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SMR-300 Core Design Update and Nuclear Analysis Codes and Methods Validation & Verification Plan

September 10, 2024

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Meeting Agenda

- Open Session
  - Purpose & Outcome
  - Core Design Overview
  - Core Design Update
  - Nuclear Analysis Codes and Methods Validation & Verification Plan
- Closed Session
  - Core Design Update (Continued)
  - Nuclear Analysis Codes and Methods Validation & Verification Plan (Continued)

Purpose & Outcome

- Present changes to the SMR-300 nuclear core design from what was previously presented in SMR-300 Design Overview meeting on May 8, 2024.
  - Solicit any questions or concerns from NRC staff on these changes.
  - Identify any technical areas related to core design that may require further preapplication engagement.
- Present Holtec's plan for verification & validation of the nuclear analysis codes and methods.
  - Solicit any questions or concerns from NRC staff on this planned approach.
  - Confirm NRC expectations for scope and justification to be included in a future Holtec Topical Report to utilize the Studsvik CMS5 Software Suite and Generic Nuclear Reliability Factors for SMR-300 nuclear analyses.

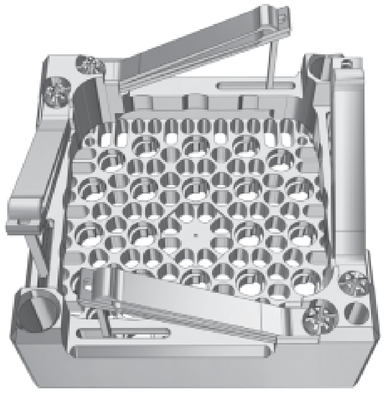
Core Design Overview

SMR-300 Core Design Overview

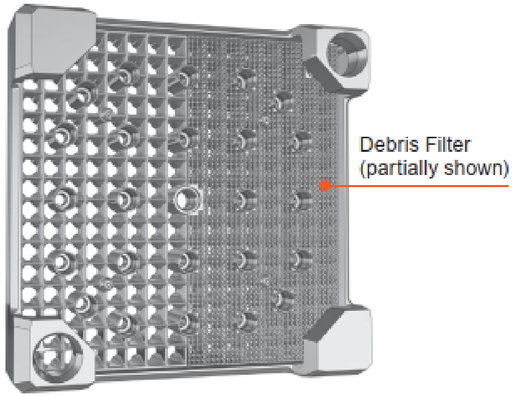
- SMR-300 core will incorporate Framatome's 17x17 GAIA fuel assembly and HARMONI rod cluster control assembly (RCCA)
- GAIA fuel is currently operating in various quantities in the US at three different Westinghouse three and four loop PWRs
- HARMONI 17x17 RCCAs have been supplied to more than 10 Westinghouse PWRs over the last 25 years

