XEDOR™
Risk-Informed PCI Management Tool

Online PCI Management

Developing high mechanical stresses from pellet-clad interaction (PCI) is an inherent result of BWR power maneuvering. Before the invention of XEDOR™, there was no means to quickly calculate maximum cladding stresses in a core with available full-scale thermo-mechanical codes. The ideal solution is to have real-time data on each fuel rod available to the plant operator to assure maneuvering rates keep stresses below levels of elevated risk for PCI-induced fuel rod failures. XEDOR™ solves this problem with reduced-order techniques that accurately model stress dynamics with rapidly executable algorithms.

Accurate Stress Modeling

The XEDOR™ model is anchored in AREVA's full-scale RODEX thermo-mechanical code, borrowing the essential modeling features for cladding and pellet dynamics, notably regarding respective creepdown and swelling characteristics. The reduced-order techniques focus on the key parameters influencing cladding stress, achieving robust and accurate calculations with efficiently computed coding. This accuracy has been validated by direct comparison to AREVA's extensive benchmarking database and through an industry-sponsored third-party comparison to results calculated with the independent single fuel rod thermo-mechanical code.

No Surprises

Preceding empirically-based maneuvering guidelines are not readily extrapolated to changing operational strategies, such as extended intervals between sequence exchanges. XEDOR™ inherently avoids the issue of divergence between evolving operations and empirical references by directly tracking fuel rod dynamics as a function of the incremental power history. Pellet and cladding conditions are updated approximately every two hours with each run step of the core monitoring system. This assures that the actual state of the fuel core-wide is accurately modeled and up-to-date for use when planning and executing specific power maneuvers.

Power Maneuver Optimization

For the first time, XEDOR™ provides operators with the means to quantify the core-wide PCI margin available at any given time. This creates the opportunity to plan power maneuvers based on maintaining a defined target PCI margin. In most cases, lost capacity factor arising from "one size fits all" maneuvering rules can be recovered. XEDOR™ has already realized benefits at one plant by showing no significant loss of PCI margin from a double notch withdrawal, eliminating the requirement to reduce power when adjusting control blade depth.

Simplified Implementation

AREVA has integrated XEDOR™ into its POWERPLEX®-XD BWR core monitoring software system. This eliminates the need for a separate system and provides XEDOR™ results within existing and familiar core monitoring displays. Operators follow a simple power ratio, similar to those tracking thermal margins, to assure adequate PCI margin is maintained throughout a power maneuver.

Offline Applications

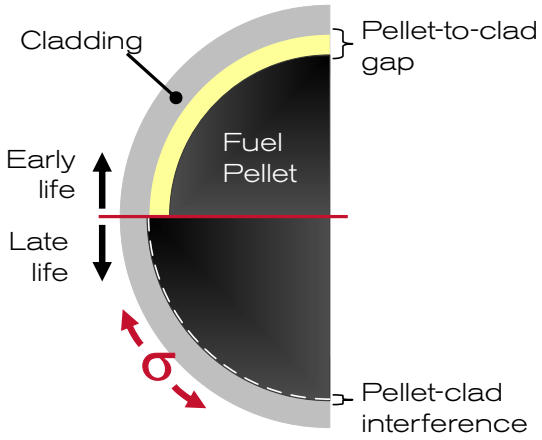
XEDOR™ can also be executed from AREVA's MICROBURN-B2 core simulator code for use in cycle design and engineering studies. This allows cycle-to-cycle comparisons to quantify the effect of core loading on PCI margin or assess the PCI impact of fuel design changes. It also allows forecasting effects of changing power levels and operating strategies to assure there are no adverse PCI surprises.

Features & Benefits

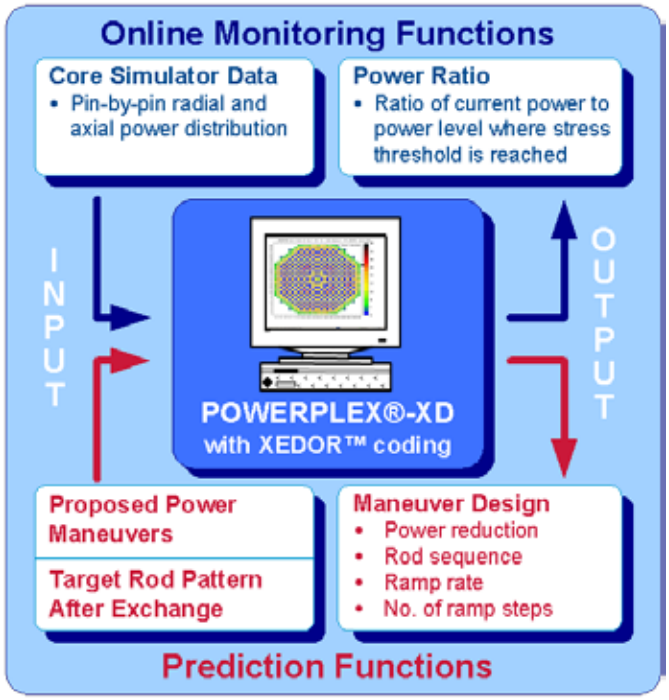
- Pellet and cladding conditions updated for each 6-inch node of every fuel rod in the core with each core monitoring run step
- Consistent PCI margin for power maneuvers
- Improved plant capacity factors without compromising fuel reliability
- Extendable to non-AREVA fuel designs

AREVA
forward-looking energy

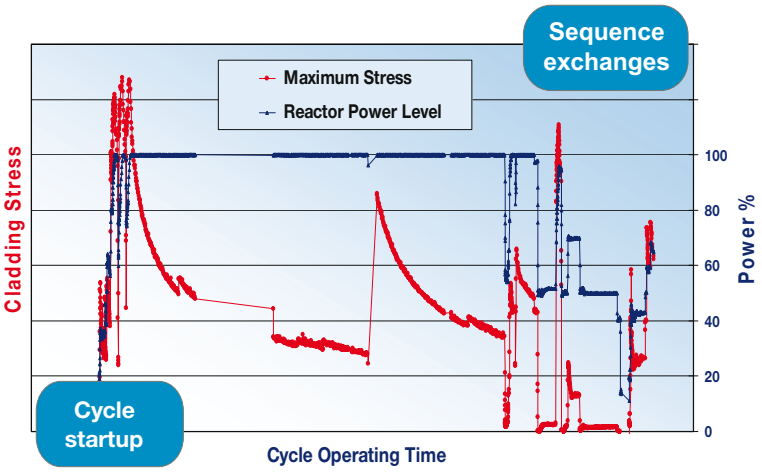
XEDOR™ can execute a whole core stress survey in approximately 30 seconds



XEDOR™ tracks changes in pellet and cladding dimensions based on incremental power history



Integration of XEDOR™ into the POWERPLEX® core monitoring system simplifies implementation



XEDOR™ calculates maximum cladding stress arising from power changes when pellet-to-clad gaps are closed

AREVA Inc.
7207 IBM Drive
Charlotte, NC 28262

To learn more,
contact: fuelsalesna@areva.com
us.areva.com

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