Fuel Delivery

Reload Physics Test Program Optimization

Westinghouse has an advanced, diverse and proven portfolio of products to optimize the final phase of your refueling outage. In response to industry demand to reduce cost and effort associated with low power physics testing (LPPT)—including options to eliminate explicit tests when feasible—Westinghouse has developed new approaches to core design validation following refueling, adding to its reliable, world-class LPPT technology and services based on the Dynamic Rod Worth Measurement (**DRWM**™) technique. The Alternate Rod Worth Verification (ARWV) methodology and Subcritical Physics Testing (SPT) leverage aspects of Westinghouse's extensive prior LPPT methods and experience to provide customers with a full range of advanced solutions to support post-reload startup test requirements.

Westinghouse's product line delivers value across all fronts

- Multiple approaches available to match varying & changing customer needs
- Minimization of outage critical path time, equipment & personnel allocation
- Continuity with, and adherence to, reload safety methods & industry standards
- Enhanced reactivity management and human performance during plant startup

LPPT with **DRWM** has an unparalleled track record. Hundreds of highly successful applications, including recent initial startup of the **AP1000**® plants, have been carried out worldwide since its generic approval by the U.S. Nuclear Regulatory Commission (NRC) in 1996. The **RhoPRO**® and **RhoPRO+** reactivity computer systems are the latest in a long line of Westinghouse reactivity computer advancements and can use either one Power Range (PR) channel or both Intermediate Range (IR) channels (which remain in service) in support of the **DRWM** method. Other benefits include a small control room footprint and a digital strip chart recorder, and the system can be operated by and supplemented with onsite support from experienced Westinghouse startup test engineers. SPT can be carried out with either the **RhoPRO** system or an add-on module to the **BEACON**™ Core Monitoring System. SPT requires input from Source Range (SR) nuclear instruments and is based on the Spatially Corrected Inverse Count Rate (SCICR) methodology, originally approved by the NRC in 2005. In the late 2010s, SCICR data collection and analysis capabilities were developed for the RhoPRO system. Most recently, the BEACON system software was equipped with SCICR capabilities, which creates additional value by effectively eliminating many ancillary aspects of traditional startup testing (e.g., use of temporary equipment and physical plant connections are no longer required, and design constants can be generated on premises at the actual plant conditions).

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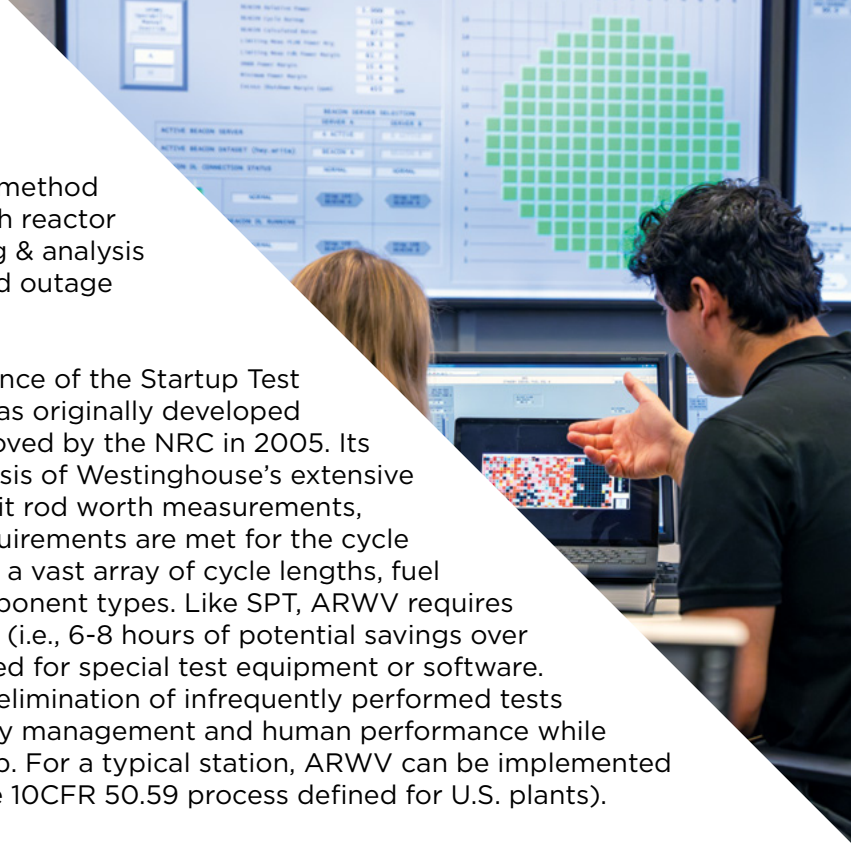

Furthermore, via the **BEACON** system, the SCICR method can be utilized anytime following refueling through reactor startup, thus offering unique shutdown monitoring & analysis capabilities to improve reactivity management and outage execution prior to criticality.

Lastly, the ARWV approach draws on the precedence of the Startup Test Activity Reduction (STAR) methodology, which was originally developed for Combustion Engineering (C-E) units and approved by the NRC in 2005. Its benefits are derived by leveraging statistical analysis of Westinghouse's extensive startup test results set in lieu of performing explicit rod worth measurements, provided pre-defined conditional applicability requirements are met for the cycle of interest. Nonetheless, ARWV can be applied on a vast array of cycle lengths, fuel enrichments, feed fuel fractions and fuel and component types. Like SPT, ARWV requires little or no critical path time upon implementation (i.e., 6-8 hours of potential savings over a typical LPPT program), while eliminating the need for special test equipment or software. But the benefits go beyond outage performance; elimination of infrequently performed tests and activities inherently improves station reactivity management and human performance while also reducing administrative burden during startup. For a typical station, ARWV can be implemented under the current plant licensing basis (i.e., via the 10CFR 50.59 process defined for U.S. plants).

Which Westinghouse product is right for you?

Westinghouse	LPPT w/ DRWM Technique	Subcritical Physics Testing (SPT)	Rod Worth Elimination (C-E STAR & ARWV)
Experience	400+ applications, 3,000+ banks measured in 6 countries	50+ applications at 10 U.S. stations prior to **BEACON** system deployment in 2023 (in use by 2 stations)	C-E STAR performed at 8 U.S. stations prior to ARWV program release in 2020 (delivered to 2 utilities)
Tool	Advanced Digital Reactivity Computer (ADRC) or **RhoPRO/RhoPRO+** System	**RhoPRO System** or **BEACON** System	No supplemental tool needed
Nuclear Instrument Connections	Power Range (PR) (ADRC or **RhoPRO+**) or Intermediate Range (IR) (**RhoPRO** system)	Source Range (SR) (**RhoPRO** system) or None (**BEACON** system)	No additional instrumentation needed
Generic NRC Approval	Yes	Yes	C-E STAR – Yes ARWV – No but can be implemented under 10CFR50.59
Conditional Applicability	No	No	Yes
Critical Path Time Spent	4–8 hours (4+ hours of savings over other LPPT methods)	1 hour or less	None

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