Nuclear Sector Value Briefing–Winter 2025

I am pleased to provide this summary of EPRI's recent nuclear R&D activity and several examples of the value our members are realizing as a result. This is the first of these summaries, which will be shared with you twice annually prior to EPRI's Nuclear Power Council (NPC) advisory meetings.

Read on to learn more about several recent and ongoing projects. We encourage you to consider how these might be adapted for application in your plants. As always, our staff stands at the ready, prepared to evolve EPRI's support to help our members meet the challenges and opportunities that lie ahead for the nuclear industry.

Steve Swilley
Vice President, Nuclear Fleet
and Chief Nuclear Officer

EPRI Product Must-Haves

Materials Management

Materials Degradation Matrix, 3002030559, is a living document that tracks global material degradation info across most reactor designs.

Fuels & Chemistry

Extending Nuclear Power Plant Refuel Cycles, 3002029122, details the process, considerations, and barriers in extending BWR & PWR refueling cycles, saving plants millions in fuel and outage costs.

Plant Performance

Limitorque Actuator Fatigue Life Extension, 3002020841, has been used by a US fleet to save $24 million on deferred valve actuator replacements.

Plant Support

Risk-Informed Repair and Replacement Code Case N-752—Implementation Guideline, 3002015823, has saved millions for members when applied to components and systems.

Strategic Initiatives

Site Selection and Evaluation Criteria for New Nuclear Facilities, 3002023910, has been used by members to outline the process and support business decisions for site selection of new plants.

Training

Hundreds of on-demand technical training modules utilized across EPRI membership are available at www.epri.com/training.

By the Numbers

~$200 million USD
in annual funding to support the industry through nuclear R&D (2024)

169
Nuclear deliverables industry committees issued in 2024 that advance technology application and best practices

200+ meetings
in 2024 with more than half being virtual or hybrid to facilitate efficient collaboration of R&D and operating experience among peers

251
Industry committees that EPRI has technical representation on and shapes technology, codes, standards, and regulations (e.g., ANSI, ASME, ACI, NEI, IEEE, & IAEA)

40,000+
professional development hours (PDH) earned by members through training interactions in both 2023 and 2024

Combined Funding Multiplies Research Value

$80 **of research for every $1 of funding**
Additional leverage that an average full nuclear member receives for every $1 of funding towards base projects

$54 **of research for every $1 of funding**
Additional leverage that an average full nuclear member receives for every $1 of funding towards supplemental projects

Recent Value Realized by Nuclear Members

SUMMARY DESCRIPTION	QUANTIFIED VALUE[1]	MEMBER	YEAR RECOGNIZED
Enhanced Steam Generator Tube Wear Evaluation Techniques Reduce Inspection Time	Estimated savings of **$33M USD per unit** by reducing SG inspection outage time	KHNP (TTA Nominee)	2023
Ultrasonic Methods for Evaluation of Prestressed Concrete Cylinder Pipe (PCCP)	**~ $200M USD** in savings for two units based on 44 repairs over 8 years	South Texas Project	2023
Smart Corrective Action Program System Helps AP1000 Nuclear Power Plant Improve Safety, Quality, and Leads to Reduced Costs Through Implementation of EPRI Data Driven Decision Making (3DM) Products	**~ 1,000 person hours** and **$1M USD** annually across SDNPC fleet	Shandong Nuclear Power Company (SDNPC)	2023
Exemption of Bottom Mounted Nozzles Ultrasonic Test Based on MRP Research	**$3M USD** in savings and **3-day reduction** in refueling outage	Taiwan Power Company	2023
Qualification of an Encoded Phased Array Ultrasonic Technique Applied to the Outer Diameter of a Reactor Vessel Nozzle to Safe End Dissimilar Metal (DM) Weld	Reduced outage time by **1.5 days**; estimated **$1.7M USD** savings	PSEG Nuclear	2023
Teams Pioneer Use of EPRI's Leveraging Risk Insights for Aging Management Program Implementation, Realizing Greater Safety and Lower Costs	**$2.3M USD** and ***>$655k*** in cost avoidance depending on application	Constellation, Ameren	2022
EPRI Guidance Helps Save Time and Resources for Self-Assessments of In-Service Testing (IST) and Air Operated Valve (AOV) Programs	Estimated savings of **1,500 hours** of FTE	Duke Energy	2022
EPRI's Boron-Induced Offset Anomaly (BOA) Risk Assessment Tool Aids Two Major Events	Satisfaction of Federal Safety Authority to prevent extraneous oversight of cycle 25 outage	EDF	2022

[1]Savings are dependent upon an individual plant's or fleet's unique circumstances and may differ based on baseline conditions, extent of deployment, financial evaluation approach, and more. EPRI did not independently corroborate or validate the reported savings.