GAIA 17x17 Fuel Assembly for SMR-300

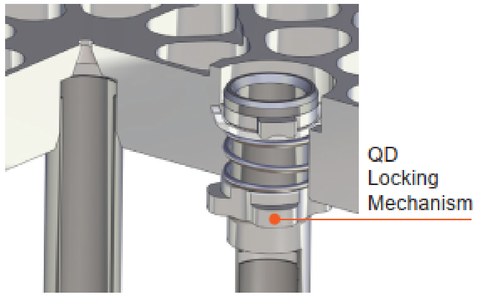
Reconstitutable Top Nozzle



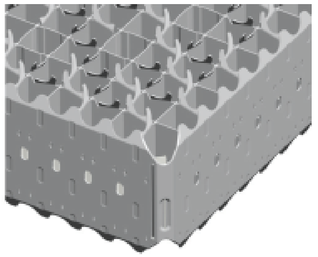
GRIP™ Bottom Nozzle



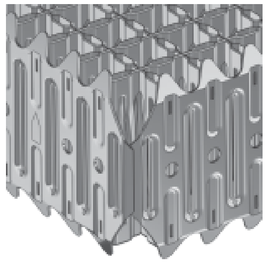
Quick Disconnect (QD) Upper Connection



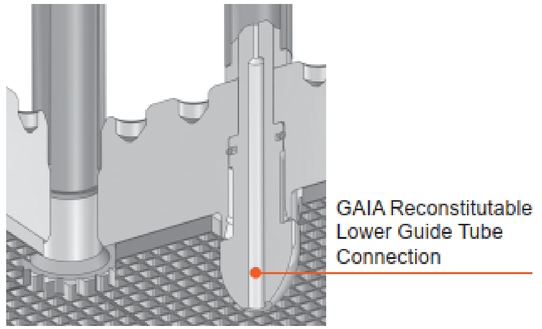
GAIA Mixing Grid



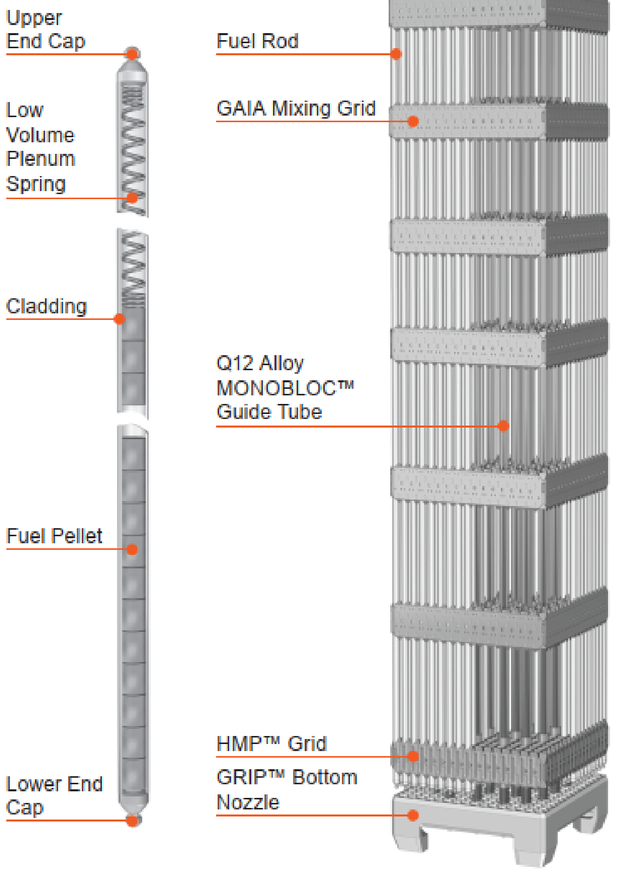
HMP™ Grid



Reconstitutable Lower Guide Tube Connection

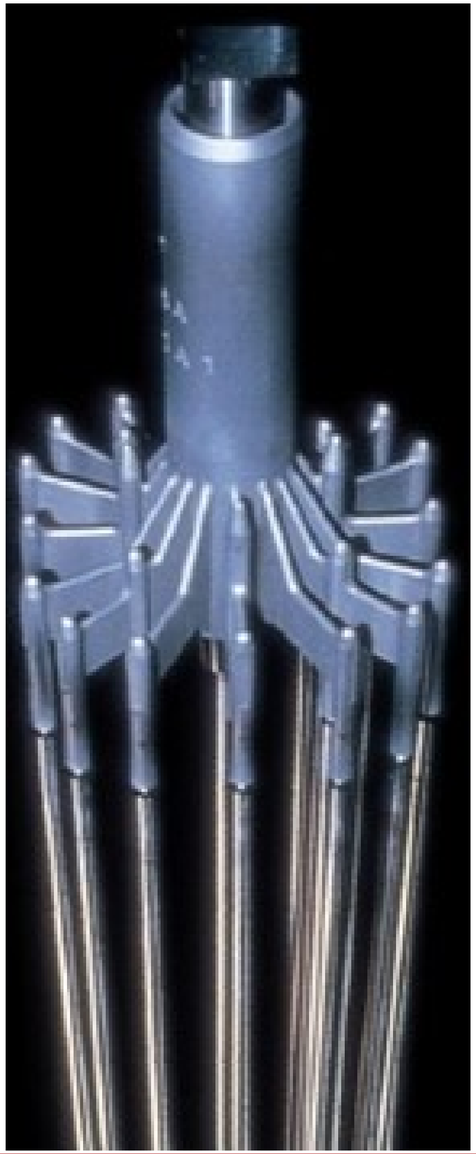


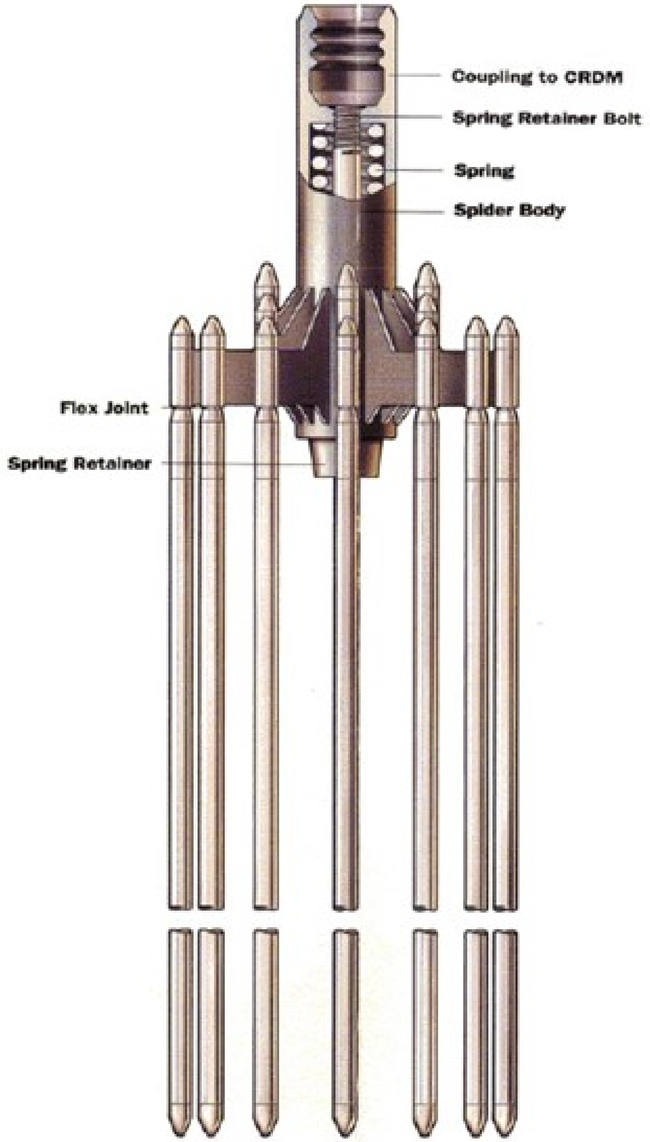
Fuel Rod



framatome

HARMONI RCCA for SMR-300





- Framatome has supplied over 7,700 HARMONI RCCAs operating in 97 reactors around the world, including the United States

Core Design Update

SMR-300 Core Design

- Efficient design with traditional reload shuffle at the end of each cycle
- Standard PWR fuel assembly and utilizes RCCAs and soluble boron to control reactivity

Parameter	Value
Reactor type	PWR
Electrical (net) capacity	300 MWe
Thermal capacity	1050 MWt
Design life	80 year
System pressure	[[ ]]
Core inlet/exit temperatures	[[ ]]
Reactivity control	Soluble boron and RCCAs
RPV height / diameter	[[ ]]
RPV or module weight	[[ ]]
Fuel type/assembly array	UO_2 pellet / rectangular array
Fuel assembly length	[[ ]]
Number of fuel assemblies	69
Fuel Lattice	17x17
Average fuel enrichment	[[ ]]
Maximum fuel enrichment	<5%
Fuel Cycle burnup	[[ ]]
Fuel cycle / Refueling Cycle	[[ ]]
Number of control rod assemblies	**29**

Changes from 5/8/2024 SMR-300 Design Overview Meeting are in **blue**

Rod Cluster Control Assemblies (RCCA) Update

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In-Core Instrumentation (ICI) Update

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SMR-300 Core Design

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Fuel Cycles and RCCA layout

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Equilibrium Cycle Burnup (BU)

