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COLOSS Core Loading Software

Optimizing loading and unloading of fuel assemblies

The COLOSS tool helps minimize the time for handling operations during outages – while avoiding any damages to fuel assemblies

Challenge

Loading and unloading of Fuel Assemblies (FAs) during outages must be done in safe way that ensures all FAs to remain undamaged, while considering time efficiency. The spaces between individual FAs in the core of a pressurized water reactor are designed to be extremely narrow. Any slight deformation in FAs can lead to problems when handling fuel assemblies during an outage by coming into contact with, and potentially damaging, neighboring FAs. Usually, these problems occur at times when the work is on a critical path, leading to longer outages, damage to FAs, or an increased need for dummy FAs.

Fig 1: COLOSS optimizes loading and unloading sequence of FAs

Solution

The COLOSS tool analyzes loading steps and supports the optimization of complete loading sequences to facilitate outages in optimal time conditions, while ensuring the integrity of FAs to remain intact.

The COLOSS tool acts as a pre- and postprocessor, providing all the necessary data to calculate contact forces between FAs.

The COLOSS tool can evaluate FA deformation patterns based on either predicted, interpolated, or measured FA deformations (straightness measurements), and create a prediction model to determine the optimal loading and unloading sequence of FAs. Thus, possible handling disturbances in core regions with high friction forces can be minimized or even avoided completely. The assessment of multiple sequences is possible on short notice during the outage.

To facilitate the creation or optimization of loading sequences, the results can be displayed graphically.

Customer benefits

- Significant reduction in fuel assembly (FA) loading and unloading times
- Optimized handling sequence of FA for safe handling operations without damage to FAs
- Assessments of multiple loading sequences in a short amount of time
- No unplanned changes of loading and unloading sequences necessary during outage
- Identification of precise region to start unloading and to complete loading of the core

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is **our** everyday **commitment**

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Technical Information

The COLOSS tool is able to take into account a variety of different parameters:

- Supports all western PWR designs (e.g. KWU , Framatome)
- Supports all FA designs (e.g. GAIA, HTP, AFA 3G, FOCUS)
- Lifetime dependencies of FAs (e.g. Burnup)
- Consideration of dummy fuel assemblies
- Consideration of all relevant core geometries for arbitrary PWRs
- Consideration of the centering device of the fuel handling machine
- Calculation of single handling steps, partial and complete loading sequences
- Graphical presentation of the friction forces in a core map (see Fig 2)

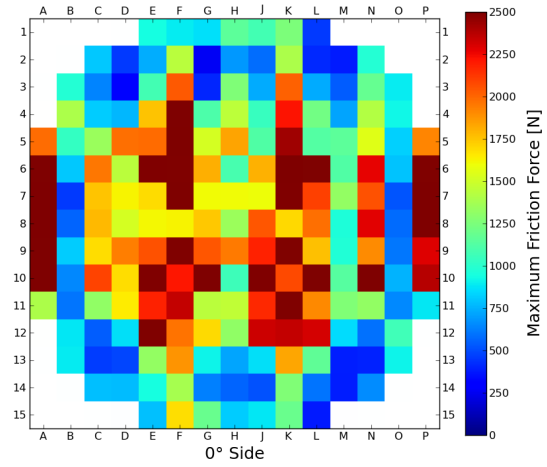

Fig 2: Sample calculation of friction forces for each core position

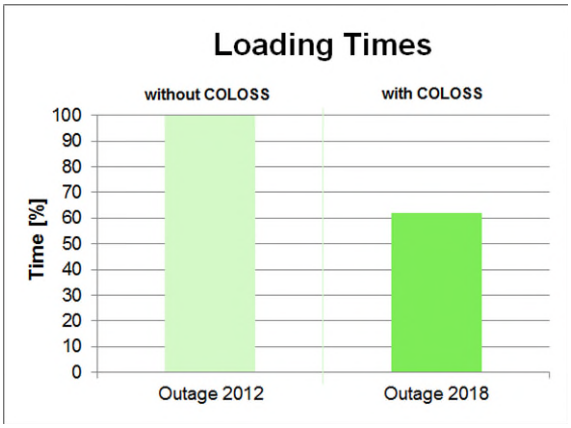

Fig 3: Comparison of loading times with and without application of the COLOSS tool

References

COLOSS is the optimal tool for planning FA loading and unloading. The COLOSS tool has been used regularly in 17x17 and KWU 16x16 plants – e.g. In one KWU 16x16 plant it has been used continuously since 2013 to prepare all outages – to the highest satisfaction of our customers.

Significant time reductions during handling operations have been achieved with COLOSS (see Fig 3). No deviations from the original loading sequence were necessary, and fuel rotations were avoided.

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