framatome

FARGO

Fuel Cycle Design Optimization with AI-based Software

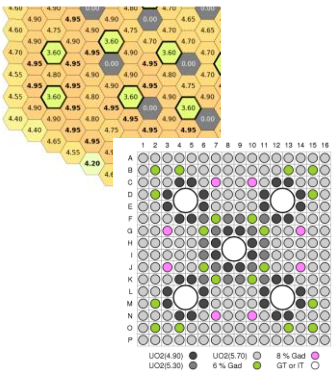
Get the most value of the fuel loading for each cycle of operation

Challenge

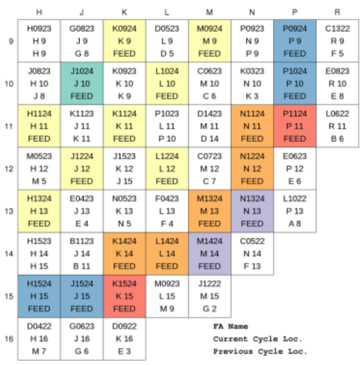
The task of designing a fuel loading pattern is determinant to the efficiency of the core. It is key to improving fuel cycle cost or for transition to **longer cycles**, for **power uprate** or for **flexible operation**.
Core design engineers search through almost **endless possible** cycle designs to find a loading pattern that balances the operational objectives while ensuring safety criteria.

Solution

FARGO AI-based software solution goes beyond engineer search and optimizes both the **fuel rod layout** and the **fuel loading pattern**.



Optimization
of fuel rod layout



Optimization
of fuel loading pattern

The AI-based optimization of the lattice and the loading pattern is driven to improve key physics parameters.

The use of FARGO enables Framatome to provide its customers improved fuel cycle cost and design margin for either PWR, BWR, VVER or SMR cores.

Customer benefits

Improved fuel cycle cost
- Maximize fuel utilization even for recurrent cycle design thanks to optimized placement of reinserted fuel assemblies.
- Increase cycle length at same cycle cost for a transition cycle design.

Improved fuel cycle design margin
- Make significant gains on targeted design limits such as power peaking or DNB.

Key figures

15 additional full power days of operation for the same fuel cycle cost reached on one transition cycle design.

1.5% additional discharge burnup reached on recurrent fuel cycle design.

4% peaking margin improvement reached on one transition cycle design.

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

Technical information

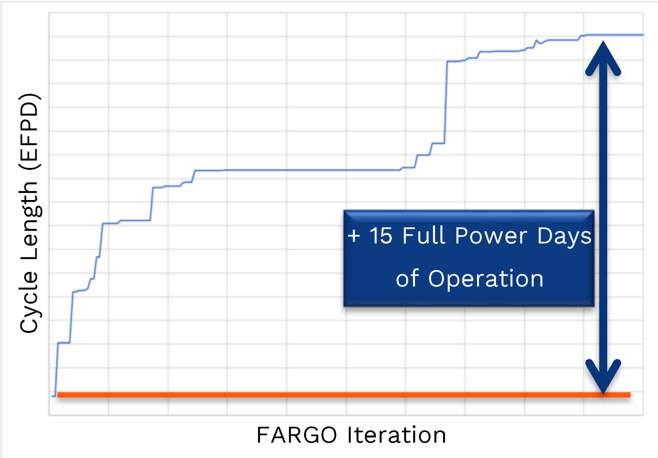
Levers for optimization

- of the fuel rod layout:
  - Definition of UO_2/MOX enrichment and placement of rods
  - Definition of gadolinia absorbers and placement of rods
- of the fuel loading pattern:
  - Definition of fresh fuel enrichment, burnable absorber content, and placement of fresh fuel assemblies
  - Definition of placement of burned assemblies reinserted from the spent fuel pool

Target for optimization

- for reload cycle design:
  - Improve fuel cycle cost efficiency by increasing cycle length without additional fuel cost
  - Improve fuel design margin by optimizing rod layout in fresh fuel assemblies
- for transition to new cycle design:
  - Facilitate the transition to a longer cycle, for example, from 18 to 24 months
  - Unleash design margin to facilitate core power uprate or flexible operation

FARGO Graphical user interface



FARGO Cycle Length Improvement

References

Long term experience in fuel assembly design and fuel loading pattern design in PWR, BWR and SMR throughout the world.

Engineering centers in Europe and the USA to support recurrent reloads and transition to longer cycle, power uprate or flexible operation.

State-of-the-art ARCADIA code chain licensed and used in several countries to support fuel justification including AFM design (LEU+).

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