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Boron Letdown & Sub-channel Factors

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Nuclear Analysis Codes and Methods Validation & Verification (V&V) Plan

SMR-300 Core V&V

- Holtec is considering the following General Design Criteria (GDC) from 10 CFR 50 Appendix A for the evaluation of physics parameters for use in safety evaluations:
  - GDC 10 – Reactor design
  - GDC 11 – Reactor inherent protection
  - GDC 12 – Suppression of reactor power oscillations
  - GDC 20 – Protection system functions
  - GDC 26 – Reactivity control system redundancy and capability
  - GDC 27 – Combined reactivity control systems capability

SMR-300 Core V&V

- SMR-300 plans to utilize the Studsvik Scandpower (SSP) Core Management System 5 (CMS5) for its nuclear core analyses
  - The CMS5 Software Suite includes CASMO5, CMSLINK5, and SIMULATE5
- NRC has generically approved the use of CMS5 and a set of generic Nuclear Reliability Factors (NRF) for PWRs that fall within the Limitations & Conditions (L&C) of the NRC's Final Safety Evaluation (SE) for SSP's Generic Topical Report (TR) "SSP-14-P01/028-TR, Rev 0" (ML17236A393 (P), ML17279A986 (NP))
  - "The NRC staff has reviewed the CASMO5/SIMULATE5 models, validation and benchmarking of the models using critical experiments, higher order code comparisons, TL [tolerance limit] statistical analysis, NUFs [nuclear uncertainty factors] derived from one-sided TL analysis and the development of conservative generic NRFs. **The staff concludes that the CASMO5/SIMULATE5 models together with the generic NRFs are suitable for core design, analysis, and depletion calculations.**"

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SMR-300 Nuclear Codes and Methods Qualification LTR

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Thank you! Questions?!