

MODERNIZATION TECHNOLOGY ASSESSMENT

MTA Number	MTA-EN-007		
Title	Improved Thermal Performance Through Cycle Isolation Monitoring		
Description	Cycle isolation is the process of recapturing lost power by minimizing the steam and heated water flow paths that bypass all or part of the turbine cycle. High-enthalpy leaks to the condenser are a major concern and are often not visually identifiable. Isolation valves, such as turbine bypass valves and main steam line drain valves, and air-operated valves (AOVs) used for level and flow control in the heat cycle may be potential isolation leakage paths that result in lost power. A cycle isolation monitoring program uses installed or wireless instrumentation or manual measurements to monitor and identify leaks caused by damaged valves. To implement a cycle isolation monitoring program, a population of valves are identified based on impact on the cycle and outfitted with instrumentation typically focused on temperature measurements (e.g., resistance temperature detectors or thermocouples) or flow measurements (e.g., acoustic sensors). Nuclear plants typically experience losses of around 1-6 MWe per unit per year due to valve leakage. These losses are recoverable after leaks are identified and repairs are prioritized through cycle isolation monitoring. The initial benefits of a cycle isolation monitoring program materialize in the first two years of implementation. Cost savings benefits are highly sensitive to the unit capacity of the plant and the price of power. As the program matures and valves have been repaired, lost MWe will decrease along with potential for MWe recovery. Cycle isolation monitoring software can also be purchased from a vendor or developed in house to automate identification and MWe quantification of leaking valves. Implementation of the software provides more efficient identification of leaking valves and improves workload efficiency but is not required. Wireless sensors may also be installed to improve data quality and workload efficiency, but permanently wired sensors can also be used for a successful cycle isolation monitoring program.		
Benefits			
Benefits Estimate	Level 1 – Savings are less than \$1 million per year, per unit. Estimated savings range from approximately \$100K-\$800K (0.5 MWe – 6 MWe recovered) per year, per unit with the greatest savings seen in the first couple of years of implementation. Savings are also sensitive to the unit capacity and power pricing at the plant.		
Benefits Description	• Increased plant output due to repaired valve leaks identified through cycle isolation monitoring • Increased maintenance planning efficiency by identifying valve leaks early on • Reduction in maintenance costs due to potential decrease in pipe cavitation erosion by identifying and repairing leaks • Reduction in labor hours associated with walkdowns for valve measurements through installation of sensors • Reduction in labor hours associated with data analysis through installation of cycle isolation software		
Costs and Schedule			
Cost	Level 3 – Implementation cost is less than \$1 million per unit. Costs range from approximately \$150K-\$350K for implementation of wireless sensors and cycle isolation software, but wireless sensors and software are not necessary to implement a cycle isolation monitoring program. Ongoing annual maintenance costs for the sensors and software range from approximately \$10K-30K per year.		

Schedule	One to three years per unit, which includes planning, procurement, and implementation.
Scope Context	Per unit
Risks	
For BWRs, there is a need to shield when installing and maintaining cycle isolation monitoring instrumentation and when performing valve repairs to reduce risk of personnel exposure to radioactivity.	
Administrative Items	
Date	12/14/21
Functional Area Where Benefits Will Be Realized	Engineering Operations Maintenance
Reference Implementation Guidance	Plant Engineering: Thermal Performance Engineering Handbook, Volume 2 (EPRI 3002000489)
Industry SME	EPRI – Kurtis Crytzer Contact: NuclearPlantMod@epri.com
Previous Implementation	This improvement has been implemented at several nuclear plants. Please contact the EPRI SME for additional information.
Implementation Enablers	If wireless sensors are implemented, a wireless network infrastructure is needed to support the sensors. • MTA-MA-003 – Implement a Wireless Network Infrastructure Using a Distributed Antenna System (DAS) • MTA-MA-004 – Implement a Wireless Network Infrastructure Using WiFi
SWEEP Score	• Cost – Level 3 – Implementation cost is less than \$1 million per unit. Costs range from approximately \$150K-\$350K for implementation of wireless sensors and cycle isolation software, but wireless sensors and software are not necessary to implement a cycle isolation monitoring program. Ongoing annual maintenance costs for the sensors and software range from approximately \$10K-30K per year. • Savings – Level 1 – Savings are less than \$1 million per year, per unit. Estimated savings range from approximately \$100K-\$800K (0.5 MWe – 6 MWe recovered) per year, per unit with the greatest savings seen in the first couple of years of implementation. Savings are also sensitive to the unit capacity and power pricing at the plant. • Payback – Level 2 – Payback period is greater than one year but less than five years. Payback period is driven by the timing of the refuel cycle when valves are repaired. • Technical Readiness – Level 3 – This technology has already been implemented at nuclear sites and is ready for wide operational deployment. • Licensing Readiness – Level 3 – No changes are required for implementation. • Implementation Proficiency – Level 3 – The technology can be implemented by all sites, regardless of digital experience. If wireless sensors are pursued, implementation proficiency is dependent on site specific experience related to wireless data infrastructure, wireless data transmission for maintenance and monitoring, and cyber-security protocols.

This MTA can be accessed from <http://www.epri.com\nuclearplantmod>. For more on MTA's please see EPRI product 3002020578

Applicability	All reactor types All geographic regions
Keywords	Cycle isolation; cycle isolation monitoring; thermal performance; valve leaks; valve repair; power recovery
Business Case Analysis Cross-Reference	Plant Modernization Business Case-Improved Thermal Performance Through Cycle Isolation Monitoring: Cost-Benefit Analysis of Cycle Isolation Monitoring for Addressing Valve Repairs That Lead to Lost MWe (EPRI 3002019844)

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