

Shielding Fuel Assemblies

The smart way to ensure plant lifetime

Framatome designs and manufactures shielding fuel assemblies to support plant life time extension, even in the short-term or during a power up-rate.

Challenge

Desired plant lifetime extension of nuclear power plants causes substantial investments. Additionally in some cases the neutron fluence on reactor pressure vessels (RPV) is so high that in some areas it might come close to design limits. Since the RPV is usually not exchangeable, this would limit the lifetime of the whole plant.

Solution

Framatome Shielding Fuel Assemblies reduce the neutron flux on critical areas, while ensuring full reactor power. Short delivery time, adaptive design, and no impact on safety or on the efficiency of fuel economics are crucial to plant lifetime extension.

Customer benefits

Customer benefits directly from:

- Easy implementation of shielding fuel assemblies during outage
- Significant neutron flux reduction on desired areas
- Delivering period comparable like for normal Fuel Assemblies
- Easy justification process through core design evaluation and high resolution neutron fluence analysis
- Core design evaluation including all documents for licensing

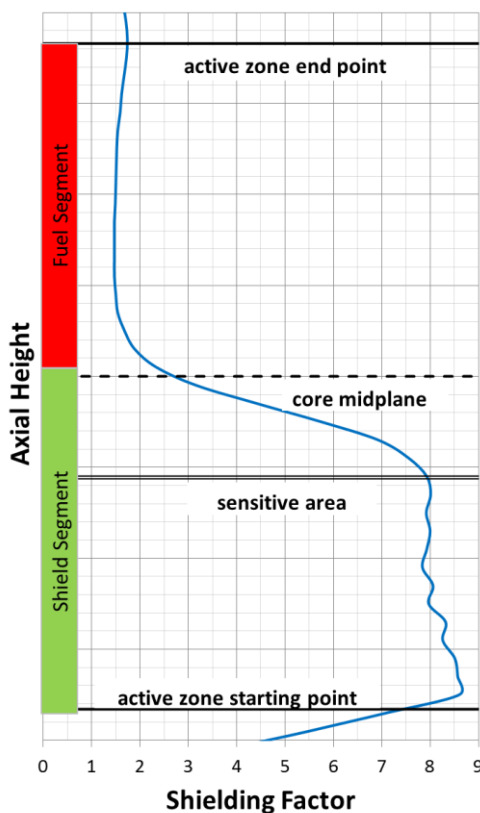


Fig.1. Example of an axial Shielding Factor Shape.

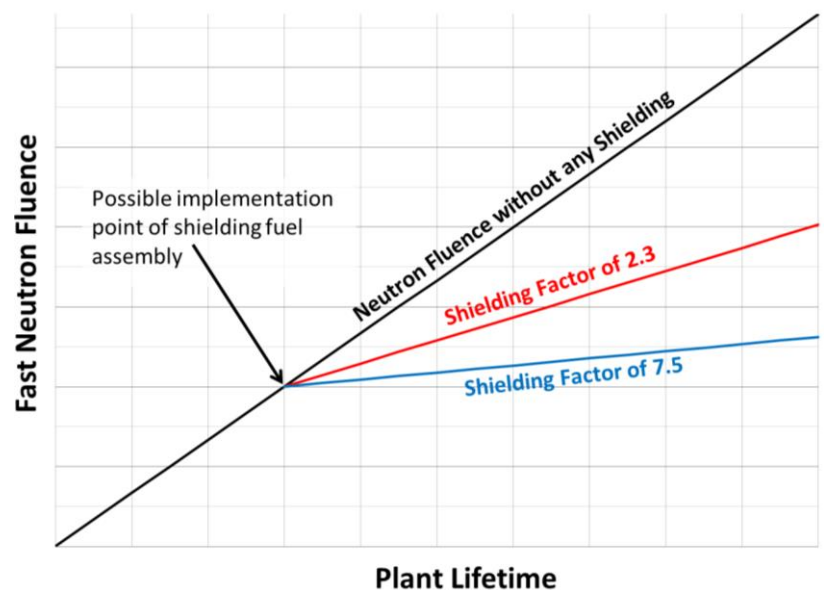
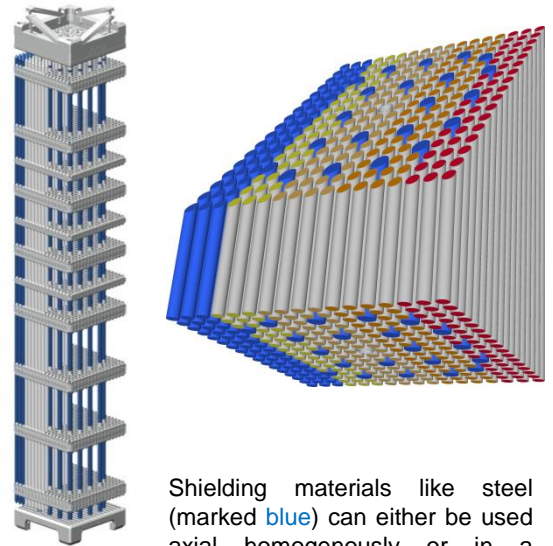


