edition in place 18 months prior to fuel load

IEEE 603-1991	
Current IBR	1991 with correction sheet
Expected use	Assessment in progress

10 CFR 50.55a

- Intent is to fully comply with all conditions as listed in 10 CFR 50.55a(b).
- No requests for relief are anticipated.
- Intent is to minimize potential exceptions.

Regulatory Guides

- DG-1380
  - NRC issued draft Regulatory Guide DG-1380 (proposed Revision 2 to Regulatory Guide 1.87), "Acceptability of ASME Code, Section III, Division 5, High Temperature Reactors" in August 2021 – incorporates ASME BPVC Section III, Division 5 - 2021

- RG 1.147
  - Incorporate ASME Section XI, Division 1, Code Cases, 2021 Edition

- RG 1.149
  - Incorporate ANSI/ANS-3.5-2018, NEI 09-09

Regulatory Guides

- RG 1.100
  - QME-1 – Endorsement of QME-2 for advanced reactors, when issued
  - IEEE 344 – 2020 Edition
- RGs 1.47, 1.62, 1.73, 1.209
  - IEEE 323 – 2020 Edition
- RG 1.52, 1.140
  - AG-1-2019
  - N511-2017

Next Steps

- Complete review of Codes and Standards
- Complete assessment of potential 10 CFR 50.55a alternatives
- Consensus Codes and Standards submittal

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Acronym List

ANS – American Nuclear Society
ASME – American Society of Mechanical Engineers
CFR – Code of Federal Regulations
DG – Draft Guide
IEEE – Institute of Electrical and Electronic Engineers
FSAR – Final Safety Analysis Report
IBR – incorporated by reference
NSRST – non-safety-related with special treatment
PSAR – Preliminary Safety Analysis Report
RG – Regulatory Guide
RIM – Reliability and Integrity Management
SFR – sodium fast reactor
SSCs – Structures, systems, and components