Nuclear Value Guide – NVG-013

Developing a Nuclear Plant Modernization Program

SUMMARY

EPRI research supported the development of a strategic framework for systematic implementation of modernization improvements at nuclear power plants, encompassing strategy and program development, project identification and selection, and project execution. A Plant Modernization program informs the implementation of new technologies or innovations that will reduce operations and maintenance (O&M) costs, while improving workforce labor efficiency, safety, and reliability.

The EPRI Plant Modernization Strategy Development and Implementation Guide leverages existing plant processes to effectively screen, prioritize, and evaluate modernization improvement candidates for implementation.

To date, three US and two international nuclear plant owners have used the EPRI guidance in developing or modifying their approach to plant modernization. These companies implemented their modernization efforts in alignment with their utility and site-specific needs. Multiple other utilities have used sections of the guidance to improve their existing processes as well. The resulting impact is detailed in the “Value” section of this document.

Background

Nuclear utilities are facing increased pressure to reduce operations and maintenance (O&M) costs and make nuclear energy more competitive with alternative generation sources. For nuclear plants built several decades ago, modernization is widely viewed as a potential avenue for decreasing ongoing O&M costs through effective use of technology and innovation. Such modernization can include the use of new technologies and revised processes that facilitate decreases in O&M costs. There are many possible process improvements and technologies that could be considered, as evidenced by the many ideas that have been developed by vendors and researchers and investigated, piloted, and implemented by nuclear power plants. However, many of these ideas have only been pursued on a project-by-project basis as solutions in response to specific problems. Modernization as an integrated and programmatic endeavor has the potential to result in transformative change to the economics of nuclear power.

EPRI's Role

Since 2018, EPRI's Plant Modernization Initiative has been working to establish the technical and programmatic foundation for nuclear power plants to adopt new technologies and related process improvements to reduce O&M costs. The Plant Modernization Initiative has been facilitating information exchange and research with EPRI, EPRI-member utilities, and other industry stakeholders allowing for more universally applicable and beneficial research products.

In 2021, the initial version of the Modernization Strategy Development & Implementation Guide was developed and piloted at two US plants. The EPRI pilot team worked with the respective site leads to work through the first six steps of the Plant Modernization Process. This included the development of a Modernization Charter, which would serve as the new program's overall "North Star", as well as a new modernization process document. The process document covered important topics such as ideation, project screening and prioritization as well as handoffs to applicable plant procedures. The new modernization processes are used to identify, screen and prioritize potential projects for further evaluation. Learnings were documented and incorporated into a subsequent revision and piloted again internationally. The guide has been revised two times, incorporating lessons learned and additional guidance based on direct member implementation.

A companion tool, the Plant Modernization Toolbox (PMTB), serves as an online resource for member plant modernization efforts. The toolbox includes modernization technology assessments (MTAs), which provide introductory content describing modernization improvements, potential savings to be gained, costs for implementation, and a list of associated reference material. The PMTB MTA list was used in the ideation process implemented as part of the two pilot projects discussed above.

The PMTB also includes the business case analysis model (BCAM) methodology which can be used to quantitatively assess the financial costs and benefits of various modernization upgrades. Examples of completed business case analyses for plant modernization initiatives are included in the PMTB and these have been used by several members as references when considering plant improvements. There is also an Online BCAM tool included for higher level, quicker evaluations. Finally, the PMTB also includes guidance on technology and process improvement enablers, which are assets that need to be implemented to gain the benefits of some new technologies (e.g., expanded Wi-Fi network to support wireless communications).

IMPLEMENTATION GUIDANCE

The utility will require an acknowledgement from the highest levels that modernization strategy is paramount for strategically driving modernization investments. A dedicated lead will need to work heavily across the organization to align the various stakeholders and gain agreement on the strategy, charter and integrated modernization process.

EPRI subject matter experts can serve as a technical resource for answering questions regarding the guidance.

Value

Three US and two international nuclear power plants (single sites and fleets) have successfully implemented modernization programs leveraging EPRI's Modernization Strategy Development & Implementation guidance. In general, feedback from the utilities is that the modernization process allowed them to more efficiently review, screen, and prioritize new technologies for implementation at their sites. Actual cost savings and gains in efficiency are realized through the installation of selected ideas.

Example 1: One of the US fleet members used the guidance to drive development of a cohesive process that will reduce operating costs by: 1) implementation of common digital I&C platforms across the fleet, resulting in common materials, training, qualifications, and operating standards; 2) development and use of common procurement specifications and fleet contracts for common system upgrades resulting in bulk pricing discounts; 3) elimination of operational risk in a common structured manner by driving the priority of system upgrades with common solutions (to initially eliminate more than 600 single point vulnerabilities across the fleet); 4) streamlined development of business automation applications by using common digital platforms and common distributed control systems; and 5) more timely adoption of innovation solutions that improve overall worker and plant efficiency (example: automated cycle isolation monitoring).

Example 2: An international NPP used the guidance to initially develop a modernization program that focused on digitizing multiple plant workflows and IT system integration. The initial success with these efforts led the program to expand its focus to include system health dashboards and expansion of the station Wi-Fi network to support increased use of wireless communications such as sensors for equipment and tablets for workers. The planned expansion of wireless sensors will be used to support online monitoring to allow implementation of Condition Based Maintenance (CBM). Finally, the site plans to digitize and expand the modernization process itself, from idea submission forms for plant personnel use, to project evaluation and implementation.

Applicability

All nuclear plant single sites, or fleets

Value

The Modernization Strategy Development and Implementation Guide provides guidance on strategy development, including determining utility specific inputs and business risks, and recommendations on internal process integration, coordination, and organizational structure. The guide also details how modernization projects can be screened and prioritized for business case evaluation for project selection. Additionally, the Guide highlights the key steps associated with effective project road mapping and planning, implementation, and validation.

Using the Guide as a resource, US and international NPPs have implemented a modernization program to reduce O&M costs, increase worker productivity, and improve safety and reliability.

EPRI Program

Operating Plant Initiatives

Resources

- 3002029089, *Nuclear Power Plant Modernization-Strategy Development and Implementation Process*
- 3002029091, Application of EPRI Plant Modernization Strategy Development at Chubu: Showcasing the Value of Establishing a Plant Modernization Programs
- 3002030384, Showcasing the Value of the Nuclear Plant Modernization Benchmarking and Assessment Project: Summary of Member Program Evaluation by EPRI
- 3002018430, *Nuclear Plant Modernization Toolbox*
- 3002024058, *Plant Modernization Benchmarking and Assessment Supplemental Project*
- ETA 5.01 Modernization Strategy Development Technical Application
- Support from EPRI subject matter experts

Access Additional Value Guides and Examples of EPRI R&D Application:

https://interactive.epri.com/nuclear-value/p/1

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