Fig.2. Comparison of fluence increase depending on Shielding Fuel Assembly design.

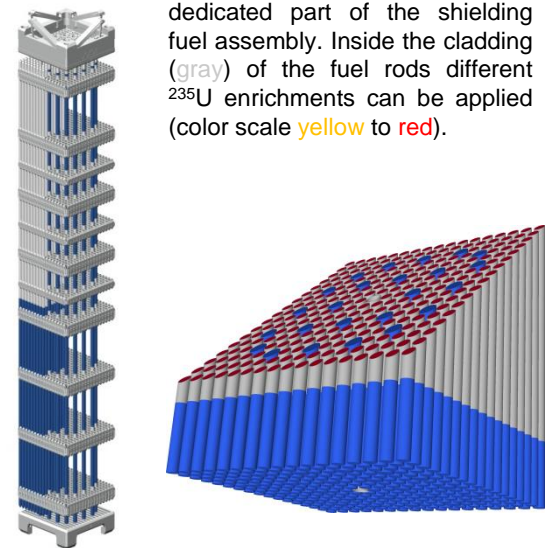
Your performance
is **our** everyday **commitment**

Technical information

- Adaptable Fuel Assembly Designs:
 - Compatible with various fuel assembly designs
e.g. HTP or GAIA
 - Full fuel machine compatibility
 - High debris filter efficiency technology
 - High fuel assembly dimensional stability
 - Available with PROtect technologies
- ^{235}U enrichment adaptable according to:
 - Required fuel economics
 - Optimizations regarding Core Design
 - Lifetime of Shielding Fuel Assemblies
 - Compatible with enriched reprocessed uranium fuel
- Adaptable Shielding Design:
 - Axial homogenous shielding for certain pin rows
 - Rotational symmetric shielding design
 - Guide tube made of full shielding bars
 - Qualified shielding material with long life experience



Shielding materials like steel (marked blue) can either be used axial homogenously or in a dedicated part of the shielding fuel assembly. Inside the cladding (gray) of the fuel rods different ^{235}U enrichments can be applied (color scale yellow to red).



References

At TopFuel 2019 in Seattle (USA) feedback was given in a joint Vattenfall and Framatome presentation about the experience of shielding fuel assemblies.

The presentation can be requested at sales-fuel@framatome.com

Find Vattenfall's operational feedback and further details on our Shielding Fuel Assemblies in our webinar recording on the European Nuclear Society (ENS) YouTube™ channel :



Key Figures

Status January 2020

> 60,000 days

operating Shielding Fuel Assemblies experience

up to 8 consecutive cycles

operating experience per shielding fuel assembly

zero

additional impacts on corrosion and bowing compared to typical fuel assemblies

> 7

is the shielding factor verified by complex monitoring program

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