Top Nuclear Products Downloaded in 2024

PRODUCT ID	PRODUCT TITLE	MEMBER USE AND VALUE
3002000505	Pressurized Water Reactor Primary Water Chemistry Guidelines: Revision 7, Volumes 1 and 2	This latest revision of the PWR water chemistry guidelines identifies an **optimum primary water chemistry program** based on the current understanding of research and field information. This revision provides further details about primary water stress corrosion cracking (PWSCC), fuel integrity, and shutdown dose rates.
3002010645	Pressurized Water Reactor Secondary Water Chemistry Guidelines: Revision 8	This eighth revision of the PWR Secondary Water Chemistry Guidelines represents another step in maintaining **proactive chemistry programs** to limit or control secondary system degradation, while optimizing station resources (see EPRI Success Story Product ID 3002021496 for documented savings). Where warranted, additional flexibility has been provided to plant personnel while maintaining appropriate chemistry requirements to protect system assets. For example, guidance regarding oxygen requirements and hydrazine use has been amended to allow plants to better optimize chemistry and resources.
3002023784	Single Point Vulnerability (SPV) Process Guide: Revision 1	This report is a compendium of industry information on **identifying and eliminating or mitigating SPVs**. It is being used by the majority of EPRI members to develop or improve their approaches towards reducing SPV-related adverse events, which can cause significant performance and financial impacts.
3002025550	BWRVIP-190 Revision 2: BWR Vessel and Internals Project, Volumes 1 and 2	This latest revision focuses on **environmentally assisted cracking (EAC)** —encompassing stress corrosion cracking (SCC) and environmentally assisted fatigue (EAF) — both of which can limit the service life of susceptible materials and components in BWR water environments.
3002003129	Advanced Nuclear Technology: Advanced Light Water Reactor Utility Requirements Document (URD): Revision 13	A sustaining element for new nuclear plant development has been the **EPRI URD for Advanced Light Water Reactors**. The 3,500+ pages containing approximately 40,000 technical and project functional requirements in the URD constitute one of the basis documents for many of the advanced plants currently being built around the world. This latest revision incorporates SMRs and was co-funded by the DOE.
3002015757	Guidelines for Electromagnetic Compatibility (EMC) Testing of Power Plant Equipment: Revision 5	This revision provides testing guidance, lessons learned, and best practices to aid nuclear plant personnel in **achieving EMI qualification and I&C equipment installation** using a consistent approach to EMC. The report methodology has been endorsed by the US regulator.
3002029184	Main Reactor Pump Seal Best Practices	This document focuses on **MRP seal degradation, characteristics, causes, and remedies** to address what stations can do to reduce events and improve performance. Implementing this guidance can lower the risk of a plant shutdown that has cost several members millions in lost generation from recent incidents.
3002011816	Digital Engineering Guide: Decision Making Using Systems Engineering	This methodology **reduces the cost of integrating digital technology into a nuclear power facility** by collapsing many isolated processes into a single structured process that can address the complete range of digital technology issues.
3002008071	Flow-Accelerated Corrosion in Power Plants: Revision 2	This revision provides a detailed treatment of the entire subject (**FAC in power plants**) in a single, comprehensive document. In combination with another EPRI report, 3002013182, a US member has recognized $1.25M USD at one site in one outage through deferred inspections.
3002015244	Valve Application Guide	A **comprehensive resource for establishing specification requirements, maintenance programs, and replacement / installation procedures for various power plant valves**. Use of this guide and companion valve guides has saved members significant effort (resources and budget) in the selection of reliable valves for power plant applications, maintenance strategy/ procedures, and setup of valve programs based on up-to-date industry lessons learned.
3002027466	The Weld Metallurgical Handbook	A collaborative project between the welding and materials groups to introduce the **weldability challenges for common materials across nuclear and thermal fleets**. Provides quick guidance for new engineers about the fundamental knowledge behind welding metallurgy and weldability issues, describing a combination of materials science, applied metallurgy, and industrial application. The guidebook is structured with key chapters associated with all aspects of welding and repair.

NDE Qualifications for Industry Technicians

In 2024, EPRI's Plant Support staff and facilities have overseen the **qualification of 122 candidates from 18 companies in the areas of reactor pressure vessel and piping NDE inspections.** This is a role only EPRI fulfills for the nuclear power industry. In addition, EPRI research outlined in product 3002018615 has completed ASME code case approval and is awaiting regulatory approval. Implementing this methodology is expected to reduce the amount of time for Level II and III certification by also allowing lab time for qualification.

Research Highlight

Multi-year research in the Fuel Reliability Program (FRP) on an Alternative Licensing Strategy (ALS) for LOCA-Induced Fuel Fragmentation has created a technical pathway for license amendment requests to allow for the use of higher burnup fuel rods in PWRs. Transition to higher burnup limits are expected to result in a **20% reduction in fuel reload batch size**, ultimately **saving $100M+ USD** over remaining plant life.

Ongoing Base Membership Value Examples

- **NDE's Performance Demonstration (PD) Lab maintains approximately $20M USD in samples** for the industry that meet program requirements for the industry to comply with Appendix VIII and 10CFR50.55a requirements.
- **The Risk and Safety Management (RSM) Program invests approximately $3M USD/year** to develop and maintain multiple software tools used across the industry to provide savings through **justifying a technical basis for risk-informed decision making**, which routinely saves members from extending outage times or having overly conservative PRA models.
- **Plant Reliability and Resilience provides 400 maintenance guides for nuclear equipment and systems**, which can be used to enhance plant efficiency and reliability, leverage industry best practices, improve procedures, and support training.
- Technical guidance from **Fuel Reliability Program improves fuel safety and reliability**, thereby reducing economic risks associated with fuel failures, which have cost the global nuclear industry more than **$500M USD** over the past 20 years.
- The **Materials Management** department continues to invest in solutions to **address long-term aging management**, ensuring that the global fleet of reactors can continue to operate their plants safely and efficiently, saving members millions of dollars.
- The **ANT Program** focuses on reducing the risk and uncertainty of building and operating new nuclear power plants by improving every stage of the deployment life cycle, including **siting, licensing, construction, startup, and initial operations**.

93% **of Nuclear members are very satisfied or satisfied with EPRI support and value (2024 member survey)**

For More Information:

Materials Management	**Randy Stark**, rstark@epri.com
Fuels and Chemistry	**Dan Wells**, dwells@epri.com
Plant Support	**Mike Ruszkowski**, mruszkowski@epri.com
Plant Performance	**Mark Woodby**, mwoodby@epri.com
Training & Development	**Heather Feldman**, hfeldman@epri.com
Strategic Initiatives	**Steve Chengelis**, schengelis@epri.com

Nuclear Value Website:

interactive.epri.com/nuclear-value